

# ***NTPC Limited***

(A Government of India Enterprise)



## **SINGRAULI SUPER THERMAL POWER PROJECT STAGE - III (2x800MW)**

### **PART - D**

#### **ERECTION CONDITIONS OF CONTRACT**

#### **SECTION – VI**


### **TECHNICAL SPECIFICATION**

### **FOR**


### **EPC PACKAGE**


**BIDDING DOCUMENT NO.: CS-1150-001R-2**

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CLAUSE NO.	ERECTION CONDITIONS OF CONTRACT			
<b>1.00.00</b>	<b>GENERAL</b>			
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.			
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such a person shall function from the Site office of the Contractor during the pendency of Contract.			
<b>2.00.00</b>	<b>REGULATION OF LOCAL AUTHORITIES AND STATUTES</b>			
2.01.00	In addition to the local laws and regulations, the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.			
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully pay-able under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees for such inspection and/or registration shall be borne by the Contractor.			
<b>3.00.00</b>	<b>WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING</b>			
	The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:			
3.01.00	<b>Qualification of Weld Procedures</b>			
	Only qualified welding procedures as per ASME Section IX shall be used by contractor at site. Procedure qualification records along with WPS shall be submitted to NTPC for review. Welding procedure shall indicate all essential and non-essential parameters as per ASME Section IX. Makes of welding consumables shall be subject to employer's approval.			
3.02.00	<b>Welder's Qualification</b>			
	<p>Only welders who are qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts and its attachment welding. In addition to such statutory qualification requirements, the welders shall also undergo a satisfactory pre-production qualification test to be conducted by the Contractor at site as per ASME Sec IX in presence of employer's representative(s), prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.</p> <p>All the welders carrying out welding at site shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested</p>			
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	and authorised to carry out welding.			
3.03.00	<b>Records</b> Welders performance shall be monitored regularly and record of their performance shall be maintained by contractor in a manner acceptable to the employer. Contractor shall maintain such records including record of procedure qualification & welder qualification and hand-over to the employer at the end of work.			
3.04.00	<b>MARKING</b> On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.			
3.05.00	Welding Equipment for high pressure (Boiler, PCP ) - For GTAW process: HF Welding machines to be used. For SMAW process: Inverter based welding machine are to be used. Main contractor to ensure the availability of sufficient numbers of welding equipment during the each phase of project construction so as not to impede the progress of the project			
4.00.00	<b>HEAT TREATMENT</b>			
4.01.00	Heat Treatment -Pre-heating, post-heating and post-weld heat treatment operations of all welds, shall be performed in accordance with the requirements of applicable code and WPS. Local post weld heat treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils as acceptable to employer. Oxyacetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of chartless recorder / IIOT sensors duly password protected with a connectivity to remote server /Cloud. All hardware and software required to meet above intent shall be in the scope of bidder.			
4.02.00	After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (as specified at clause no 7.00.00- of this chapter) etc.			
4.03.00	Heat Treatment - weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding. Schedule shall be mentioned on data for identification.			
5.00.00	<b>WELD EDGE PREPARATION</b>			
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	<p>Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.</p> <p><b>6.00.00 CLEANING AND SERVICING</b></p> <p>6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt, and loose scales before being erected. All the pipelines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.</p> <p>6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and serviced prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.</p> <p>6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.</p> <p><b>7.00.00 FIELD WELDING SCHEDULE</b></p> <p>The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field-welding schedule to be issued by the Contractor shall contain the following:</p> <ul style="list-style-type: none"> <li>(a.) Drawing No (s)</li> <li>(b.) Location of the weld</li> <li>(c.) Size of the weld (outside diameter and thickness)</li> <li>(d.) Type of joints</li> <li>(e.) Material specifications</li> <li>(f.) Size of fillet on backing ring, when the type of joint is with backing ring</li> <li>(g.) Electrode/ filler metal specifications</li> <li>(h.) Number of welds per unit</li> <li>(i.) Quantity of filler metal per weld</li> <li>(j.) Indication of required Non-destructive Examination (NDE) for each weld</li> <li>(k.) Pre-heat temperatures for welding</li> <li>(l.) Process of welding</li> </ul>			
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<p><b>8.00.00</b></p> <p><b>9.00.00</b></p> <p><b>10.00.00</b></p> <p>10.01.00</p> <p>10.02.00</p>	<p>(m.) Post-welding heat treatment temperature ranges, duration, under as specified at clause no 4.00.00 of this chapter entitled "Heat Treatment".</p> <p>(n.) Qualification details of weld procedures to be adopted as specified at clause no 3.01.00 of this chapter entitled 'Qualification of Weld Procedures'.</p> <p><b>SITE RUN MISCELLANEOUS PIPING</b></p> <p>Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of such site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipes between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.</p> <p><b>THERMAL EXPANSIONS</b></p> <p>All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.</p> <p><b>PIPING SUPPORTS</b></p> <p>Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly levelled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.</p> <p>The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.</p>			
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<b>11.00.00</b> 11.01.00 11.02.00  11.03.00	<b>PRESSURE TESTING</b> <p>On completion of erection of pressure parts, a hydraulic test in accordance with the requirements of the Indian Boiler Regulations shall be performed by the Contractor.</p> <p>All the valves, high pressure pipes and inter-connected pipes connecting the pressure parts shall be tested along with pressure parts. All blank flanges or any removable plugs required for openings not closed by the valves, and piping provided, shall be furnished by the Contractor. The pressurization equipment including water piping from the supply, needed for the above test shall also be furnished by the Contractor. Any defects noticed during the testing are to be rectified and the unit re-tested. If any welding is done on the pressure parts after the Hydraulic test, the Hydraulic test for that portion of pressure parts shall be repeated.</p> <p>Thy hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting Authority as per the provisions of the Indian Boiler Regulations and the Employer.</p>			
<b>12.00.00</b> 12.01.00 12.02.00	<b>THERMOWELLS AND FLOW NOZZLES</b> <p>All the thermowells and flow nozzles in the equipment furnished under the technical specifications shall be installed as a part of this work.</p> <p>All thermowell connections incorporated in the steam service shall be plugged during the pressure testing and the blow out of steam piping systems. Upon completion of the blow out operation, all thermowells shall be installed and seam welded. Similarly, all flow nozzles in the steam lines shall also be installed only on completion of steam blowing operations unless otherwise agreed to by the Employer, depending upon the sequence of cleaning and purging operations to be adopted by the Contractor at the field.</p>			
<b>13.00.00</b>  13.01.00  13.01.01    13.01.02	<b>INSULATION, LAGGING AND CLADDING</b> <p>The provision of insulation, lagging and cladding of the various equipments and portion of the equipment covered under the Contract, shall be furnished by the Contractor as specified elsewhere or agree to separately in writing. Welds required for holding insulation on pressure parts shall be carried out by IBR qualified welder.</p> <p><b>Piping, Pipe Fittings &amp; Valves</b></p> <p>All piping insulation and metal cladding furnished with the equipment to be erected shall be applied as specified herein.</p> <p><b>Piping</b></p> <p>The insulation on piping shall be applied using wire loops on 150mm centres. These wire loops shall be thoroughly embedded into the outer insulation surface and all cracks, voids and depressions shall be filled with insulating cement suitable for the piping temperature so as to form a smooth base for application of cladding. The wires used for piping insulation shall be of 16 SWG. The surface shall be smooth and uniform before applying the outer covering. All piping insulation ends shall be terminated at a sufficient distance from flanges to facilitate removal of bolts.</p> <p><b>Flanges</b></p> <p>Insulation on flanges shall be by means of blocks of insulating material securely bound to the flange by wire loops. Such blocks of insulation shall be long enough to</p>			
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	<p>overlap the adjacent pipe insulation by an amount equal to the thickness of adjacent pipe insulation. Smooth finish shall be obtained by the application of insulating cement. Alternatively, sectional pipe insulation of proper diameter may be used. Insulation on flanges shall not be done until the pipe and equipment have been in service during the initial operation and till all the flange bolts have been retightened.</p>			
13.01.03	<b>Bends and Elbows</b>			
	<p>Insulation on bends and elbows shall be cut into sections sufficiently short to form a reasonable smooth external surface. After the application of insulation material in place, it shall be smoothly coated with insulating cement. Elbows may be insulated as above or alternatively by means of specially moulded insulation enclosures.</p>			
13.01.04	<b>Cladding</b>			
	<p>Cladding shall be of aluminium sheet of thickness as per details given in detail Technical Specification or will be provided during detail engineering shall be machine rolled and formed to accurately fit insulation curvatures. Cladding shall be secured using self-tapping screws. Screws shall be adequate number and so located as to produce tight joints. The spacing of screws shall be as far as possible uniform and on centres not exceeding 150 mm. For outside diameters less than 230 mm, spacing of screws shall be on centres not exceeding 100 mm. adequate number of screws shall be provided for fixing the cladding and be so placed in such locations, as to produce a smooth cladding finish without bellying'. Insulated elbows having insulated diameters less than 330 mm shall be provided with preformed smooth aluminium elbow jackets. Wherever possible, all joints should be lapped a minimum of 50 mm with joints facing downwards and so placed that they are obscured from normal points of vision. All the joints in the cladding shall be made with suitable provisions for expansions. All butt joints such as those at piping tees shall be made using rolled seams. In addition, to prevent galvanic corrosion, suitable action, as specified at clause no 13.02.00 of this chapter, shall be taken.</p>			
13.01.05	<b>Valves and Fittings</b>			
	<p>All valves and fittings (above valve size of 2 inches) installed in the pipelines shall also be applied with insulation and furnished with suitably shaped boxes so as to facilitate easy dismantling of the fittings. The insulation thickness for valves, valve fittings etc., shall be same as that used on the line on which they are installed. All voids shall be properly filled up with insulating material and as per the directions of the Employer.</p>			
13.02.00	<b>Protection of Equipment during Insulation Applications</b>			
	<p>All equipment and structures shall be suitably protected from damage while applying insulation after completion of insulation. All equipment and structures shall be thoroughly cleaned and remove insulating materials which might have fallen on them.</p>			
14.00.00	<b>CODE REQUIREMENTS</b>			
	<p>The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules &amp; Codes, Indian Boiler Regulations, ASME codes and accepted good practices, the Employer's Drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.</p>			
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<p><b>15.00.00</b></p> <p>15.01.00</p> <p>15.02.00</p> <p>15.03.00</p> <p>15.04.00</p> <p>15.05.00</p>	<p><b>ELECTRICAL SAFETY REGULATIONS</b></p> <p>In no circumstances will the Contractor interfere with fuses and electrical equipment belonging to the other Contractor or Employer.</p> <p>Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall:</p> <ul style="list-style-type: none"> <li>(a) Satisfy the Employer that the appliance is in good working condition.</li> <li>(b) Inform the Employer of the maximum current rating, voltage and phase of the appliances.</li> <li>(c) Obtain permission of the Employer detailing the socket to which the appliances may be connected.</li> </ul> <p>The Employer will not grant permission to connect until he is satisfied that</p> <ul style="list-style-type: none"> <li>(d) The appliance is in good condition and is fitted with suitable plug</li> <li>(e) The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthened metal sheath surrounding the cores.</li> </ul> <p>No electric cable in use by the other Contractor/Employer will be disturbed without permission. No weight of any description will be imposed on any such cable and ladder or similar equipment will rest against or to be attached with it.</p> <p>No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work issued before any work is carried out.</p> <p>The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation..</p>			
<p><b>16.00.00</b></p>	<p><b>REMOVAL OF MATERIAL</b></p> <p>No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.</p>			
<p><b>17.00.00</b></p>	<p><b>INSPECTION, TESTING AND INSPECTION CERTIFICATES</b></p> <p>The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.</p>			
<p><b>18.00.00</b></p> <p>18.01.00</p> <p>18.02.00</p>	<p><b>ACCESS TO SITE AND WORKS ON SITE</b></p> <p>Suitable access to site and permission to work at the Site shall be accorded to the Contractor by the Employer in reasonable time.</p> <p>In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work</p>			
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<p><b>19.00.00</b></p> <p><b>20.00.00</b></p> <p>20.01.00</p> <p>20.02.00</p> <p><b>21.00.00</b></p> <p>22.00.00</p> <p>22.01.00</p>	<p>on the Site, except by the special permission, in writing by the Employer or his representative.</p> <p><b>CONTRACTOR'S SITE OFFICE ESTABLISHMENT</b></p> <p>The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.</p> <p><b>CO-OPERATION WITH OTHER CONTRACTORS</b></p> <p>Contractor, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the works under the Contract. The Contractor shall also arrange to perform his work as to minimise, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the same shall be dealt in accordance with GCC.</p> <p>Employer shall have full access to visit the contractor's site at any time for inspection and surveillance checks.</p> <p>The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.</p> <p><b>DISCIPLINE OF WORKMEN</b></p> <p>The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or is incompetent, negligent or otherwise unde-sirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.</p> <p><b>CONTRACTOR'S FIELD OPERATION</b></p> <p>The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.</p>			
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22.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.			
<b>23.00.00</b>	<b>PHOTOGRAPHS AND PROGRESS REPORT</b>			
23.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.			
23.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.			
23.03.00	Project Management System to be implemented as defined in Annexure-A to sub section IIC (Project Management) of technical specifications Section VI, Part A.			
<b>24.00.00</b>	<b>MAN-POWER REPORT</b>			
24.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.			
24.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill- wise and the areas of employment of such labour.			
<b>25.00.00</b>	<b>PROTECTION OF WORK</b>  The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the as specified at clause no 20.00.00- of this chapter entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.			
<b>26.00.00</b>	<b>EMPLOYMENT OF LABOUR</b>			
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26.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work its employees with relevant skills and experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be deployed. The deployment shall be in compliance of all the applicable labour laws.			
26.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allow-ances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.			
26.03.00	The hours of work on the Site shall be decided by the Principal Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.			
26.04.00	Contractor's employees shall wear identification badges while on work at Site.			
26.05.00	In case the Principal Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contact Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Principal Employer may make such payments and shall recover the same from the Contractor's Bills.			
27.00.00	FACILITIES TO BE PROVIDED BY THE EMPLOYER			
27.01.00	Communication  The Employer will extend the telephone facilities, if available at Site, for purposes of Contract. The Contractor shall be charged at actuals for such facili-ties.			
27.02.00	Railway Siding  Railway siding shall be provided by owner (up to plant entry point) for coal transportation to site. However the same may not be available to the bidder for material/supplies transport etc. Bidder has to plan its own arrangement for movement of ODC consignment to plant site.  Further, irrespective of readiness of railway siding, owner reserves the option of coal supply in stackyard before the synchronization of first unit for which bidder has to ensure readiness of coal supply system up to mill bunker.			
28.00.00	FACILITIES TO BE PROVIDED BY THE CONTRACTOR			
28.01.00	Contractor's site office Establishment  The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC. The site office will include one conference meeting room (250-300 Sq Ft) for site meetings between the Contractor and the Employer. The contractor shall also provide four (4) furnished office rooms (150-250 SqFt) for use by the Employer to facilitate effective co-ordination during the tenancy of the contract.			
28.02.00	Tools, tackles and scaffoldings  The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without			
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	the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailer, etc. for the purpose of fabrication, erection and commissioning.			
28.03.00	<b>Testing Equipment and Facilities:</b> The contractor shall provide the necessary testing, equipment and facilities.			
28.04.00	<b>Site laboratory for civil works:</b> Contractor shall provide and maintain a site laboratory for the testing of construction material under the direction and general supervision of employer.			
28.05.00	<b>First-aid</b>			
28.05.01	The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.			
28.05.02	As per NTPC Safety rules, ambulance is to be provided by the contractor, however, in case of any emergency, employer may provide the services of an ambulance for transportation to the nearest hospital.			
28.06.00	<b>Cleanliness</b>			
28.06.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.			
28.06.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.			
28.07.00	<b>Not used</b>			
28.08.00	<b>Electricity</b> Refer to construction power, as envisaged in Sub Section-II-B, Part A, Sec VI of Technical specification.			
28.09.00	<b>Water</b> Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite/colony. However, drawal of construction/potable water from bore-well shall be permitted if found suitable. Any statutory clearance required shall be obtained by the contractor. Assistance, if required shall be provided by the owner.			
29.00.00	<b>LINES AND GRADES</b> All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance			
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<p>30.00.00</p> <p>30.01.00</p> <p>30.02.00</p> <p>30.03.00</p> <p>30.04.00</p> <p>31.00.00</p> <p>32.00.00</p>	<p>of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.</p> <p><b>FIRE PROTECTION</b></p> <p>The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.</p> <p>Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.</p> <p>All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.</p> <p>The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.</p> <p><b>SECURITY</b></p> <p>The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.</p> <p><b>CONTRACTOR'S AREA LIMITS</b></p> <p>The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.</p>			
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33.00.00	<p><b>CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER</b></p> <p>In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and installed by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.</p>			
34.00.00	<p><b>PRE-COMMISSIONING AND COMMISSIONING ACTIVITIES</b></p>			
34.01.00	<p><b>GENERAL</b></p>			
34.01.01	<p>The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the equipment/systems ready for safe, reliable and efficient operation on sustained basis. All pre-commissioning/commissioning activities considered essential for such readiness of the equipment/systems including those mutually agreed and included in the Contractor's quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the contractor.</p>			
34.01.02	<p>The pre-commissioning and commissioning activities including Guarantee/demonstration/acceptability tests, checks and trial operations of the equipment/systems furnished and installed by the contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at site during such operations.</p>			
34.01.03	<p>The following activities shall be carried out by the contractor, 18 month prior to schedule date of commissioning of the equipment/systems installed by him.</p> <ul style="list-style-type: none"> <li>(a.) The contractor shall furnish the organization chart of his operation and commissioning engineers for the acceptance of employer. Adequate number of operation and commissioning engineers shall be deployed by the contractor to effectively meet the requirement of round the clock operation in shifts also, till the plant is taken over by the employer.</li> <li>(b.) The contractor shall submit the bio-data containing the details of experience of his operation and commissioning engineers for the acceptance of employer.</li> <li>(c.) The contractor shall furnish the deployment schedule of his operation and commissioning engineers for the acceptance of the employer.</li> </ul>			
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	<p>(d.) Apart from above, contractor shall ensure deployment of sufficient skilled/semi-skilled/unskilled manpower during pre-commissioning and commissioning activities.</p> <p>34.01.04 It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment/systems which are installed by him.</p> <p>34.01.05 The Contractor shall also be responsible for flushing and initial filling of all oils and lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications and documents.</p> <p>34.02.00 <b>COMMISSIONING DOCUMENTATION</b></p> <p>34.02.01 The contractor shall submit the commissioning documentation, comprising of Standard checklists, pre-commissioning procedures, testing schedules, commissioning schedules and commissioning networks for various equipment/ systems covered under the contract, for the approval of employer.</p> <p>34.02.02 Standard checklist, as the name suggests, shall be a fairly general documents, containing the list of all checks required to be carried out for similar and repetitive type of equipment to ensure consistent and thorough checking. An indicative list of such equipment is enclosed as Annexure I.</p> <p>34.02.03 The testing schedule is a document, designed for safe and systematic commissioning of individual equipment/sub-system (for example Boiler Feed Pump, condensate pump, compressor etc) Commissioning schedule is a document envisaged for commissioning of a system (for example feed system, Condensate system, Compressed Air system, Fire water system, Unit commissioning etc). The testing/Commissioning schedule shall have a standard format in order to maintain consistency of presentation, content and reporting. A brief write up on the contents of the Testing Schedule/Commissioning Schedule is enclosed as Annexure-II.</p> <p>34.02.04 The contractor shall submit the list of commissioning documentation to be submitted by him, alongwith their submission schedule for various equipment/systems covered under the contract, with in 6(six) month from the date of award of contract, for the acceptance of employer.</p> <p>34.02.05 The Contractor shall submit the commissioning documentation, for various equipment/covered under the contract, for the approval of employer, at least 18 months before the scheduled date of commissioning of the equipment/systems.</p> <p>34.03.00 <b>COMMISSIONING ACTIVITIES</b></p> <p>34.03.01 Upon completion of pre-commissioning activities/tests, the contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carry out system checking and reliability trials on various parts of the facilities.</p> <p>34.03.02 Contractor shall carry out the checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified.</p> <p>34.03.03 Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance,</p>			
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	<p>parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.</p> <p>34.03.04 The Contractor shall also demonstrate the performance of all C&amp;I equipment, the tests on main equipment of prior to that as the case may be.</p> <p>34.03.05 Other tests shall be conducted, if required by the Employer, to establish that the plant equipment are in accordance with requirements of the specifications.</p> <p>34.03.06 The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all electrical and C&amp;I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied and installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications.</p>			
34.05.00	<p><b>Initial Operation</b></p> <p>Upon completion of system checking/Tests as above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation as stipulated in General Technical Requirements.</p>			
35.00.00	<p><b>MATERIALS HANDLING AND STORAGE</b></p>			
35.01.00	<p>All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.</p>			
35.02.00	<p>Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.</p>			
35.03.00	<p>The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.</p>			
35.04.00	<p>All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.</p>			
35.05.00	<p>All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.</p>			
35.06.00	<p>All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance as per OEM Practice. Storage of EHV/Generator transformers</p>			
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<p>35.07.00</p> <p>35.08.00</p> <p>35.09.00</p> <p>35.10.00</p> <p>35.11.00</p> <p>35.12.00</p> <p>35.13.00</p> <p>36.00.00</p> <p>36.01.00</p> <p>36.02.00</p>	<p>under Nitrogen /Dry air shall not exceed the time duration as defined by OEM practice.</p> <p>The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.</p> <p>The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.</p> <p>All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.</p> <p>If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.</p> <p>The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.</p> <p>Sound Storage Management system need to be followed for storage of material. First in First Out method (FIFO) to be adopted to avoid longtime storage. Storage duration of any material at site shall not be more than 3 months. Accordingly supply of material in sequence of erection at site to be ensured. To achieve the same, following is to be adopted:</p> <ol style="list-style-type: none"> <li>Dispatch clearance is to be given in order of sequence of erection. To achieve the goal, proper tags shall be maintained in ascending order. The tag shall be self-explanatory.</li> <li>MDCC shall be issued by RIO based on clearance from Site FQA head, Main contractor, Erection head for dispatch and supply of material. Strict adherence to sequential supply of material as per supply schedule.</li> </ol> <p>An automated storage and retrieval system consists of a variety of computer-controlled systems for automatically placing and retrieving of material may be adopted. Accordingly, each material shall be marked with unique identification code.</p> <p><b>CONSTRUCTION MANAGEMENT</b></p> <p>The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.</p> <p>The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In</p>			
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<p>36.03.00</p> <p>36.04.00</p> <p>36.05.00</p>	<p>addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.</p> <p>Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.</p> <p>The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.</p> <p><b>Site management during construction phase till handing over of plant</b></p> <p>Bidder shall ensure that the plant site within the plant boundary is managed in a coordinated and professional way all through the construction phase till handing over of plant, ensuring safe, easy &amp; unhindered working conditions and a healthy &amp; hygienic working environment at site. He shall ensure the following measures at site while executing the project.</p> <p>a) Unhindered motorable road access to all work areas and facilities both during the construction/erection and as they get completed progressively. Required temporary access roads other than the permanent roads shall also be provided. Bidder shall prioritize the construction of approach roads, roads around the main plant block, roads to office &amp; storage areas and the offsite areas from the start of project itself. He shall finalize and submit the complete road layout plan along with priority and completion schedule immediately after the award for review by the Employer. He shall ensure that the roads are promptly repaired and maintained against any damages due to movement of traffic/heavy trailers &amp; cranes etc providing motorable access at all times. Adequate onsite stock of road materials shall be kept and maintained disturbed over the site for repairs especially before the monsoon period.</p> <p>b) Proper drainage of rainwater, ground water from excavations, water flows from batching plant / construction sites etc. He shall prioritize the construction of permanent drains from the start of the project itself. Till such time the permanent drainage network is done, he shall construct adequate temporary drains to ensure that there is no accumulation /stagnation of water in the plant site. Bidder may consider providing pre-cast RCC drains for temporary/ permanent drain construction for faster construction of drains. The drain construction shall be matched with progress of road construction for preventing damage to roads. Bidder shall provide and maintain adequate number of drainage pumps (both electrical and diesel operated) of suitable capacity for pumping out accumulated water especially during the monsoon periods. All drain diversions required shall be undertaken at the start of the project itself.</p> <p>c) The plant site is fully secured against unauthorized access.</p>			
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	<p>d) Proper housekeeping by systematic and proper disposal of earth from excavations(separately for usable &amp; surplus earth), muck (from pile bores or otherwise), wastes (from dismantling of pile tops, concrete works etc), packing &amp; insulation wastes, steel scrap, cable wastes etc generated during construction / erection works. Suitable disposal sites for each of above shall be identified in the layout and at site in the beginning of the project itself. It shall be ensured that all agencies engaged by the bidder follow the discipline to dispose off of earth spoils and wastes at the designated places. Preferably once in a week suitable time slot will be identified for housekeeping by all agencies and suitable instructions shall be issued in this regard. Bidder may engage a separate agency or identify a gang for collection of wastes and disposal to designated places. Suitable arrangement / tie-up will also be made for periodic disposal of wastes/ scrap from the designated places.</p> <p>e) All fabrication areas shall be suitably hard crusted to provide a water free and proper working platform. Suitable sheds preferably pre-engineered structures to be provided for paint shops, fabrication workshops etc for ensuring all weather work conditions for onsite structural works. For the main plant and auxiliary buildings, bidder should preferably plan the works in such a way that structural fabrication is done in suppliers' offsite works / workshops and onsite fabrication works are avoided / kept minimum.</p> <p>f) Suitable onsite maintenance workshop for day to day breakdown maintenance heavy plant and equipment like batching plants, cranes, earth moving equipment, welding equipment etc. The workshop shall have stock of frequently needed spares and suitable repair facilities with experienced technicians/mechanics. A central test laboratory equipped with test equipment for routine tests like tests on soil, concrete, bricks, aggregates, welds etc with experienced staff shall be established at the start of the project itself.</p> <p>g) All office and covered store buildings of the bidder and its agencies shall be of prefab/ pre-engineered / porta cabin construction. Shabby semi-finished constructions in brickwork/ GI / asbestos roof etc shall not be permitted.</p> <p>h) First aid facilities and amenities like rest rooms, suitable pre-engineered toilets (separate for men and women), drinking water fountains/tanks, canteen, crèche for women workers shall be planned and established at the beginning of the project itself. These facilities shall be distributed over the plant area to enable easy access by the construction workers and staff and shall be marked on the plant layout. Suitable treatment for toilet discharge, like bio digesters etc shall be planned and conventional septic tanks / soak pits etc shall be avoided.</p> <p>i) Proper lighting of all construction / erection areas. Bidder shall erect adequate number of high lighting masts in main plant, offsite, office and store areas for lighting during night. DG sets of adequate capacity shall be provided for emergency backup. The street lighting along the roads shall also be prioritized along with road construction. The construction power ring main shall be planned and erected immediately after the award.</p> <p>j) Well planned and coordinated storage and movement of plant, equipment and construction materials. System wise / agency wise storage / laydown areas shall be planned and marked on the plant layout at the beginning itself. Bidder shall ensure that all its agencies comply to the areas allocated to</p>			
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	<p>them and follow the designated storage and movement plans. Adequate covered storage shall be constructed for storage of critical equipments like switchgears, MCCs, insulation etc.</p> <p>k) Proper access control for construction workers, staff and visitors. Bidder shall ensure that suitable electronic based gate pass system is in place from start of project itself to keep record and track of all workers, staff and visitors entering/exiting the plant premises shift wise on daily basis.</p> <p>l) Compliance to all safety requirements as specified in this document. Bidders shall establish a safety centre at the start of the project itself. It shall have a 24X7 manned safety control room in addition to a permanent safety equipment display room, separate training / lecture hall with AV facilities for safety training, store room with adequate stock of specified safety equipment, a first aid room and other amenities. Bidder shall install 25 Nos. CCTV cameras at all strategic locations in the plant area which shall be linked to the safety control room."</p> <p>m) Compliance to all environment and other conditions stipulated by the concerned statutory authorities while according clearance / NOC (No objection certificate) to the project. Bidder shall ensure adequate sprinkling of water by deploying water tankers to prevent the fugitive dust nuisance during construction.</p> <p>n) Development of suitable landscape &amp; green belt areas and rainwater harvesting within the plant premises. Bidder shall plan to develop the landscape &amp; green belt areas and rainwater harvesting from the start of the project itself. The landscape and rain water harvesting plan shall be finalized immediately after award of work and suitable work plan with priority and schedule shall also be finalized thereafter. Top soil before excavation shall be suitably preserved and stacked for landscape and green belt development.</p> <p>o) Provision of adequate shelters, water supply, sanitation and lighting in construction workers and staff camps. No camps for workers and staff shall be permitted within the plant premises and Bidder shall make separate arrangement outside the plant premises for locating and development of camps for construction workers and staff. The designated areas shall be suitably developed with infrastructure like roads, drains, water supply and sewerage and shall be free from water logging. Suitable low cost shelters will be provided for the workers. Complete area shall be secured by fencing and shall be provided adequate area lighting. Suitable waste disposal, shopping and recreation facilities will be developed in these camps.</p> <p>Bidder shall ensure that due importance is given to site management as discussed above and a detailed work plan considering the above aspects is finalized immediately after the award. A senior level executive shall be identified who shall be responsible for implementation of the work plan. Suitable format for progress reporting on site management plan shall be developed and made part of the project progress report. The progress on implementation of above work plan shall be reviewed along with project progress in the monthly project review meetings with Employer. In case the progress on site management plan is unsatisfactory, and in the opinion of Employer, bidder's actions on site management aspects is not adequate, Employer may get the relevant work executed through a separate agency</p>			
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	<p>and deduct the expenses incurred from Bidder's bill along with overheads in line with GCC.</p> <p>p) If Employer decides to retain or withhold any amount from the Contractor, the Employer shall clearly articulate and share with contractor, the reasons and justifications for the retention or withholding of funds. Additionally, specific conditions for releasing the withheld amount shall also be established and communicated at the time of withholding. Upon rectification of the identified issues or deficiencies by the Contractor to the satisfaction of the Employer, the Employer shall promptly release the withheld amount. The release shall be made in accordance with the terms and conditions specified in the contract agreement.</p>			
36.06.00	<b>QUALITY CONTROL ROOM</b> Bidder to refer clause no 1.01.00 -G of section IV -Part-A.			
36.07.00	Welder Training Center -Contractor shall setup a small welding training center 3 -4 welding booths equiped with GTAW & SMAW setup in a pota cabin/suitable enclosed space to train & hone skill of high pressure welders who are giving high rate of welding defect.			
36.08.00	<b>SMART STORAGE AREA/YARD MONITORING</b> Bidder to refer clause no 1.01.00 -F of section IV -Part-A.			
37.00.00	<b>FIELD OFFICE RECORDS</b> <p>The Contractor shall maintain at his Site Office up-to- date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.</p>			
38.00.00	<b>CONTRACTOR'S MATERIALS BROUGHT ON TO SITE</b>			
38.01.00	The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.			
38.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty			
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38.03.00	and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.  After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under as specified at clause no 38.02.00- of this chapter and credit the proceeds thereto to the account of the Contractor.			
39.00.00	<b>PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY</b>			
39.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be re-sponsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.			
39.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign - boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utili-ties when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.			
40.00.00	<b>PAINTING</b>  For painting refer Part-A, sub section-III, Section VI of Technical specification.  Painting for structures shall conform to the painting specification specified in Part-B under Civil.  Painting for piping shall conform to the painting specification given in Part-B of the respective chapter.  Painting for Electrical equipments/systems shall conform to the painting specification given in Electrical portion of Part-A and Part-B of technical specifications.			
41.00.00	<b>INSURANCE</b>			
41.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.			
41.02.00	<b>Workmen's Compensation Insurance</b>  This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:  Workmen's Compensation - As per Statutory Provisions			
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41.03.00	Employee's Liability	-	As per Statutory Provisions	
	<b>Comprehensive Automobile Insurance</b>			
	This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:			
	Fatal Injury	:	Rs.100, 000 each person	
		:	Rs.200, 000 each occurrence	
	Property Damage	:	Rs.100, 000 each occurrence	
41.04.00	<b>Comprehensive General Liability Insurance</b>			
41.04.01	The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Loss of or Damage to Property; Accident or Injury to workers; Indemnification" in Section General Conditions of Contract (GCC).			
41.04.02	The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.			
41.05.00	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.			
42.00.00	<b>UNFAVOURABLE WORKING CONDITIONS</b>			
	The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavorable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.			
43.00.00	<b>PROTECTION OF MONUMENTS AND REFERENCE POINTS</b>			
	The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer.			
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<p><b>44.00.00</b></p> <p>44.01.00</p>	<p>The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.</p> <p><b>WORK &amp; SAFETY REGULATIONS</b></p> <p><b>General</b></p> <p>i) The contractor shall comply with all the requirements of "The Building and Other Construction Workers (Regulation of Employment &amp; Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.</p> <p>ii) The Contractor shall follow NTPC Safety Rules as specified in GCC with respect to safety in construction &amp; erection.</p> <p>iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to Engineer in charge.</p> <p>iv) The contractor shall submit the safety plan comprising of methods to implement the Safety Policy/ Rules, Risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, Supervision and responsibility to ensure Safety at various levels, Safety training to employees and workers, review of Safety and accident analysis, ensure Health and Safety Procedures to prevent accidents for approval as per the format of Safety plan as annexed at Annexure - III.</p> <p>Bidder shall furnish the Safety Plan, duly filled in as per EMPLOYER's Format.</p> <p>The above proposed "Safety Plan" shall be further discussed/ finalized at Site, in line with the NTPC safety rules, and shall be approved by Project Manager/ Head of Project before start of work at Site.</p> <p>v) The Contractors shall ensure proper safety of all the workmen, materials, plant and equipment belonging to him or to the Employer or to others, working at the Site.</p> <p>vi) All equipments used in construction and erection by the contractor shall meet BIS / International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the contractor in accordance with manufacturer's operation manual. The contractor should also follow Guidelines / Rules of the Employer in this regard.</p> <p>vii) The Contractors shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Engineer I/c shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.</p> <p>viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs, and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings</p>			
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	<p>shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.</p> <p>ix) The Contractor shall follow and comply with all the Safety Rules, standards, code of practices of NTPC and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer / obtain copy of NTPC safety documents as stated above.</p> <p>x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.</p> <p>The medical examination of the workers employed in hazardous areas shall be conducted as per Rule 223 Of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health records shall be maintained accordingly and to be submitted to Engineer I/c when asked for. If any worker found suffering from occupational health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to Engineer I/c. The medical fitness certificate to be submitted to Engineer (I/c).</p> <p>xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen &amp; office bearers working at site.</p> <p><b>44.01.01 Emergency Action Plan</b></p> <p>The contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.</p> <p><b>44.01.02 Scaffolding</b></p> <p>The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold should conform to the BIS / International standards.</p> <p><b>44.01.03 Opening</b></p> <p>The contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.</p>			
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44.01.04	<b>Explosives</b>  The contractor shall take all precautions while handling, using, storing or transporting of all explosives. Before usage of any explosive necessary warning / danger signals be erected at conspicuous places to warn the workers and general public. The contractor should strictly ensure that all measures and precautions required to be complied for use, handling, storing or transportation of explosives under the rules framed under the Explosives Act, 1884.			
44.02.00	<b>Fencing of Machinery</b>  The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.  The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.			
44.03.00	<b>Carrying of Excessive Weight by a Worker</b>  The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction Workers.			
44.04.00	<b>Dangerous and Harmful Gases / Equipment</b>  The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.  The contractor should not allow any worker to go into the confined space unless it is certified by Engineer (I/c) to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.			
44.05.00	<b>Overhead Protection</b>  The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.  Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.			
44.06.00	<b>Working at Heights</b>  All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.  Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.  Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.  Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire			
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44.07.00	<p>rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards. Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.</p> <p>The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (fall arrestors) for climbing/getting down through ladders to prevent fall from height.</p> <p><b>Handling of Hazardous Chemicals</b></p> <p>The Contractor will notify well in advance to the Engineer I/c of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. NTPC shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract shall strictly adhere to and comply with such instructions. The Engineer I/c shall have the right at his sole discretion to inspect any such container or such construction plant / equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by NTPC and NTPC shall not entertain any claim of the Contractor towards additional safety provisions / conditions to be provided for / constructed.</p> <p>Further, any such decision of the Engineer I/c shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by NTPC, the Contractor shall use alternative methods with the approval of the NTPC without any cost implication to the NTPC or extension of work schedule.</p> <p>Where it is necessary to provide and / or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Engineer I/c. In case any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.</p> <p>The Contractor shall be fully responsible for the safe storage of his and his Sub-contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/ Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.</p> <p>The contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.</p> <p>As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.</p>			
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44.08.00	<b>Eye Protection</b> The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eyes.			
44.09.00	<b>Excavation</b> The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding material or article from any bank or side of such excavation which is more than one and a half meter above his footing by providing adequate piling, shoring, bracing etc. against such bank or sides. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.			
44.10.00	<b>Electrical Hazards</b> The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts / rules. The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs / RCCBs for all the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks. The contractor should ensure use of single / double insulated hand tools or low voltage i.e., 110 volts hand tools. The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.			
44.11.00	<b>Vehicular Traffic</b> The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act, 1988.			
44.12.00	<b>Lifting Appliances, Tools &amp; Tackles, Lifting Gear And Pressure Plant &amp; Equipment etc.</b> The contractor shall ensure all the lifting appliances, tools & tackles including cranes etc., lifting gear including fixed or movable and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting / hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Engineer I/c or by the person authorized by him.			
44.13.00	<b>Excessive Noise, Vibration</b> The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The ambient noise should not exceed the limits prescribed under the concerned rules, Noise Pollution (Regulation and			
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<p>44.14.00</p> <p>44.14.01</p>	<p>Control) Rules, 2000. Generally for brownfield projects background noise is in the range of 58-60 DB, however it shall be responsibility of contractor to collect and measure the latest noise data at site.</p> <p><b>Electrical Installations</b></p> <p>The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Engineer I/c to handle such fuses, wiring or electrical equipment.</p> <p>Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the NTPC, he shall</p> <ul style="list-style-type: none"> <li>i) Satisfy the Engineer I/C that the appliance is in good working condition;</li> <li>ii) Inform the Engineer I/C of the maximum current rating, voltage and phases of the appliances;</li> <li>iii) Obtain permission of the Engineer I/C detailing the sockets to which the appliances may be connected.</li> </ul> <p>The Engineer I/C will not grant permission to connect until he is satisfied that:</p> <p>The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.</p> <p>Wherever armored / metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.</p> <ul style="list-style-type: none"> <li>iv) No repair work shall be carried out on any live equipment. The Engineer I/c must declare the equipment safe and a permit to work shall be issued by the NTPC / contractor as the case may be to carry out any repair / maintenance work. While working on electric lines / equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / Officers.</li> <li>v) The contractor shall employ necessary number of qualified, full time Electricians / Electrical Supervisors to maintain his temporary electrical installation. The installations are provided with suitable ELCBs and RCCBs wherever required.</li> </ul>			
<p>44.15.00</p> <p>44.15.01</p> <p>44.15.02</p> <p>44.16.00</p>	<p><b>Safety Organisation</b></p> <p>The contractor shall employ full time safety officer(s) as per requirement stipulated in NTPC Safety Rules, exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the NTPC Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of The Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees / workmen of the sub-contractor shall also be considered as the contractor's employees/workmen for the above purpose.</p> <p>The name and address of such Safety Officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the Contract.</p> <p><b>Reporting of Accident and Investigation</b></p>			
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	<p>In case any accident occurs during the construction / erection or other associated activities undertaken by the Contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Engineer I/C, NTPC Safety Officer with a copy to NTPC Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.</p> <p><b>44.17.00 Right to stop Work</b></p> <p><b>44.17.01</b> The Engineer I/C shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and / or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury / accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the Contractor.</p> <p><b>44.17.02</b> The Contractor shall not be entitled for any damages / compensation for stoppage of work, {Sub-Clause XVIII (I)} due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.</p> <p><b>44.18.00 Fire Protection</b></p> <p>The contractor shall provide sufficient fire extinguishers at place /s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers / equipment.</p> <p><b>44.19.00 Penalties</b></p> <p>I If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Engineer I/c shall have the right to regulate the payment in accordance with provisions of GCC. Further such defaulting worker shall be sent out of the workplace immediately and shall not be allowed to work on that day. Engineer I/c / Safety Officer of NTPC will also issue a notice in this regard to the contractor.</p> <p>II If two or more fatal accidents occur at same NTPC site under the control of contractor during the period of contract and he has</p> <ol style="list-style-type: none"> <li>(1) not complied with keeping adequate PPEs in stock or</li> <li>(2) defaulted in providing PPEs to his workmen</li> <li>(3) not followed statutory requirements / NTPC safety rules</li> <li>(4) been issued warning notice/s by NTPC head of the project on nonobservance of safety norms</li> <li>(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents in NTPC for two years from the date of last accident.</li> </ol> <p>The contractor shall submit the accident data including fatal / non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise</p>			
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<p>44.20.00</p> <p>44.21.00</p> <p>44.22.00</p> <p>a)</p> <p>b)</p> <p>c)</p> <p>d)</p> <p>e)</p> <p>f)</p> <p>g)</p>	<p>along with the tender documents. If the information given by the contractor found incorrect, his contract will be liable to be terminated.</p> <p>The Contractor will make available minimum quantity of all safety equipments and safety PPEs of required specifications as per suggestive list included bidding documents as a part of "List of minimum T &amp; P". Further Contractor will ensure availability of additional requirement for individual worker and safety equipment as per site requirement during execution of the contract till its completion.</p> <p>The Contractor shall abide by the following during Construction and Erection activities:</p> <p>I. Chain pulley block shall not be used for loads more than 2 (Two) tonne.</p> <p>II. Hydra shall not be used for material transport.</p> <p>III. Cage shall necessarily be provided to Monkey ladders of height more than 4 m.</p> <p>IV. Fencing shall be provided to all Electrical Distribution boards and transformers etc.</p> <p>Contractor shall ensure following regarding implementation of Safety:</p> <p><b>Two Tier Safety Monitoring System:</b>  <b>Separate Safety Consultancy contract</b> shall be awarded by NTPC for assisting and guiding overall Plant Safety during Construction. The safety consultant shall induct and engage manpower required as per specific requirements of project.  <b>For Construction safety</b>, Contractor shall engage certified safety team in consultation with NTPC Safety team /safety Consultant for each package/area.</p> <p>Risk level of different area of plant shall be evaluated by NTPC Safety &amp; Safety consultant. Based on the severity of risk level, total project area shall be categorized into different safety zones and each zone will be identified with different color coding.</p> <p>Dedicated Project Safety Manager of Safety Consultant will be deployed. Contractor to deploy area/ system wise safety representative for each system/ area of project e.g. SG area, TG Main Power House area and similarly in other BOP Systems.</p> <p>The Safety Officer can stop work of any contractor if safety rules are violated.</p> <p>There should also be safety clearance in Quarterly RA bills in addition to the clearances being presently taken from HR and Quality dept.</p> <p>PPEs, scaffoldings, safety nets, testing tools etc. should be monitored by NTPC Safety Manager to control and maintain the uniformity of Quality for Safety equipment/ PPEs.</p> <p>There should be 24/7 Safety Control room equipped with IP Camera, AI Input alarms and proper communication system for monitoring safety. All CCTV</p>			
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	<p>footage shall be available to control room. Drone based safety monitoring shall be done during day. The safety control room shall be operated &amp; managed by NTPC through safety consultant.</p> <p>h) Safety management plan for the Project must be submitted for approval before start of work.</p> <p>i) In line with the Project Planning, Safety planning will be done jointly by Project Team and Consultants.</p> <p>j) Availability of Fire Tender shall be ensured by contractor before start of construction work.</p> <p>k) <b>Number of Safety Stewards:</b> Each area (e.g. SG, TG, etc.) should have minimum 5 safety Stewards from Main Agency and 5 from the sub agency.</p> <p>l) Contractor should provide scaffolding material, pipes, clamps, boards and scaffolding of standard quality.</p> <p>m) Uses of Safety net, Fire blankets and fall arrester shall be adequate.</p> <p>n) Construction Elevators shall be used during erection phase.</p> <p>o) Material transport through Hydra shall be avoided.</p> <p>p) Good Quality and new PPEs and tools and machinery shall be used.</p> <p>q) All Agency /Sub Agency will deploy Safety manpower after getting approval from Head of safety Consultant.</p> <p>r) Contractor Safety officer shall take approval of JSA /HIRA of each area from Safety consultant. Before Start of work in a particular area, concerned Safety consultant clearance is must.</p> <p>s) Inspect the site to ensure it is a hazard-free environment &amp; promotes safe practices at the job site.</p> <p>t) Verifies that injury logs and reports are completed and submitted to NTPC.</p> <p>u) Receives reports from and responds to orders issued by NTPC and Labor inspectors.</p> <p>v) Serve as primary contact for project site incident and injury notification, investigation, and follow-up.</p> <p>w) Organize and maintain necessary project safety documentation.</p> <p>x) Training Setup to be created for giving basic education of Safety to workers.</p> <p>y) Safety Park and work simulation facility to be created at site.</p> <p>z) Health Check Up facility of workers.</p> <p>aa) Vendor Safety circle (with max 25 nos person) and monthly safety award to be created.</p> <p>bb) 24/7 first aid center (common for all agency) and expenditure on contribution basis which is decided by NTPC safety department.</p> <p><b>45.00.00 FOREIGN PERSONNEL</b></p> <p>45.01.00 The Contractor shall submit to the Employer data on all personnel he proposes to bring into India from abroad for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each</p>			
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	<p>person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.</p> <p>45.02.00 Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.</p> <p>45.03.00 No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.</p> <p>45.04.00 The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.</p> <p>45.05.00 The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time nor full-time nor shall they take part in any local politics.</p> <p>45.06.00 The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.</p> <p><b>46.00.00 FOUNDATION DRESSING &amp; GROUTING FOR EQUIPMENT/ EQUIPMENT BASES</b></p> <p>46.01.00 The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to placement of equipment/equipment bases on the foundations.</p> <p>46.02.00 All the equipment/ equipment bases, shall be grouted and finished by bidder as per these specifications unless otherwise recommended by the equipment manufacturer.</p> <p>46.03.00 The concrete foundation surfaces shall be properly prepared by bidder by chipping, grinding as required to bring the top of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength.</p> <p>46.04.00 <b>Grout</b></p> <p>The grout for equipment foundation shall be high strength grout having a minimum characteristic compressive strength of 60 N/mm<sup>2</sup> at 28 days. The grout shall be ready mix non-shrink, chloride - free, cement based, free flowing, non-metallic grout</p>			
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46.05.00 46.05.01    46.05.02    46.05.03    46.06.00    46.07.00     47.00.00	<p>as recommended by equipment manufacturer. The ready mix grout shall be of reputed make as approved by the Employer.</p> <p>The Grout shall have good flowability even at very low water/ grout powder ratio.</p> <p>The Grout shall have characteristics of controlled expansion to be able to occupy its original volume to fill the voids and to compensate for shrinkage. Grout shall be of pre-mix variety so that only water needs to be added before use.</p> <p>The mixing of the Grout shall conform to the recommendations of the manufacturer of the Grout.</p> <p><b>Placing of Grout</b></p> <p>After the base has been prepared, its alignment and level has been checked and approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back &amp; forth to push the grout into every part of the space under the base.</p> <p>The grout shall be poured either through grout holes if provided or shall be poured at one side or at two adjacent sides to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.</p> <p>In addition to the above, recommendations of Grout manufacturer shall also be followed.</p> <p><b>Finishing of the Edges of the Grout</b></p> <p>The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothened with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.</p> <p><b>Checking of Equipment After Grouting</b></p> <p>After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Employer.</p> <p><b>SHAFT ALIGNMENTS</b></p>			
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	<p>All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall conform to Zone A of ISO 10816. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.</p>			
48.00.00	<p><b>DOWELLING</b></p> <p>All the motors and other equipment shall be suitably doweled after alignment of shafts with tapered machined dowels as per the direction of the Employer.</p>			
49.00.00	<p><b>CHECK OUT OF CONTROL SYSTEMS</b></p> <p>After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.</p>			
50.00.00	<p><b>COMMISSIONING SPARES</b></p>			
50.01.00	<p>It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.</p>			
50.02.00	<p>These spares will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.</p>			
51.00.00	<p><b>CABLING</b></p>			
51.01.00	<p>All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends or fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Employer.</p>			
51.02.00	<p>Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.</p>			
51.03.00	<p>Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened,</p>			
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	compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.			
51.04.00	In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.			
51.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to the Employer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly cut.			
51.06.00	The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.			
<b>52.00.00</b>	<b>EQUIPMENT DELIVERY AND ERECTION</b>			
52.01.00	<p><b>General Requirements</b></p> <p>(a.) This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification.</p> <p>(b.) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, write up, technical data, drawings, check-lists, documentation formats for all activities after equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following:</p> <ol style="list-style-type: none"> <li>(1.) Instructions for packing, shipping, receiving handling, warehousing and storage.</li> <li>(2.) Instructions for location and installation of equipment furnished by this specification.</li> <li>(3.) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.</li> <li>(4.) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.</li> <li>(5.) Check lists and quality assurance hold points.</li> <li>(6.) Format for all related documentation.</li> </ol> <p>(c.) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment</p>			
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52.02.00	<p>manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.</p> <p>(d.) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engg.</p> <p><b>Crating</b></p> <p>(a.) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.</p> <p>(b.) Equipment shall be packed with suitable desiccants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.</p> <p>(c.) Desiccants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate desiccants shall be of a chemical nature to absorb moisture. In any case, the desiccant shall not be of a type that will absorb enough moisture to go into solution. Desiccants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough desiccant shall be used for the volumes enclosed in wrapping.</p> <p>(d.) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.</p> <p>(e.) All accessory items shall be shipped with the equipment. ; Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.</p> <p>(f.) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.</p> <p>(g.) An itemized list of contents shall be enclosed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number:</p> <ol style="list-style-type: none"> <li>Export case markings</li> <li>Case number</li> <li>Gross weight and net weight in Kilograms</li> <li>Dimensions in centimeters</li> <li>Complete description of material</li> </ol> <p>(h.) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's</p>			
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	<p>responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.</p> <ul style="list-style-type: none"> <li>(i.) Electrical equipment, control and instrumentation shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.</li> <li>(j.) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.</li> <li>(k.) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.</li> <li>(l.) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.</li> <li>(m.) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.</li> <li>(n.) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.</li> <li>(o.) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.</li> </ul>	
52.03.00	<p><b>Factory Assembly</b></p> <ul style="list-style-type: none"> <li>(a.) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismantled from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.</li> <li>(b.) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.</li> </ul> <p>A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.</p>	
52.04.00	<p><b>Equipment Installation</b></p> <ul style="list-style-type: none"> <li>(a.) <b>General Requirements</b></li> </ul>	
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	<p>(1.) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all equipments furnished under this specification.</p> <p>(2.) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.</p> <p>(3.) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.</p> <p>(4.) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.</p> <p>(b.) <b>Installation Materials</b></p> <p>All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.</p> <p>(c.) <b>Regulatory Requirements</b></p> <p>All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.</p> <p>(d.) <b>Cleaning</b></p> <p>All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.</p> <p>(e.) <b>Equipment Assembly</b></p> <p>Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.</p> <p>(f.) <b>Equipment Setting</b></p> <p>Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.</p> <p>Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block / isolating cock comes within 1600 mm from operating floor level.</p> <p>(g.) <b>Free-Standing Equipment</b></p>			
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	<p>Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.</p> <p>(h.) <b>Non-free Standing Equipment</b></p> <p>(1.) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.</p> <p>(2.) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.</p> <p>(i.) <b>Equipment Location</b></p> <p>(1.) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.</p> <p>(2.) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.</p> <p>(3.) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.</p> <p>(4.) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.</p> <p>(5.) Permanent temperature wells on the main steam, hot reheat and cold reheat piping shall not be installed until steam blowing has been completed. Temporary temperature wells shall be installed in the main and reheat steam piping during steam blow and discarded after completion.</p> <p>(6.) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.</p> <p>For location of C&amp;I related equipment/devices, the requirement specified elsewhere in the technical specification may be referred.</p> <p>(j.) <b>Installation of Field Mounted Instruments and Devices</b></p> <p>The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.</p>			
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	<p>In addition to above relevant Portion as specified elsewhere in technical specification may be referred.</p> <p>(k.) <b>Piping Connections</b></p> <p>(1.) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall, however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.</p> <p>(2.) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.</p> <p>(l.) <b>Equipment Checkout</b></p> <p>(1.) All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.</p> <p>(2.) After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.</p> <p>(m.) <b>Defects</b></p> <p>(1.) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.</p> <p>(2.) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.</p> <p>(n.) <b>Equipment Protection</b></p> <p>(1.) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.</p> <p>(2.) The equipment shall be protected during storage as described herein.</p> <p>(3.) Equipment shall be protected from weld spatter during construction.</p> <p>(4.) Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.</p> <p>(5.) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.</p> <p>(6.) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and</p>		
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	<p>constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.</p> <p><b>53.00.00 WELDING - SPECIAL REQUIREMENTS</b></p> <p>If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.</p> <p><b>54.00.00 DEVIATIONS DISPOSITIONING:</b></p> <p>Any deviation to the contract and employer approved documents shall be properly recorded in the format prescribed by NTPC. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.</p> <p><b>55.00.00 NON-DESTRUCTIVE TESTING (NDT):</b></p> <p>The contractor shall record results of NDTs carried out at site in the format acceptable to employer. All the radiographs &amp; its report duly signed &amp; correlated to the job shall be handed over to the employer. Sensitivity of all the test equipment shall be compatible to the job &amp; acceptance norms agreed.</p> <p>Computed RT shall be used as an advanced Engineering Practice. Main contractor to ensure minimum 10% computed radiography of weld joint to be performed in construction phase for scope agreed in FWS for boiler pressure parts. Main contractor to ensure the transfer &amp; storage of these records in Server</p> <p>55.01.00 Sub contracting of NDT &amp; PWHT / SR Agencies- NDT &amp; PWHT / SR contract shall be directly awarded by the main contractor to their approved NDT &amp; PWHT / SR agencies .</p> <p><b>56.00.00 TESTING EQUIPMENT &amp; FACILITIES:</b></p> <p>Contractor shall provide the testing equipment and facilities necessary to carry out tests &amp; inspections.</p>			
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	<p style="text-align: right;"><b>ANNEXURE-I</b></p> <p style="text-align: center;"><b>STANDARD CHECKLIST</b></p> <p style="text-align: center;"><b>COMMISSIONING/TESTING ESSENTIAL PRE-REQUISITE</b></p> <p><b>1. MECHANICAL</b></p> <p><b>(A.) VALVES</b></p> <ul style="list-style-type: none"> <li>(1.) MANUALLY OPERATED VALVE</li> <li>(2.) ELECTRICALLY OPERATED VALVE</li> <li>(3.) PNEUMATICALLY ACTUATED VALVE</li> <li>(4.) HYDRAULICALLY ACTUATED VALVE</li> <li>(5.) SAFETY VALVE</li> <li>(6.) ELECTROMATIC RELIEF VALVE</li> <li>(7.) STEAM TRAP</li> <li>(8.) BUTTERFLY VALVE (ELECTRICALLY OPERATED)</li> <li>(9.) BUTTERFLY VALVE (MANUALLY OPERATED)</li> <li>(10.) BUTTERFLY VALVE (FOUR WAY-ELECTRICAL)</li> <li>(11.) NON-RETURN VALVE (INCLUDING HYDRAULIC/PNEUMATIC FCNRVS)</li> <li>(12.) THREE WAY CONTROL VALVE</li> <li>(13.) RELIEF VALVE</li> <li>(14.) DIFFERENTIAL PRESSURE REGULATING VALVE</li> <li>(15.) FLOAT OPERATED VALVES</li> </ul> <p><b>(B.) TANKS AND PRESSURE VESSELS</b></p> <ul style="list-style-type: none"> <li>(1.) TANKS (METAL) UPTO 20 M2</li> <li>(2.) TANKS (LARGE STORAGE)</li> <li>(3.) PRESSURE VESSEL (BELOW 17 BARS)</li> <li>(4.) AIR RECEIVER</li> <li>(5.) PRESSURE VESSEL-ACCESS DOOR</li> <li>(6.) TURBINE MAIN OIL TANK</li> </ul> <p><b>(C.) PUMPS</b></p> <ul style="list-style-type: none"> <li>(1.) PUMP LOW PRESSURE CENTRIFUGAL (MOTOR DRIVEN)</li> <li>(2.) PUMP UP TO 350 HP (260 KW)</li> <li>(3.) PUMP SUMP INSTALLATION</li> <li>(4.) GEAR PUMP/SCREW PUMP</li> </ul> <p><b>(D.) PIPE WORK SYSTEM</b></p> <ul style="list-style-type: none"> <li>(1.) STEAM SERVICES</li> </ul>			
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	<ul style="list-style-type: none"> <li>(2.) WATER SERVICES</li> <li>(3.) OIL/FIRE RESISTANT FLUID SYSTEM</li> <li>(4.) AIR SERVICES (COMPRESSOR)</li> <li>(5.) HIGH PRESSURE SERVICES</li> <li>(6.) CONSTANT LOAD SUPPORT</li> <li>(7.) SPRING SUPPORTS</li> <li>(8.) HANGERS AND OTHER SUPPORTS</li> <li>(E.) STRAINER AND FILTER               <ul style="list-style-type: none"> <li>(1.) STRAINER/FILTER BASKET TYPE</li> <li>(2.) STRAINER ROTARY (LOW PRESSURE)</li> <li>(3.) FILTER &amp; STRAINERS CENTRIFUGAL SEPARATORS</li> <li>(4.) FILTER &amp; STRAINER Y-TYPE</li> <li>(5.) FILTER &amp; STRAINER (PLATE TYPE)</li> <li>(6.) PURIFIER</li> <li>(7.) FILTER-COMPRESSED AIR LINE</li> </ul> </li> <li>(F.) HEAT EXCHANGER               <ul style="list-style-type: none"> <li>(1.) HEAT EXCHANGER (GENERAL)</li> <li>(2.) HEAT EXCHANGER-OIL/WATER</li> <li>(3.) ROTARY AIR HEATER</li> </ul> </li> <li>(G.) FANS AND COMPRESSORS               <ul style="list-style-type: none"> <li>(1.) FANS-NON-PRESSURE LUBRICATED</li> <li>(2.) FANS-AXIAL FLOW PRESSURE LUBRICATED</li> <li>(3.) COMPRESSORS-GENERAL</li> <li>(4.) DAMPERS &amp; GATES</li> </ul> </li> <li>(H.) CRANES AND ELEVATORS               <ul style="list-style-type: none"> <li>(1.) AUXILIARY OVERHEAD/GANTRY CRANE</li> <li>(2.) TRAVEL SUPPORT STRUCTURE FOR CRANE</li> <li>(3.) LONG TRAVEL &amp; CROSS TRAVERSE MOTION OF CRANE</li> <li>(4.) MAIN AUX. HOIST MOTION (CRANE)</li> <li>(5.) ELECTRIC HOIST</li> </ul> </li> <li>(I.) POWER TRANSMISSION               <ul style="list-style-type: none"> <li>(1.) POWER TRANSMISSION GEAR BOX</li> <li>(2.) BEARING</li> <li>(3.) FLUID COUPLINGS</li> </ul> </li> </ul>			
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	<p><b>2. ELECTRICAL</b></p> <p>(1.) SWITCHYARD</p> <p>(2.) POWER TRANSFORMERS, LT INDOOR TRANSFORMERS, OUTDOOR TRANSFORMERS.</p> <p>(3.) BATTERY CHARGERS, DC BATTERIES, DG SETS, STATION LIGHTING, OVERHEAD LINES.</p> <p>(4.) MV BUS DUCTS</p> <p>(5.) D.C. MOTOR</p> <p>(6.) HV SQUIRREL CAGE INDUCTION MOTOR</p> <p>(7.) 415 V SQUIRREL CAGE INDUCTION MOTOR</p> <p>(8.) MOTOR OPERATED ACTUATORS</p> <p>(9.) LT SWITCHGEARS/MCC</p> <p>(I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM</p> <p>(II.) PT CARRIAGE AND CUBICLES</p> <p>(III.) CABLE/BUS DUCT/BUS BARS</p> <p>(IV.) CONTRACTOR MODULE</p> <p>(V.) SWITCH FUSE MODULE</p> <p>(VI.) MASTER PANEL OF LUBE OIL PANEL</p> <p>(VII.) FEEDER PANEL OF LUBE OIL PANEL</p> <p>(VIII.) SPACE HEATER AND CABLE MODULE</p> <p>(IX.) CONTROL TRANSFORMER MODULE</p> <p>(X.) HT CIRCUIT BREAKER</p> <p>(XI.) 415 V CIRCUIT BREAKER</p> <p>(10.) POWER CABLE</p> <p>(11.) CONTROL CABLE</p> <p>(12.) AUXILIARY CABLE</p> <p>(13.) D.C. CABLE</p> <p>(14.) EXPLOSION PROOF ELECTRICAL EQUIPMENT</p> <p>(15.) JUNCTION BOX</p> <p>(16.) CONTROL TRANSFORMER MODULE</p> <p>(17.) BRUSH GEAR ASSEMBLY</p> <p>(18.) AUX. CONTROL AND RELAY PANEL DESK</p> <p>(19.) INDICATING INSTRUMENT</p>			
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	<p>(20.) RECORDING INSTRUMENT</p> <p>(21.) INTEGRATING INSTRUMENT</p> <p><b>3. CONTROL &amp; INSTRUMENTATION</b></p> <p>(A.) CONDUCTIVITY ANALYSING EQUIPMENT INCLUDING TEST PROCEDURES</p> <p>(B.) PH ANALYSER INCLUDING TEST PROCEDURE</p> <p>(C.) SILICA ANALYSER</p> <p>(D.) LEVEL SWITCH (FLOAT ACTUATED)</p> <p>(E.) LEVEL SWITCH (ELECTRODE TYPE)</p> <p>(F.) LEVEL SWITCH (DISPLACER ACTUATED)</p> <p>(G.) TRANSMITTER (FLOAT OPERATED PNEUMATIC OUTPUT) INCLUDING TESTING PROCEDURE</p> <p>(H.) LEVEL INDICATOR (FLOAT/PULLEY TYPE)</p> <p>(I.) LOCAL TEMPERATURE INDICATORS INCLUDING TEST PROCEDURE</p> <p>(J.) RESISTANCE THERMOMETER ELEMENT INCLUDING TEST PROCEDURE</p> <p>(K.) THERMOCOUPLE ELEMENT AND CONNECTING CABLE</p> <p>(L.) THERMOCOUPLE AND RESISTANCE THERMOMETER CONVERTOR/TRANSMITTER INCLUDING TEST PROCEDURES.</p> <p>(M.) TEMPERATURE SWITCH/THERMOSTAT INCLUDING TEST PROCEDURES</p> <p>(N.) COLD JUNCTION BOXES</p> <p>(O.) ZENER BARRIER</p> <p>(P.) O<sub>2</sub> ANALYSER</p> <p>(Q.) O<sub>2</sub> IN HYDROGEN INCLUDING TEST PROCEDURES</p> <p>(R.) PRESSURE AND VACUUM GAUGE</p> <p>(S.) PRESSURE AND VACUUM SWITCH INCLUDING TEST PROCEDURE</p> <p>(T.) DIFFERENTIAL PRESSURE TRANSMITTER INCLUDING TEST PROCEDURE</p> <p>(U.) DIFFERENTIAL PRESSURE SWITCH INCLUDING TEST PROCEDURE.</p> <p>(V.) FLOW INDICATOR (VARIABLE AREA)</p> <p>(W.) ORIFICE PLATE</p> <p>(X.) TURBINE FLOW TRANSMITTER</p> <p>(I.) FLOW SWITCH</p> <p>(II.) WEIR</p>			
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	<p>(III.) NOZZLE</p> <p>(IV.) FLOW INDICATOR (PNEUMATIC INPUT) INCLUDING TEST PROCEDURE</p> <p>(V.) FLOW INTEGRATOR (PNEUMATIC INPUT) INCLUDING TESTPROCEDURE</p> <p>(VI.) FLOW INDICATOR (FLOAT OPERATED) INCLUDING TEST PROCEDURE</p> <p>(VII.) VENTURI (FLUID)</p> <p>(VIII.) FLOW SWITCH (MAGNETIC TYPE)</p> <p>(IX.) AVERAGING INLET</p> <p>(X.) LIMIT SWITCHES</p> <p>(Y.) TURBINE SUPERVISORY MEASURING SYSTEM</p> <p>(Z.) POSITION MEASUREMENT AND INDICATION INCLUDING TEST PROCEDURES</p> <p>(AA.) TACHOMETER</p> <p>(BB.) VIBRATION MEASUREMENT</p> <p>(CC.) DIGITAL INDICATOR</p> <p>(DD.) MOVING COIL INDICATOR INCLUDING TEST PROCEDURE</p> <p>(EE.) RECORDER INCLUDING TEST PROCEDURE</p> <p>(FF.) FLAME SCANNER</p> <p>(GG.) ELECTRICAL AUTO MANUAL CONTROL STATION</p> <p>(HH.) PUSH BUTTON MODULE</p> <p>(II.) ALARM ANNUNCIATOR EQUIPMENT INCLUDING TEST PRO</p> <p>(JJ.) TEST PROCEDURE FOR ELECTRONIC MODULES OF DDCMIS</p> <p>KK.) THERMO CONTROL VALVE</p> <p>(LL.) TEST PROCEDURE FOR ADJUSTMENT OF MODULATING CONTROLLER - PID TERMS</p> <p>(MM.) TEST PROCEDURE INDICATING CONTROLLER-ELECTRICAL INPUT AND PNEUMATIC OUTPUT</p> <p><b>Note:</b> The items which are not part of this specification may be considered as not applicable.</p>			
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	<div>ANNEXURE-II</div> <div>BRIEF WRITE UP ON THE CONTENTS OF TESTING</div> <div>SCHEDULE / COMMISSIONING SCHEDULE</div> <p>Testing Schedules should be designed to ensure that the plant area, equipment or apparatus are tested and commissioned and will operate as per the employer's specifications and good engineering practices.</p> <p>Testing Schedule/Commissioning Schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting.</p> <p>Testing Schedule/Commissioning Schedule should contain the following sections to make the document a self-contained one:</p> <div><div>1.</div><div>Plant Details/Design data</div></div> <div><div>2.</div><div>Testing Objective/Proposals</div></div> <div><div>3.</div><div>State of the Plant</div><div><div>a)</div><div>Erection Status with respect to Mech. Elect and C&amp;I</div></div><div><div>b)</div><div>Availability of the services required</div></div><div><div>c)</div><div>Safety requirements as per Manufacturer's</div></div></div> <div><div>4.</div><div>Test method including completion/acceptance criteria</div></div> <div><div>5.</div><div>Results</div></div> <div><div>6.</div><div>Appendix</div><div><div>a)</div><div>Testing Programme</div></div><div><div>b)</div><div>Mech/Elect/C&amp;I -Plant item completing list</div></div><div><div>c)</div><div>List of Drawing/documents required for carrying out the testing.</div></div></div>			
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	<p style="text-align: right;"><b>ANNEXURE - III</b></p> <p style="text-align: center;"><b>SAFETY PLAN</b></p> <ol style="list-style-type: none"> <li>01. Safety Policy of the Contractor to be enclosed:</li> <li>02. When was the Safety Policy last reviewed:</li> <li>03. Details of implementation procedure / methods to implement Safety Policy / Safety Rules:</li> <li>04. Name, Qualification, experience of Safety Officer</li> <li>05. Review of Accidents Analysis Method, Methods to ensure Safety and Health:</li> <li>06. Unit executive responsible to ensure Safety at various levels in work area:</li> <li>07. List of employees trained in safety employed before execution of the job. Give the details of training:</li> <li>08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees:</li> <li>09. Details of checklist for different jobs / work and responsible person to ensure compliance (copy of checklist to be enclosed):</li> <li>10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed:</li> <li>11. Risk Assessment, Safety Audit by Professional Agencies, Periodicity:</li> <li>12. Implementation of Recommendations of Audit / Inspections. Procedures for implementation and follow up:</li> <li>13. Provision for treatment of injured persons at work site:</li> <li>14. Review of overall safety by top Management and Periodicity:</li> <li>15. System for Implementation of Statutory legislations:</li> <li>16. Issue of PPEs to employees, Periodicity / stock on hand etc:</li> </ol> <p style="text-align: right;">Signature Head of the Organisation with date &amp; stamp</p>			
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<p>1.</p> <p>1.1</p>	<p style="text-align: right;"><b>ANNEXURE-IV</b></p> <p><b>Health Safety and Environment (HSE) Policy and HSE Management Manual</b></p> <p><b>INTRODUCTION</b></p> <p><b>Background</b></p> <p>NTPC safety policy and various safety requirement has already been indicated in the site regulation and safety section of GCC. This document shall be supplementary to above document and shall be read in conjunction with site regulation and safety section of GCC. In case of any contradiction, the stringent of the two requirements (in the opinion of the employer) shall prevail.</p> <p>NTPC being India's largest power utility and a responsible corporate entity, the statement of policy on health and safety at work sets out the commitment of NTPC to manage health and safety effectively, and what shall be achieved by NTPC, the Contractor and any appointed sub- contractor.</p> <p>NTPC, the Contractor and any appointed sub-contractor is committed to provide and maintain a safe and healthy workplace for all staff, and to provide the information, training and supervision needed to achieve this.</p> <p>All involved parties are committed to protect the fundamental rights of all appointed workers and feel obliged to create a sound worker-managementrelationship as a key ingredient in a sustainable and successful project execution.</p> <p>All involved parties will have to assume the responsibility for H&amp;S procedures, and need to be made aware of their responsibilities and to comply with NTPC's H&amp;S Policy.</p> <p>The following requirements are mandatory for each worker in maintaining a safe and healthy workplace through:</p> <ul style="list-style-type: none"> <li>• Being involved in the workplace H&amp;S System;</li> <li>• Sticking to correct procedures and equipment;</li> <li>• Wearing protective clothing and equipment whenever required;</li> <li>• Reporting any pain or discomfort as soon as possible;</li> <li>• Ensuring that all accidents and incidents are reported;</li> <li>• Helping new workers, trainees and visitors to the workplace understandthe right safety procedures and why they exist;</li> <li>• Telling the responsible managers immediately of any H&amp;S concerns;</li> <li>• Keeping the work place tidy to minimise the risk of any accidents.</li> </ul> <p>The aim of all the stake holders is to achieve the following goals:</p> <ul style="list-style-type: none"> <li>• Zero fatalities of workers, visitors or the public;</li> <li>• Zero accidents and incidents of workers, visitors or the public;</li> <li>• Zero harmful, hazardous or dangerous situations or occurrences;</li> <li>• Zero environmental concerns or impacts;</li> <li>• Continuous improvement of the health &amp; safety performance at site under practical conditions.</li> </ul>			
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1.2	<p><b>Definition of Occupational Health &amp; Safety</b></p> <p>Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995 and is defined as follows:</p> <p>Occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.</p> <p>"The main focus in occupational health is on three different objectives:</p> <ul style="list-style-type: none"> <li>• the maintenance and promotion of workers' health and working capacity;</li> <li>• the improvement of working environment and work to become conducive to safety and health and</li> <li>• the development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings.</li> </ul> <p>The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking."</p> <p>Workers safety has to be understood as the practice of an employer using preventative measures to prevent hazards to the employees' personal safety. This practice includes creating plans and procedures for employees and managers in the workplace. In addition, workplace safety involves creating policies and keeping emergency materials available for employee and manager use while at a work site.</p>			
1.3	<p><b>Purpose of the H&amp;S Management Manual</b></p> <p>The present H&amp;E Management Manual shall delineate the Health and safety Requirements, incl. policies and guidelines, and outline the roles and responsibilities of the different parties involved in the implementation and oversight of Health, Safety and Environment Measures to ensure community, worker and public health and safety during construction.</p> <p>The H&amp;S Management Manual considers the applicable national occupational health, safety and welfare legislation as well as guidelines and standards established by the relevant Ministries and Authorities.</p> <p>The H&amp;S Management Manual other than Site Regulation and Safety provisions provided in Bidding Documents takes the following applicable IFC Performance Standards (PS) into account:</p> <ul style="list-style-type: none"> <li>• PS 2: Labour and Working Conditions, dated January 1, 2012</li> <li>• PS 3: Resource Efficiency and Pollution Prevention, dated January 1, 2012</li> <li>• PS 4: Community, Health, Safety and Security, dated January 1, 2012.</li> </ul> <p>The H&amp;S Management Manual includes the Occupational Health &amp; Safety Requirements and arrangements that are mandatory for the Contractor for consideration and implementation.</p>			
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<p><b>1.4</b></p> <p><b>2.</b></p> <p><b>2.1</b></p> <p><b>2.2</b></p>	<p>In case the provisions in Site Regulation and Safety provisions provided in Bidding Documents are superior than the provisions indicated in this manual, the provisions provided in Site Regulation and Safety provisions provided in Bidding Documents shall prevail.</p> <p>The defined H&amp;S Standards are part of the contractual obligations, and no changes are possible without a prior written approval by NTPC.</p> <p><b>Content of the H&amp;S Management Manual</b></p> <p>The H&amp;S Management Manual contains an outline of the required H&amp;S Organization at site and to be implemented by the Contractor.</p> <p>It describes the overall H&amp;S Management required for the organization of a safe and healthy working environment for the workers and to ensure that the <del>pl</del> will not be affected by the construction activities. In addition to the organizational arrangements roles and responsibilities of the required H&amp;S Staff of the Contractor are defined.</p> <p>Attention is paid to the need for training to be implemented by the Contractor. It starts with the evaluation of training needs and defines the requirement of developing a training schedule as well as workers and visitor induction.</p> <p>Communication procedures are addressed and needed H&amp;S Reporting is specified for the entire construction period.</p> <p>As one of the most important subjects, the entire risk management process is comprehensively described, specifying the risk management process, the hierarchy of control and the safe system of work.</p> <p>Reporting and monitoring procedures are developed for the fulfillment by the Contractor and the standards for PPE are included.</p> <p>The H&amp;S Management Manual shall highlight the entire H&amp;S Management System and also provide information on the H&amp;S Standards to be followed by the Contractor.</p> <p><b>HEALTH &amp; SAFETY MANAGEMENT SYSTEM</b></p> <p>An H&amp;S Management System is implemented for the Project. The management system comprises of different components to be developed by the Contractor.</p> <p>That the Contractor must implement human resource policies and procedures that set out the approach to manage workers consistent with the requirements of IFC PS 2 as well as the applicable national laws and standards.</p> <p><b>Health &amp; Safety Management Manual</b></p> <p>Contractor will implement this H&amp;S Management Manual in order to delineate the Project's H&amp;S Requirements, Policies and Guidelines as well as to outline the roles and responsibilities of the different parties involved in the <del>implementation</del> and oversight of measures to ensure community, worker and public health and safety during construction.</p> <p><b>Contractor's H&amp;S Plans</b></p> <p>All Contractors shall establish an effective project specific H&amp;S Plan. The H&amp;S Plan will be subject of NTPC's written approval. The H&amp;S Plan shall be submitted by the Contractor not later than 4 weeks prior to any commencement of works at site.</p> <p>Any work at site, incl. mobilization to the site will not be allowed to commence until NTPC deems the Contractor's H&amp;S plan to be suitable and sufficient.</p> <p>The H&amp;S Plan shall describe how health and safety will be managed at site, incl. mobilization and transport to the site, and how the specified H&amp;S Standards will be applied in practice. In</p>			
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	<p>addition the Contractor shall ensure adequate communication of these requirements throughout the supply chain, its supervision, and the workers themselves.</p> <p>The H&amp;S Plan shall specify the management arrangements for carrying out the work including but not limited to:</p> <ul style="list-style-type: none"> <li>• Overview of the project;</li> <li>• Clearly identified risks associated with the scope of works;</li> <li>• Program and milestones;</li> <li>• Site management and organization;</li> <li>• Key contractors and sub-contractors;</li> <li>• Communication, Cooperation and Co-ordination;</li> <li>• Site security;</li> <li>• Traffic management;</li> <li>• Welfare facilities and provision;</li> <li>• Arrangements for supervision of contractors on site;</li> <li>• Arrangements for information, instruction and training including induction;</li> <li>• Management of hazards on site;</li> <li>• Arrangements for identification of hazards, assessment of risk and production of Method Statements;</li> <li>• Arrangements for hazardous undertakings e.g. confined space, work at height, hot work, excavations, cofferdams etc.;</li> <li>• Permit to work system;</li> <li>• Site rules;</li> <li>• Arrangements for managing plant and equipment;</li> <li>• Management of lifting operations;</li> <li>• Management of temporary works;</li> <li>• Arrangements for monitoring and auditing etc.;</li> <li>• Requirements as defined by relevant statutory planning authorities e.g. traffic, noise, working hours etc.;</li> <li>• Incident &amp; accident investigation.</li> </ul> <p>The H&amp;S Plan shall also consider the site rules outlining the H&amp;S Requirements for all workers. The site rules shall include but should not be limited to:</p> <ul style="list-style-type: none"> <li>• Site access;</li> <li>• Access to and transport on the site;</li> <li>• Entering and leaving the site;</li> <li>• Use of mobile phones;</li> <li>• Smoking;</li> <li>• PPE requirements;</li> <li>• General behaviour;</li> <li>• Transport to the site;</li> <li>• Vehicle traffic within the site area;</li> <li>• Access to the site and Working Areas;</li> <li>• Restricted areas.</li> </ul> <p>The H&amp;S Plan shall consider related plans and the corresponding direct and indirect H&amp;S Requirements. This refers especially to the following related plans and assessments:</p>			
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2.3	<ul style="list-style-type: none"> <li>Hazardous materials and waste management plan;</li> </ul> <p>A checklist for the review and approval of project specific H&amp;S Plans shall be developed prior to the construction contract. The checklist shall define the minimum requirements to be met by the Contractor.</p> <p><b>Contractor's H&amp;S Procedures</b></p> <p>The Contractor is requested to develop workplace specific H&amp;S Procedures. In this matter, it should be noted that procedures are similar to method statements probably better known by Contractors. The required content of H&amp;S Procedures is described below.</p> <p>H&amp;S Procedures are part of the Project framework for effective H&amp;S Management. The H&amp;S Policy states the intention to provide a safe and healthy workplace, and states the H&amp;S goals of a workplace.</p> <p>Specific health &amp; safety workplace procedures shall address particular issues or hazards and the measures how to control those identified hazards. The procedures should be used together with other hazard control measures to eliminate or reduce the risks of accidents and incidents and illness and/or injuries at the working place.</p> <p>H&amp;S Procedures shall be developed for the following activities expected to apply during construction:</p> <ul style="list-style-type: none"> <li>Site access control and site security procedure;</li> <li>Health &amp; safety protection at transmission line worksites;</li> <li>Isolation and lock-out;</li> <li>Use of hazardous chemicals;</li> <li>Simultaneous activities;</li> <li>Live line work;</li> <li>Shift work, shift rotation and fatigue;</li> <li>X-ray and NDT;</li> <li>Risk assessment;</li> <li>Job Safety Analysis;</li> <li>Working at height;</li> <li>Working in confined spaces;</li> <li>Use of personal protective equipment;</li> <li>Excavation works;</li> <li>Hot works;</li> <li>Welding;</li> <li>Emergency response procedure;</li> <li>Evacuation procedure (if applicable);</li> <li>First aid;</li> <li>Working in water (if applicable);</li> <li>Use of electrical equipment;</li> <li>Work on high voltage.</li> </ul> <p>This checklist shall define the minimum requirements to be met by the Contractor.</p>			
2.4	<p><b>Contractor's Safe Work Instructions</b></p>			
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<p>2.5</p>	<p>Safe work instructions shall be developed by the Contractor identifying the health and safety issues that may arise from use of the machinery and equipment. The safe work instruction must be based on the H&amp;S Plan.</p> <p>A safe work instruction should identify:</p> <ul style="list-style-type: none"> <li>• the hazard associated with the use of a specific tool or equipment;</li> <li>• the required control measures to be checked to ensure a safe use of a specific tool or piece of equipment;</li> <li>• the specific training and/or qualification required;</li> <li>• the personal protective equipment to be worn.</li> </ul> <p>Safe work instructions do not replace the requirement for a risk assessment, preparation of a workplace procedure, the need of a permit to work or the need for training.</p> <p>A risk assessment of the equipment must be performed before developing safe work instruction procedures to identify the hazards and risk controls.</p> <p>A checklist for the review and approval of project specific Safety Work Instructions will be developed by the PIC prior to the first construction contract. The checklist will define the minimum requirements to be met by the Contractor.</p> <p><b>Contractor's H&amp;S Forms</b></p> <p>The Contractor must develop forms like checklists for risk assessment etc. to support the support the use of workplace procedures, instructions, audits etc.</p> <p>These forms must be attached to the respective documents, and must be read in closed conjunction with the corresponding document(s).</p> <p>The checklists shall be subject of an update and revision in case improvements or needed changes were found suitable and required.</p> <p>The checklists must be subject of project documentation, in the same way and considering the same procedure that is applicable for the project documentation in general.</p> <p>H&amp;S Forms have to comprise the following subjects as a minimum:</p> <ul style="list-style-type: none"> <li>• Contractor Audit Questionnaire</li> <li>• Basic Risk Assessment</li> <li>• Permit to Work</li> <li>• Workplace Inspection Checklist</li> <li>• Accident/Incident Report/Investigation</li> <li>• Fire Risk Assessment</li> <li>• Hazardous Substance Risk Assessment</li> <li>• Ladder Inspection Checklist.</li> </ul> <p>The forms to be used by the Contractor must include all pertinent information. Additional forms like inspection checklists, workplace inspection checklists might be necessary and should be prepared by the Contractor and are subject of approval by NTPC.</p> <p>2.6</p> <p><b>Contractor's Grievance Management System</b></p> <p>2.6.1</p> <p><b>Workers Grievance Management System</b></p> <p>The Contractor must implement a grievance management system to enable the workers to raise complaints and to inform about non-compliances with the implemented H&amp;S</p>			
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<p>2.6.2</p> <p>2.7</p> <p>3.</p> <p>3.2.1</p> <p>3.2.2</p>	<p>Management System. The grievance management system should provide the possibility to issues complaints in case of discrimination and/or the non-consideration of equal opportunities.</p> <p>The grievance management system shall consider the possibility to contact directly a member of the H&amp;S Staff. The contacted staff members must take a note of the reported complaint or non-compliance and must report it to the site manager and the H&amp;S Manager.</p> <p>The H&amp;S Management is requested to solve a complaint or non-compliance within 3 working days. In case the problem could not be solved an action procedure specifying the needed activities together with a final deadline until the problem is expected to be solved must be prepared and submitted to NTPC.</p> <p>The Contractor is requested to provide the possibility for the workers to notify a complaint or non-compliance in a confidential way.</p> <p><b>Public Grievance Management System</b></p> <p>The grievance management system shall also be open for public complaints.</p> <p>A respective procedure must be developed by the Contractor for review and approval. The grievance management system for the public must consider a reporting procedure to the local authority to demonstrate to the administrative body that the complaint was identified, noted, managed and solved.</p> <p>The responsible authorities at the community level must be identified by the Contractor 4 weeks prior to the start of the construction activities or 4 weeks prior to the mobilization to the site.</p> <p>The reporting procedure should be discussed and agreed upon together with the administrative body and specific attention should be paid to any specific requirements to be announced by the authority. The contact with the authority should be established by having a face-to-face meeting. This meeting should be attended by an H&amp;S Representative of the Contractor.</p> <p><b>H&amp;S Committee</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>ROLES, RESPONSIBILITIES AND ACCOUNTABILITY</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>Child Labour</b></p> <p>The contractor shall not deploy any person below the age of 18 years.</p> <p><b>Pregnant Woman</b></p> <p>Pregnant employees have the following four major prerogatives:</p> <ul style="list-style-type: none"> <li>• paid time off for antenatal care</li> <li>• maternity leave</li> <li>• maternity pay</li> <li>• protection against unfair treatment, discrimination or dismissal.</li> </ul> <p>In addition, the contractor must not change a pregnant employee's contract terms and conditions without agreement. If this will be done by a contractor, it has to be handled as a breach of contract.</p> <p>It's illegal for contractor to refuse to give pregnant employees time off for antenatal care or refuse to pay their normal rate for this time off.</p>		
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	<p>The following rights shall be considered:</p> <ul style="list-style-type: none"> <li> <b>Pregnancy-related illnesses</b>            If the employee is off work for a pregnancy-related illness in the 4 weeks before the expected date of birth of the child, maternity leave and statutory maternity pay by the employer has to start automatically.         </li> <li> <b>Compulsory maternity leave</b>            In case the employee does not take statutory maternity leave, they must take 4 weeks off after the child is born.         </li> <li> <b>Telling the contractor about the pregnancy</b>            Employees are obliged to inform their contractor about the pregnancy at least 15 weeks before the beginning of the week of the expected date of birth or, in case of unawareness of the pregnancy during this timeframe, the contractor must be told as soon as possible.             Employees must also tell the contractor when they want to start their statutory maternity leave and pay.         </li> <li> <b>Health and safety for pregnant employees</b>            After the receipt of information about the pregnancy of an employee, the employer should assess the risks to the woman and her baby.             Risks could be caused by:           <ul style="list-style-type: none"> <li>heavy lifting or carrying</li> <li>standing or sitting for long periods without adequate breaks</li> <li>exposure to toxic substances</li> <li>long working hours</li> <li>vibration and mechanical shocks</li> <li>extreme heat</li> <li>noise</li> <li>ionising radiation</li> <li>non-ionising (electromagnetic) radiation</li> <li>carbon monoxide</li> <li>lead</li> <li>polychlorinated Biphenyls</li> <li>organic solvents</li> <li>pesticides and herbicides</li> <li>tobacco smoke.</li> </ul> </li> </ul> <p>The MSDS to be provided together with each chemical substance to be in use or to be delivered at the construction site, storage area etc. should highlight the category.</p> <p>Where there are risks, the contractor should take reasonable steps to remove the risks or by offering the employee different work or work places or by changing the working hours by the adaption of sufficient breaks.</p> <p>In case the contractor can't remove any risks, the contractor must suspend the employee on full pay and without any reduction.</p> <p>Pregnant worker who think they're at risk but their employer disagrees should report to NTPC's H&amp;S Manager during a site audit.</p> <p>The contractor is obliged to inform every pregnant employee about their rights in writing and this information must be recorded.</p>		
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	<p>Apart from above, all the provisions of Maternity Benefit Act, 1961 as applicable from time to time, shall be complied with by the contractor.</p> <p><b>4. TRAINING</b> It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>5. HEALTH &amp; SAFETY REPORTING</b></p> <p><b>5.1 Contractors Reporting Obligations</b></p> <p>Independent from the general requirement and contractual obligations to implement a reporting scheme with respect to the progress, construction schedule and project reporting in general, the Contractor will be obliged to implement an H&amp;S Reporting.</p> <p>The H&amp;S Reporting should provide an overview of the H&amp;S Performance within a particular timeframe and with specific topics as mentioned below:</p> <p>The H&amp;S Reports should be submitted to NTPC Project Manager</p> <p><b>5.1.1 Health &amp; Safety Performance</b></p> <p><b>5.1.1.1 Weekly Reports</b></p> <p>The Contractor shall prepare weekly H&amp;S reports. The weekly reports shall be submitted by close of business on the first working day after a completed working week, e.g. the reporting timeframe is from Monday to Saturday and the respective following working day is the upcoming Tuesday, if not a public holiday.</p> <p>The weekly reports shall comprise of the following information with respect to the reporting timeframe:</p> <ul style="list-style-type: none"> <li>• Originator</li> <li>• Name of the project</li> <li>• Activities performed</li> <li>• Health occurrences</li> <li>• Safety occurrences</li> <li>• Resulting accidents, incidents or dangerous situations</li> <li>• Undertaken measures.</li> </ul> <p><b>5.1.1.2 Monthly Reports</b></p> <p>The Contractor shall prepare monthly H&amp;S reports. The monthly reports shall be submitted by close of business of the last working day of the first working week after the reporting timeframe, e.g. the reporting timeframe is from 1<sup>st</sup> of January until 31 of January and the due day of the submission of the report is the Friday of the first working week in February, if not a public holiday.</p> <p>The weekly reports shall comprise of the following information with respect to the reporting timeframe:</p> <ul style="list-style-type: none"> <li>• Originator</li> <li>• Name of the project</li> <li>• Activities performed</li> <li>• Health occurrences</li> <li>• Safety occurrences</li> </ul>			
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<p>5.1.2</p> <p>6.</p> <p>6.1</p> <p>6.2</p>	<ul style="list-style-type: none"> <li>Resulting accidents, incidents or dangerous situations</li> <li>Investigation results</li> <li>Undertaken measures</li> <li>Lessons learned</li> <li>Informed authorities and resulting obligations/conditions</li> <li>Results of workplace inspections.</li> </ul> <p><b>Hazards Reporting</b></p> <p>The H&amp;S Staff of the contractor is requested to undertake workplace inspections. In case that hazards and risks are identified during workplace inspections, it is needed that the identified hazard or risk has to be solved immediately and without delay during the inspection.</p> <p>In case that the problem could not be solved, a written report has to be prepared and issued to the H&amp;S Manager or site manager highlighting:</p> <ul style="list-style-type: none"> <li>a description of the problem;</li> <li>the reason why it could not be solved during the inspection;</li> <li>the needed action;</li> <li>the responsible person;</li> <li>the associated hazards and risks;</li> <li>the deadline until the problem must be solved.</li> </ul> <p>The occurrence must be reported in the monthly H&amp;S Report.</p> <p>Any other reporting requirements with respect to H&amp;S, e.g. audit reports, weekly and monthly H&amp;S Reports, remain unchanged.</p> <p><b>HEALTH &amp; SAFETY RISK MANAGEMENT</b></p> <p>The risk management process with specifically requested forms requires a careful document administration and control. The Contractor should be aware that the documents resulting from the risk management process, in particular, the risk assessments, permits to work and job safety analysis, must be available during construction site audits and/or exemplary as part of a monthly report.</p> <p><b>Risk Management Process</b></p> <p>Risk management is the identification, assessment and prioritization of risks to avoid impacts on workers and the public.</p> <p>The Contractor has to implement a suitable and appropriate risk management process to enable his site staff to prevent any non-compliances resulting in critical, harmful or dangerous situations followed by incidents, accidents or fatalities.</p> <p>Alternatively suggested risk management processes shall be provided in the H&amp;S Plan.</p> <p><b>Hierarchy of Control</b></p> <p>The first part of evaluating the risk stage, consideration must be given how likely each hazard could cause harm. When the potential for harm has been decided, the existing control measures should be identified. In this course, each step of the activity has to determine what control measures might already in place. When evaluating a risk it is imperative to check the</p>			
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	<p>applicable legislation and to ensure that everything required by law is in place or has to be done.</p> <p>When considering current controls and further required control measures, the general principles of control should be applied:</p> <p>Eliminate</p> <ul style="list-style-type: none"> <li>It has to be checked if the risk associated with the hazard could be eliminated.</li> </ul> <p>Reduce</p> <ul style="list-style-type: none"> <li>It has to be assessed if the possible amount of the hazard or the exposure to the hazard could be reduced.</li> </ul> <p>Isolate</p> <ul style="list-style-type: none"> <li>It must be evaluated if the hazard could be isolated. Isolating is the principle of preventing the contact with the hazard.</li> </ul> <p>Control</p> <ul style="list-style-type: none"> <li>It must be assessed if a safe system of work, permit to work and/or procedures are in place to control the hazard to prevent that some body becomes injured.</li> </ul> <p>Personal Protective Equipment</p> <ul style="list-style-type: none"> <li>As a final result of running through the hierarchy of control, the supply of personal protective equipment is the final result of controlling the hazard. The provision of PPE must not be the first and final stage of risk mitigation.</li> </ul> <p><b>6.3 Safe System of Work</b></p> <p><b>6.3.1 Risk Register</b></p> <p>The Contractor is requested to develop and prepare a risk register. A risk register is a document that summarizes and defines the possible risks resulting from a particular activity, in the present case from particular construction or construction related activities. The concept of a risk register recognises that risk elements arising from proposed or actual activities fall into one of following three categories:</p> <ul style="list-style-type: none"> <li>Risks which are deemed to have a low risk and do not need to be managed;</li> <li>Risks that have a medium or high risk and will need to be managed;</li> <li>Risks which have an extreme risk and therefore the activity should probably not proceed.</li> </ul> <p>The risk register records details all the risks identified for the construction phase and associates them in terms of likelihood of occurring and seriousness of impact.</p> <p>The risk register to be prepared should identify:</p> <ul style="list-style-type: none"> <li>a description of each risk and its potential consequences;</li> <li>factors that may impact upon the likelihood and severity of the risk;</li> <li>an assessed risk ranking, such as <ul style="list-style-type: none"> <li>low,</li> <li>medium</li> <li>high or</li> <li>very high;</li> </ul> </li> </ul>			
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- whether the risk ranking is acceptable or not;
- actions and controls that currently exist to mitigate risks

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

Likelihood					
	Severity				

**Table 6-1: Risk ranking table**

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

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


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


- **Medium (Risk ranking 3 to 4):** Mitigation actions to reduce the likelihood and severity should be identified and appropriate actions must be endorsed.
- **High (Risk ranking 6 to 9):** If uncontrolled, a risk event at this level may have a significant impact for the actions and tasks at a construction site as a whole. Mitigating actions need to be very reliable and should be approved and monitored by the Contractor. Even with mitigating actions in place, the construction site staff potentially exposed to that risk should be advised of identified or potential risks which have been graded at this level.
- **Very High (Risk ranking 12 to 16):** Activities and projects with unmitigated risks at this level should be avoided or terminated. Mitigation actions of these types of risks may outweigh the benefits of the execution method. This is because risk events graded at this level have the potential to have significant adverse effects with the potential to cause serious accidents and incidents resulting in fatalities.


It needs to be identified if any risk mitigation procedures are in place.

If it is found that there are none, procedures must be developed considering the following:

- Planned actions: -  
Reduction the likelihood a negative risk will occur and/or reduce the seriousness should it occur (What should you do now?)

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6.3.2	<ul style="list-style-type: none"> <li>Contingency actions: Planned actions to reduce the immediate seriousness of a negative risk when it does occur. (What should you do when?)</li> <li>Recovery actions: Planned actions taken once a negative risk has occurred to allow you to move on. (What should you do after?)</li> <li>Risk Transfer: e.g. through assignment of contractual responsibilities or insurance.</li> <li>Actions: Necessary to ensure the realisation of opportunities (positive risks).</li> </ul> <p>A risk register for every single construction site must be developed by the responsible Contractor considering as well the tasks and activities to be undertaken and executed by sub-contractors. The risk register has to be prepared by a competent and experienced group of engineers and workers approx. 4 weeks before mobilization to the site and start of any works at site even if they deemed to be of general nature and without having a risk potential. The risk register has to consider as well every transportation activity to the construction site.</p> <p>The risk register will be subject of review and approval by NTPC.</p> <p><b>Risk Assessment</b></p> <p>The Contractor is requested to undertake a risk assessment for all activities assessed to be of a medium, high or very high risk.</p> <p>The risk assessment has to be carried out with the participation of the staff experienced with the tasks and activities and the equipment:</p> <ul style="list-style-type: none"> <li>the responsible H&amp;S Manager or a H&amp;S Supervisor</li> <li>the foreman for the execution of the activity</li> <li>the worker(s) asked to undertake the activity.</li> </ul> <p>The risk assessment has to be performed prior to the execution of the activity and it must be done in written. The written risk assessment must be documented and stored in the project file.</p> <p>The risk assessment has to be undertaken in a simple and comprehensive way, understandable by each participant.</p>			
	<p><b>6.3.3 Permit to Work</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>Stage 1- Highlight Potential Hazards:</b></p> <p>Worker(s) and the foreman guided by the H&amp;S Advisor highlight potential hazards of a task and identify all necessary safety measures. The hazard identification must consider all required electrical and mechanical equipment. Stage 1 has to be carried out in writing.</p> <p>Work is not permitted to commence until Stage 4.</p> <p><b>Stage 2-Application of Permit:</b></p> <p>The Foreman applies for permission to start work on a prescribed form and submit the application to the H&amp;S Advisor only when all requirements and conditions</p>			
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6.3.4	<p>described in the permit to work have been fulfilled. The Foreman has to indicate in the written permit to work that risk assessment was conducted. The risk assessment must be attached to the permit to work.</p> <p><b>Stage 3-Evaluation of Permit:</b></p> <p>The H&amp;S Advisor will evaluate and verify that all safety conditions specified in the permit to work have been fulfilled and are adequate described. He may also recommend additional measures in the permit to work when necessary. He will need to inspect the location of work where the permit to work has been applied for, with the Foreman during this process.</p> <p>Only when all safety requirements and conditions stated in the permit to work are fulfilled, the H&amp;S Advisor will then endorse the permit to work form and forward to the Health &amp; Safety Manager.</p> <p><b>Stage 4-Approval of Permit:</b></p> <p>The H&amp;S Manager may approve and issue the permit to work only when he is satisfied that:</p> <ul style="list-style-type: none"> <li>• Proper evaluation of risk and hazards for the work concerned has been conducted;</li> <li>• No incompatible work will be carried out in the same time and location of the permit to work, which may pose a risk to the persons at work;</li> <li>• All reasonably practicable safety measures have been taken and all persons involved in the work have been informed of the work hazards under the PTW;</li> <li>• All electrical and mechanical equipment is demonstrably checked and in safe conditions.</li> </ul> <p>A work permit is valid for one working day and for the specified working time. In case the tasks could not be finalised within the validity of the permit to work, the permit to work must be renewed before commencement of work on the day the work may continue.</p> <p>The permit to work form must include at least the following information:</p> <ul style="list-style-type: none"> <li>• Originator</li> <li>• Date</li> <li>• Description of task activity</li> <li>• Duration of the task</li> <li>• Needed equipment</li> <li>• Security certificates of equipment</li> <li>• Risk Assessment</li> <li>• Already implemented mitigation measures</li> <li>• Further mitigation measures</li> <li>• Needed training or induction</li> <li>• Approved by</li> <li>• Date and time of approval.</li> </ul> <p><b>Job Safety Analysis (JSA)</b></p> <p>The Contractor has to undertake a JSA which is a procedure to integrate safety and health principles and practices into a particular job operation. In a JSA, each basic step of the job related hazards has to be identified and recommendations have to be provided to choose the safest way to do the job.</p>			
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	<p>For conducting a JSA four main steps have to be considered:</p> <ul style="list-style-type: none"> <li>• selecting the job to be analyzed</li> <li>• breaking the job down into a sequence of steps</li> <li>• identifying potential hazards</li> <li>• determining preventive measures to overcome these hazards.</li> </ul> <p>The Contractor must provide a specific methodology for conducting a JSA .</p> <p><b>7. EMERGENCY RESPONSE</b></p> <p><b>7.1 Emergency Response Procedures</b></p> <p>An emergency is a serious, unexpected, often dangerous situation that requires immediate action. The emergency procedure is the strategy of actions to be outlined in the emergency response plan to response to an emergency event.</p> <p>This could include, but not limited to rescue:</p> <ul style="list-style-type: none"> <li>• from working at height;</li> <li>• in confined spaces, shafts and tunnels;</li> <li>• from fire &amp; smoke, etc.</li> </ul> <p><b>7.2 Emergency Response Plan (ERP)</b></p> <p>The Contractor has to develop an ERP for review and approval by NTPC.</p> <p>The ERP has to consider at least the following information and instruction for an adequate management of emergency situations:</p> <ul style="list-style-type: none"> <li>• Result of a risk assessment to determine the most probably emergency situation;</li> <li>• Identification of suitable emergency response procedures, such as: <ul style="list-style-type: none"> <li>• Determination of safe evacuation areas;</li> <li>• Determination of safe evacuation routes;</li> <li>• Determination of accurate and suitable fire fighting equipment;</li> <li>• Determination of fire brigade;</li> <li>• Training and induction of emergency response procedure.</li> </ul> </li> </ul> <p>Note: Specific attention should be paid to the investigation of the nearest hospital or first aid station. The contact numbers of the hospital or first aid station together with at least one contact of a medically examined staff team member of the hospital or first aid station must be included in the ERP in case of injuries at night-time hours or during weekends or during bank holidays.</p> <p><b>7.3 First Aid at Site</b> It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>7.4 Fire Protection and Control</b></p>			
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7.4.1	<p>The Contractor shall undertake a suitable and adequate fire risk assessment for whatever is applicable under the scope of work of the respective construction contract.</p> <p>The Contractor shall ensure that the necessary fire prevention, protection and control measures are installed and maintained. This shall commence during mobilisation and updated accordingly.</p> <p>The Contractor shall nominate certain of his employees who shall be trained in fire fighting duties. Nominated fire fighting personnel shall be available at all times during ongoing works on site.</p> <p><b>Fire Prevention, Protection &amp; Control</b></p> <p>The following requirements apply with respect to fire prevention, protection &amp; control and must be considered wherever applicable:</p> <ul style="list-style-type: none"> <li>• Adequate and suitable means for extinguishing fire shall be provided and maintained.</li> <li>• All stocks of inflammable substances shall be kept in a fire resisting store or in a safe place outside any occupied building.</li> <li>• Provided that no such store shall be so situated as to endanger the means of escape from the workplace or from any part thereof in the event of a fire occurring in the store.</li> <li>• Chemical fire-extinguishers shall be freshly charged at intervals not greater than those specified by the manufacturers, or otherwise once annually, and tested by the application of such hydraulic pressure thereto as shall be suited to the type of extinguisher tested, at intervals of not more than four years; and the dates of recharging the extinguisher and the last hydraulic test shall be clearly marked on the body of the extinguisher or on a tab securely attached thereto.</li> <li>• Install a temporary or permanent water supply with sufficient flow volume and duration to supply the standpipes, hose stations, and sprinkler systems, before the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, connect the standpipe to the water supply, install the standpipe concurrently with construction of the structure, and maintain the standpipe in operable condition for fire protection use. Provide the standpipes with fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location at street or road level.</li> <li>• No fire, flame, open light or other agent likely to ignite volatile and inflammable substances shall be allowed or used in any part of a workplace in which volatile and inflammable substances are used.</li> <li>• No person shall smoke in any part of a workplace where volatile and inflammable substances are used, and a notice prohibiting smoking shall be posted in a conspicuous place in every such part of the workplace.</li> <li>• Inform workers of the fire hazards of the materials and processes to which they are exposed. Brief new workers on the parts of the plan that is essential for their protection and emergency evacuations.</li> <li>• Provide additional training for personnel assigned tasks that require them to remain in a facility during a fire emergency.</li> <li>• When working in potentially explosive atmospheres, safe non-electric tools and apparatus suitable for the use in such areas shall be employed.</li> <li>• No plant, tank or vessel which contains or has contained any explosive or inflammable substance shall be subjected to any welding, brazing or soldering operation, or to any cutting operation which involves the application of heat, until all practicable steps have been taken to remove the explosive or inflammable substance and any fumes arising there from, or to render them non-explosive or non-inflammable; and if any plant, tank or vessel has been subjected to any such operation as aforesaid, no explosive or inflammable substance shall be allowed to enter the plant, tank or vessel until the metal has cooled sufficiently to prevent any risk of igniting the substance.</li> </ul>			
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7.4.2	<b>Means of Fire Escape</b>  Every workplace shall have adequate means of escape in case of fire.and must be properly maintained and kept free from obstruction.																																																			
7.4.3	<b>Fire Alerts</b>  The Contractor has to set up a system to alert workers on site and the public in the neighbourhood. This should be a permanent installed fire alarm (which must be tested on a weekly basis), a klaxon, an air horn or a whistle,depending on the size and complexity of the site.  Any warning needs to be distinctive, audible above other noise andrecognizable by everyone in case of fire.																																																			
8.	<b>HEALTH, SAFETY MANAGEMENT &amp; MEASUREMENT</b>																																																			
8.1	<b>Noise Management</b>  The Contractor is requested to develop a working noise monitoring plan to identify those areas at site where noise levels are occurring in a harmful range.  Generally, a reasonable mitigation measure, of more importance than wearing hearing protection devices, is the reduction of noise levels to a levelas low as reasonable possible. Avoidance has always the priority in comparison to passive reduction.  Noise levels must be kept below 80 dB (A) wherever possible. In case of exceeding this value, hearing protections must be provided to the workers and warning signs must be installed.  The noise monitoring must be repeated every week in case that the location of the construction site remains unchanged. In case of a change of the site, the noise monitoring has to be undertaken after implementation of site arrangements.  In case that a construction site could not be demarked in detail, the noisemonitoring has to be done for different activities.  The following table provides the standards, exposure times and need forpersonal protective equipment.																																																			
<table><tr><th rowspan="2">dB(A)</th><th colspan="2">Exposure time<sup>1)</sup></th><th rowspan="2">Need for PPE</th><th rowspan="2">Comment</th></tr><tr><th>hours</th><th>minutes</th></tr><tr><td>80</td><td>25</td><td>24</td><td>No</td><td rowspan="10">Suitable hearing protection must be provided. The hearing protection must be able to insulate the noise level to a value of 89 dB(A) or below.</td></tr><tr><td>85</td><td>8</td><td>0</td><td>No</td></tr><tr><td>86</td><td>6</td><td>21</td><td>Yes</td></tr><tr><td>87</td><td>5</td><td>2</td><td>Yes</td></tr><tr><td>88</td><td>4</td><td>0</td><td>Yes</td></tr><tr><td>89</td><td>3</td><td>10</td><td>Yes</td></tr><tr><td>90</td><td>2</td><td>31</td><td>Yes</td></tr><tr><td>95</td><td>0</td><td>47</td><td>Yes</td></tr><tr><td>100</td><td>0</td><td>15</td><td>Yes</td></tr><tr><td>105</td><td>0</td><td>4</td><td>Yes</td></tr></table>					dB(A)	Exposure time <sup>1)</sup>		Need for PPE	Comment	hours	minutes	80	25	24	No	Suitable hearing protection must be provided. The hearing protection must be able to insulate the noise level to a value of 89 dB(A) or below.	85	8	0	No	86	6	21	Yes	87	5	2	Yes	88	4	0	Yes	89	3	10	Yes	90	2	31	Yes	95	0	47	Yes	100	0	15	Yes	105	0	4	Yes
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8.2	110	0	1	Yes	
	<p><b>Table 8-1: Noise standards, exposure times and need for PPE</b></p> <p>1) Applicable to a 8h-working-shift Source: US Department of Health and Human Services, Occupational Noise Exposure, page 18, dated June 1998.</p> <p>Contractor shall ensure at a construction site that adequate measures are taken to protect workers against the harmful effects of excessive noise or vibration at such construction site and the noise level in no case exceeds the limits laid down in BOCW act. Additionally, compliance of The Noise Pollution (Regulation and Control) Rules, 2000) is to be ensured by the agency w.r.t ambient noise level.</p> <p><b>Air Quality Management</b></p> <p>The air quality at site could be affected by different emissions resulting from combustion engines or resulting from the generation of dust during dryweather conditions.</p> <p>Emissions from combustion engines are difficult to reduce. Some efforts notto affect the air quality are the switch-off of machines whenever possible and to limit the number of machines and equipment to a level as low as reasonable possible. The Contractor is requested to consider these recommendations during the construction phase.</p> <p>Considering this requirement, the Contractor must undertake all necessary actions to reduce the generation of dust to the lowest possible levels. Project specific measures shall be included in the H&amp;S Plan.</p> <p>Mitigation measures to prevent increased dust generation include using</p> <p>dust-suppressing water spray in areas of active earthmoving and on unpaved roads, using aggregate-covered access roads to minimize dust emissions and minimizing the areas of exposed soil or cleared of vegetation. Truck beds should be covered with a tarp or similar material to minimize dust during the transport.</p> <p>Mitigation measures during project activities to prevent increased air emissions would include using requiring emission control devices on equipment, maintaining properly tuned engines, avoiding unnecessary idling, using electric motors instead of internal combustion engines, usinglow-sulfur diesel fuel where available, preparing asphalt away from populated areas.</p> <p><b>8.3 Pre-employment Health Assessment</b></p> <p>Pre-employment health checks for construction site workers shall be mandatory. These checks shall ensure that in no case the state of health ofemployed workers can be impaired by possible pre-existing diseases. TheContractor shall deploy a suitable experienced medic and appropriate materials and premises for these checks.</p> <p>Workers shall be checked, and all the results shall be analysed, before hisfirst workday, in order to mitigate any risk.</p> <p>Therefore, the Contractor shall provide the abovementioned medical staff and material during the entire year. Usage of hospital capacities is an often used option to fulfil these</p>				
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	<p>requirements, where those capacities are available. Only personnel with appropriate health condition with respect to their particular job shall be employed.</p> <p>All workers who are subject to an exposure to occupational health risks shall undergo periodic medical surveillance. This would be required for workers:</p> <ul style="list-style-type: none"> <li>• exposed to noise levels exceeding 85dB(A);</li> <li>• exposed to hazardous materials, e.g. chemicals;</li> <li>• carrying heavy loads.</li> </ul> <p>In addition to the pre-employment health checks and periodic medical surveillance, the Contractor shall enable the site workers to pass an exit medical check after finishing their jobs on site. The exit medical check shall be provided to all workers who worked more than 3 months constantly on the construction site.</p> <p>All pre-employment, periodic or exit health checks must be documented for each worker. The assessment records must be kept confidential and for the use by the project management only. The workers will have the right to ask for the results of the health checks.</p> <p>The workers will have the right to decline any pre-employment, periodic or exit medical checks. In this case they will not have the possibility to apply for any compensation in case of health interferences resulting from their work activities in connection to existing diseases.</p> <p>All pre-employment, periodic or exit health checks must be provided to the workers free of charge. The application for a health check must not result in a negative treatment of the respective worker.</p> <p>The Contractor must ensure that any health checks requiring specific facilities, equipment or medical staff will be available at the construction site or in a reachable distance to travel.</p> <p><b>8.4 Covid-19 Prevention</b></p> <p>Contractor shall take all necessary measures related to Covid-19 prevention as per guidelines issued by Government authorities as well as NTPC guidelines (if any).</p> <p><b>8.5 Health Surveillance</b></p> <p><b>8.5.1 Management of Alcohol and Drugs</b></p> <p>Smoking shall be prohibited at all times at the construction site, at worker's camp and at storage and fabrication areas. This includes the operating or use of all electrical or manual work equipment.</p> <p>Smoking shall be restricted to clearly defined and highly visible areas, only.</p> <p>The presence and consumption of non prescription drugs and alcohol is strictly prohibited at all areas.</p> <p>Drug and, especially, alcohol testing shall be arranged after weekends and especially for workers appointed for works consisting of potentially high-risk activities. The drug and alcohol test shall be undertaken in case of indications of a respective consumption.</p>			
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<p>9.</p> <p>10.</p> <p>11.</p> <p>11.1</p> <p>11.2</p> <p>11.2.1</p> <p>11.2.2</p>	<p>Until the result of the test is public, the worker(s) must refrain from any work at site.</p> <p>In case of a positive test result, the worker has to be expelled from the site without any undue delay until the completion of the project.</p> <p><b>PERSONAL PROTECTIVE EQUIPMENT</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>INCIDENT &amp; ACCIDENT MANAGEMENT</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC</p> <p><b>HEALTH &amp; SAFETY REVIEWS</b></p> <p><b>MCA H&amp;S Audits and Reviews</b></p> <p>Prior to commencement of the main construction phase, NTPC will conduct a pre-construction phase H&amp;S Review to ensure that all the necessary arrangements are in place and suitable for the work being undertaken at that time. This will include compliance with this H&amp;S Standards document, the project H&amp;S Plan and country specific legislation.</p> <p>NTPC will conduct site specific H&amp;S Reviews on a regular basis and formal H&amp;S Audits of the Contractor and its supply chain. Formal H&amp;S Audits will be conducted at least, every 6 months. The duration of this audit will be a minimum of 1 day and will require the full co-operation of the Contractors project management team.</p> <p>In addition to H&amp;S Reviews to be undertaken by NTPC, it is possible that further H&amp;S Audits and Reviews will be carried out by relevant stakeholders i.e. Ministry of Labour or Ministry of Health etc.</p> <p>The Contractor is obliged to provide any necessary support to the stakeholders to enable them to undertake their tasks and duties and to allow the access to the sites for undertaking the audits and reviews.</p> <p><b>Contractors Health &amp; Safety Review Programme</b></p> <p>The Contractor shall implement an H&amp;S Review Programme applicable for his construction site(s) that shall include a systematic evaluation of the implemented management system, compliance with this H&amp;S Standards document, and the project H&amp;S Plan and local legislative requirements.</p> <p><b>Contractors H&amp;S Audits</b></p> <p>H&amp;S Construction Site Audits must be undertaken on a monthly basis. The audits should be performed by the Site Manager, the H&amp;S Manager and the H&amp;S Advisor.</p> <p>The audits should comprise the construction site itself, material and equipment storage areas, workshop areas and accommodation areas (Worker's camp area).</p> <p>These audits shall be recorded and the results should be slipped into the monthly H&amp;S Reports. A copy of the audit report must be attached to the monthly report.</p> <p><b>Contractors H&amp;S Inspections</b></p>			
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<p>11.2.3</p> <p>11.2.4</p> <p>11.3</p> <p>11.4</p> <p>11.5</p> <p>12.</p>	<p>H &amp; S Inspections must be carried out on specific work areas and work places associated with the project on a weekly basis but independent thereof if they are assessed as medium or high risk areas or workplaces according to the risk register. The results of the inspections must be considered in the weekly H&amp;S reports to be submitted to NTPC. A copy of the H&amp;S Inspection report must be attached to the weekly report. The H&amp;S</p> <p>Inspections shall be executed by the H&amp;S Manager together with the H&amp;S Advisor.</p> <p><b>Contractors Health &amp; Safety Surveys</b></p> <p>H &amp; S Surveys shall be conducted by the Contractors' H&amp;S Advisor on a daily basis. The date and time of the surveys must be documented but the results must not be recorded in a written report but significant findings must be communicated to the H&amp;S Manager.</p> <p><b>Contractors Management Surveys</b></p> <p>Management surveys to be undertaken by the Contractors General Manager or his representatives shall be conducted at least every 3 months. The surveys must not be done by the responsible Site Manager, H&amp;S Manager or H&amp;S Advisor of the particular construction site. The results shall be recorded.</p> <p><b>Reporting</b></p> <p>The results of H&amp;S Audits and H&amp;S Inspections must be recorded and the reports must be submitted to NTPC within 3 working days after finalisation of the audit or inspection respectively. Forms to be used for the audits and audit reports respectively, inspections and surveys will be provided by NTPC.</p> <p>The reports must include all relevant subjects according to the purpose of the H&amp;S Reviews, but at least the results and the needed corrective actions.</p> <p>An reporting schedule for each particular construction site must be developed by the Contractor and should be submitted to NTPC for review and approval.</p> <p><b>Corrective Actions</b></p> <p>The H&amp;S Review reports must include the need for corrective actions. The list corrective actions must include the following information:</p> <ul style="list-style-type: none"> <li>• Identified risks and non-compliances;</li> <li>• Needed corrective actions;</li> <li>• Needed personal and material resources;</li> <li>• Responsible person;</li> <li>• Date for latest finalisation.</li> </ul> <p>The effectiveness of the corrective actions will be subject of NTPC's H&amp;S Audits.</p> <p><b>Compliance Reviews</b></p> <p>One week after the implementation of the corrective actions, the H&amp;S Manager is requested to undertake a compliance review. After observation of the full compliance of the corrective actions, the H&amp;S Manager has to report the finalisation to NTPC.</p> <p><b>SITE H&amp;S REQUIREMENTS</b></p> <p>It shall be governed by site regulation and safety requirement as stipulated in GCC.</p>			
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13.	<p><b>STAYING &amp; FOOD ARRANGEMENT FOR WORKERS</b></p> <p>The contractor may consider providing hygienic food, beverages and refreshments during period of Project construction which may enhance the productivity level of the workers.</p> <p>The contractor shall also arrange quarters in workers habitat area for accommodation of workers during period of stay at SIPAT STPP. The proper cleaning and hygiene shall be maintained in quarters. The random checks for hygiene and cleanliness shall be done by Employer and any violation on cleanliness shall not be acceptable. Employer may take action for the same as deemed fit.</p>			
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# **SUB-SECTION–A-07**


## **STEAM TURBINE & AUXILIARIES SYSTEM**





CLAUSE NO.	<div style="text-align: center;"> <b>TECHNICAL REQUIREMENTS</b>  </div>			
1.00.00 1.01.00 1.02.00  1.03.00 1.03.01    1.04.00       1.05.00       1.05.01	<div style="text-align: center;"><b>TURBINE GENERATOR AND AUXILIARIES</b></div> <div><b>STEAM TURBINE AND AUXILIARY SYSTEMS</b></div> <div><b>Steam Turbine</b></div> <div><b>MAINTENANCE REQUIREMENTS</b></div> <p>Provision of Wet steam washing (if applicable), forced cooling arrangement, turbine preservation system (Portable, skid mounted) and Boroscopic Inspection ports in turbine for in situ inspection of turbine internals as per standard practice of turbine manufacturer with latest portable boroscopic inspection system.</p> <div><b>TURBINE CASING</b></div> <p>The turbine casing design shall have following features:</p> <p>(a) Adequate drainage facility and temp. sensing devices in casings, strainers housings, stop and control valves, extraction lines etc and in drain lines at upstream of the isolating valve to detect any chocking and passing of high energy drains. The power operated high energy drain isolating valves seat tightness shall be conforming to MSS SP61.</p> <div><b>STEAM TURBINE ROTORS</b></div> <p>(a) Provide forged alloy steel rotor.</p> <p>(b) Maximum permissible shaft vibration measured at bearing housing will be as per zone A of ISO 7919 and maximum permissible bearing vibration measured at bearing housing will be as per zone A of ISO 10816-2.</p> <p>(c) Turbine assembly radial seal clearances at rotor blade tip and interstage area shall not be less than 0.8 mm.</p> <p>(d) Critical speed of composite rotor and blade assembly shall not be within - 10% and +15% of rated speed.</p> <p>(e) The design of radial seals shall be such that it should be easily replaceable, maintenance friendly and repairable close to design condition post repair.</p> <div><b>NOZZLES AND BLADES</b></div> <p>(a) Ensure material is hard, corrosion &amp; erosion resistant alloy steel.</p> <p>(b) Ensure that there is no resonance of LP blading in the continuous operating frequency range of 47.5 Hz. to 51.5 Hz. Furnish Campbell diagrams for all free standing blade stages offered for LP blading.</p> <p>(c) Ensure LP stage design for effective removal of moisture.</p> <p>(d) Ensure stress induced in LPT blading due to back end steam loading under V.W.O.conditions not to exceed 90% of design stress value.</p> <div><b>On-line Blade Vibration Monitoring System</b></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.06.00	<p>(a) Bidder shall provide online blade vibration monitoring system for LP Turbine last stage free standing blades (as applicable). In case the Blade design comprises integral shroud and snubber which becomes integral at higher speed due to continuous centrifugal force shall not be treated as free standing blade.</p> <p><b>BEARINGS</b></p> <p>(a) Tin base babbit lining properly secured to the bearing shell.</p> <p>(b) Provision for measuring bearing temperature as near the point of heat generation as possible and for measuring the oil temperature leaving the bearing</p> <p>(c) Provide following instrumentation for each Journal/Thrust bearings.</p> <p>(1) Local temperature indicators in each bearing lube oil drains.</p>			
1.07.00	<p><b>TURNING GEAR</b></p> <p>Provide suitable turning gear device, either High-speed hydraulic type or motorised turning gear as per standard proven practice of the Bidder. Provide manual hand barring facility also for manually cranking the turbine in case of emergency including A-C power failure. Ensure availability of lube oil to the bearings during manual barring operation. Alternatively, Bidder can provide permanent arrangement for manual barring as per their standard practice for each unit. However, such system/arrangement shall be capable of rotating the TG rotor train independent of electrical power source like Air motor.</p>			
1.08.00	<p><b>GLAND SEALING SYSTEM FOR STEAM TURBINE and BFPDT</b></p>			
1.08.01	<p><b>Operation and maintenance requirement:</b></p> <p>(a) During start up and low load operation, sealing steam shall be supplied from alternate source of steam i.e. aux. steam header, along with a facility to automatically switchover arrangement from alternative source to the main source and vice-versa. The system should allow Smooth Changeover.</p> <p>(b) Two nos. modulating type control valves shall be provided, one discharging surplus steam to condenser or any other location as optimized by the bidder and another one for supplying extra steam to gland sealing header from steam source to maintain sealing steam header pressure at a preset value. However for the drive turbine, the requirement of modulating valve for discharging surplus steam shall be as per process requirement.</p>			
1.09.00	<p><b>STEAM ADMISSION VALVES (EMERGENCY STOP, REHEAT STOP, INTERCEPTOR STOP VALVES AND CONTROL VALVES)</b></p>			
1.09.01	<p><b>Design, constructional and operational requirement:</b></p> <p>(a) Provide Temporary &amp; Permanent steam strainers for Emergency stop and Reheat Stop or control valves. In case there is no provision for temporary strainer, one set of strainers per unit shall be provided in addition to the permanent strainer. The strainers shall be arranged to permit easy inspection and cleaning.</p> <p>(b) Provide hydraulically operated valves, fail safe type &amp; equipped with test device to permit complete closing of one valve at a time while the Unit is carrying load.</p>			
1.10.00	<p><b>TURBINE GOVERNING SYSTEM</b></p> <p>Provide adjustable steady state speed regulation between +3% to +8% of rated speed. Ensure dead band at rated speed and at any power output within rated output shall not exceed 0.06% of rated speed.</p>			
SINGRAULI SUPER THERMAL POWERPROJECT STAGE-III (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 2 OF 25	


CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.11.00	<b>TURBINE PROTECTIVE DEVICES</b> (a) Emergency controller as per standard practice of bidder meeting following requirements. Bidder shall provide overspeed trip of the Unit at 110% of rated speed in case speed governor fails to limit the turbine overspeed. It shall meet the IEC-45 requirements for overspeed trip. Bidder shall provide means for testing the actual overspeed of Turbine. Further provision shall be given for testing of overspeed protection. Bidder shall provide emergency local hand trip device to facilitate manual tripping of the unit alongwith facility to trip turbine from UCB.  (b) <b>TG Protection:</b> Advisory trips by Operator shall be avoided. All protections related to safety of turbine and/or its components and personnel shall be provided with Tripping in AUTO mode. Apart from mandatory turbine protection, these protections shall include, but not be limited to, following: a. TG Bearing temperature b. TG Shaft/bearing vibration c. Differential Expansion d. Low Main steam temperature e. Any other safety requirement as required			
1.12.00	<b>UNLOADING DEVICE</b> (a) <b>Initial Pressure Regulator</b> (1) It shall ensure turbine unloading to a preset point to run on house load in case main steam pressure falls below a predetermined value. (2) It shall be possible to adjust or bypass the initial pressure regulator from UCB at start up condition to facilitate starting with low steam pressure and during sliding pressure operation. (3) Contact to be provided for signalling the device in, "Operation" and "Reset".			
1.13.00	<b>VACUUM BREAKER</b> Bidder shall provide D.C operated device for rapid reduction of vacuum in condenser for turbine rotor to be brought to rest as quickly as possible.			
1.14.00	<b>TURBINE LUBRICATION OIL SYSTEM</b> (a) A self contained LUBRICATION oil system for each TG Unit consists of : (1) Centrifugal / gear type, Main oil pump (MOP) directly driven by Turbine as per Bidder's standard practice. In addition of above 2x100% AC Aux. oil pumps for start up, shut down of TG unit and as standby to M.O.P. for automatic operation shall be provided. OR 2x100% AC oil pumps as per Bidder's standard practice (2) One DC motor driven emergency oil pump with sufficient capacity for meeting lube oil requirement of bearings during emergency with automatic starting on low lube oil pressure preset value. (3) 1x100% each AC & DC jacking oil pumps (if applicable for bidder design) with an interlocking not to start till lube oil pressure is established. (4) Temperature measurement device to be provided at inlet and outlet of oil and water side of the lube oil coolers.			
SINGRAULI SUPER THERMAL POWERPROJECT STAGE-III (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B	SUB SECTION-A-07 STEAM TURBINE AND AUXILIARIES SYSTEM	PAGE 3 OF 25

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1.15.00	<p><b>Design codes:</b> Shell and tube type: TEMA (latest). Plate type: Pressure parts as per ASME Sec-VIII.</p> <p>(b) <b>Purification System</b> Provide permanently Connected, Continuous Oil purification system having capacity to purify 20% of total oil charge in system per hour. Purified oil shall have moisture not more than 500 PPM &amp; max. particle size conforming to code 15/12 as per ISO 4406 or requirement of the turbine manufacturer whichever is better. The above particle size and moisture content shall be demonstrated with inlet oil quality conforming to 21/18 as per ISO: 4406 and 15000 PPM moisture respectively in one pass. All components of the oil purification system including purifier vessel, which are coming in contact with oil shall be constructed from high grade stainless steel.</p> <p><b>Type test(s):</b> Particle size impurities test and moisture test as detailed out in the technical specification, is to be carried out on one purification system of main turbine.</p> <p>(c) Provide double oil piping or equivalent shielding arrangement for all high pressure lines and all pipes close to hot pipes and parts to protect against fire hazards.</p> <p>(d) All the piping, fittings, valves, Main Oil Tank and complete strainers including body and element shall be of stainless steel. Further all the parts of lube oil coolers (tubular or plate type) which are coming in contact of lube oil shall be of stainless steel.</p> <p>(1) Ensure oil return lines from bearings fitted with sight fittings, or any other device to see the flow of oil depending upon the standard proven practice of the bidder.</p> <p>(2) Oil supply and return lines to / from each bearing may have provision for oil flushing filters.</p>		
	<p><b>TURBINE CONTROL FLUID SYSTEM</b></p> <p>(a) Provide control fluid system for each unit consisting of :</p> <p>(1) Fire resistant fluid for control fluid system for all hydraulically operated valves, servo motor for turbine stop and control valves. 2x100% AC driven pumps connected to fluid reservoir alongwith hydraulic accumulators.</p> <p>(2) Ensure surfaces of reservoir in contact with fluid to be stainless steel, with 2x100% vapour extraction fans (if required) alongwith access ladders, platforms railings and manholes with covers on reservoir etc (If applicable).</p> <p>(b) <b>Piping and other equipments/components</b> All the piping of the system coming in contact with control fluid shall be of stainless steel and any other component of the system to be preferably of stainless steel or of material compatible to control fluid depending on the standard practice of the bidder.</p>		
1.16.00	<p><b>HP-LP STEAM TURBINE BYPASS SYSTEM</b></p> <p>(a) Seat tightness of the HP and LP bypass valves shall be equivalent to tightness conforming to MSS SP61.</p> <p>(b) Ensure all valves (both in steam and spray water service) to be electro hydraulically operated.</p> <p>(c) Provide separate oil system with 100% redundant pumps, motors, accumulators and control cubicles etc. for both HP and LP bypass systems. Accumulators shall be</p>		
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.17.00	<p>sized to take sufficient number of stroking operations of all actuators under a condition of loss of oil supply from the pumps.</p> <p>(d) Provide warming up arrangement of HP/LP bypass valves and associated piping.</p> <p>(e) Ensure that boiler operation is not affected in the event of loss of load on the turbine, by disposing off the steam produced in the boiler automatically by providing a quick opening device. The full stroking time of valve under quick action shall be within 2 to 3 seconds.</p> <p>(f) HP-LP bypass valve body shall be forged.</p> <p>(g) LP Bypass shall be of double stem design with separate STOP and CONTROL valves.</p> <p>(h) All the piping, fittings, valves, oil tanks, strainers including body and element associated with oil system of HP &amp; LP bypass system shall be of stainless steel.</p> <p>(i) LP Bypass stop and control valve main plug and pilot plug area shall be sized and selected in such a way that the pressure balancing of lower and upper chamber occurs in shortest possible time without transmitting any unbalance force to the stem/spindle. Calculation for pressure balancing time and force being transmitted to the main plug stem during valve opening for each design cases of LP bypass shall be submitted by the Bidder/ LP Bypass valve supplier during detail engineering.</p> <p>(j) HP-LP Bypass should have the provision of removable valve seat/any other arrangement for ease of maintenance.</p> <p>(k) HP Bypass valves shall be designed as per degree of superheat based on Boiler-Turbine combined start-up curve i.e, degree of superheat based on Main steam pressure and Temperature at the time of HP Bypass valve opening during cold start-up. For achieving degree of superheat as per approved combined start-up curve bidder shall make necessary arrangement for combination of drain lines with drain pots at the upstream of HP Bypass valves.</p> <p>Bidder shall provide necessary pressure and temperature measuring instruments near to HP Bypass valve for calculation of degree of superheat at upstream.</p>			
	<p><b>PERFORMANCE REQUIREMENTS</b></p> <p>(a) Under all conditions of operation, the steam turbine generator set shall perform continuously without the noise levels of its components and auxiliaries (individually or collectively) exceeding the limits as specified under General Technical Conditions.</p> <p>(b) Maximum permissible vibration for auxiliaries shall conform to Zone-A of ISO10816.</p>			
	1.18.00	<p><b>Heat balance Diagrams:</b></p>		
1.18.01	<p>Following Heat balances complete in all respects to be computed &amp; furnished for the conditions stipulated with units indicated in MKS system &amp; IAPWS-IF 97 steam tables. Pressure (in ata), temperature (in deg C), enthalpy (in kcal/kg) and flow (in tonnes/hr) to be indicated at all required locations to facilitate manual checking by the Employer. Other conditions for computing heat-balances are given at Annexure-I to this sub-section.</p> <p>a) 105% of rated load under rated steam condition at condenser pressure 77 mm Hg (abs), with zero make up <b>(Output guarantee)</b></p> <p>b) 100% of rated load under rated steam conditions at condenser pressure of 77 mmHg (abs) with zero make-up <b>(Heat Rate Guarantee)</b></p>			
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	<p>c) 55% of rated load under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and rated main steam temperature / rated reheat steam temp. at turbine inlet at condenser pressure of 77 mm Hg (abs) with zero make-up with one TDBFP in operation. <b>(Heat Rate Guarantee)</b></p> <p>(d) 105% of rated load at 0% make-up, design CW temperature and CW flow <b>(Condenser Pressure Guarantee Condition)</b></p> <p>f) 100% of rated load under rated steam conditions at condenser pressure of 77 mm &amp; 89 mm Hg (abs) with 3% make-up.</p> <p>g) 100% of rated load under sliding pressure conditions at condenser pressure of 77 mm Hg (abs) with 3% make-up.</p> <p>h) 95 % of rated load under turbine throttle inlet steam conditions corresponding to Modified sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) with 3% make-up &amp; 1 TDBFP and 1 MDBFP in operation.</p> <p>i) For 80%, 60% &amp; 50% of rated output under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) 3% make-up.</p> <p>j) 65% of rated output under turbine throttle inlet steam conditions corresponding to modified sliding pressure at condenser pressure of 77 mm Hg (abs) with 3% make-up.</p> <p>k) For 40%, 30% &amp; 20% of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation at condenser pressure of 77 mm Hg (abs) with 3% make-up with all HP Heaters in service.</p> <p>l) Output corresponding to VWO flow under rated steam conditions at condenser pressure of 89 mm Hg (abs) with 3% make-up.</p> <p>m) Output (not less than 105% of rated load) corresponding to VWO flow under rated steam conditions at condenser pressure of 77 mm Hg (abs) with 3% makeup.</p> <p>n) HP heaters out of service (One string and both strings) under rated steam conditions at condenser pressure of 89 mm Hg (abs) with 3% make-up and maximum continuous output not less than rated output or output corresponding to BMCR heat duty whichever is lower.</p> <p>o) HP-LP bypass operation under rated steam conditions with bypass valves open to full capacity and turbine on house load operation.</p> <p>p) HP-LP bypass operation under rated steam conditions with steam generator output of 65% of BMCR.</p> <p>q) Steam generator output corresponding to BMCR flow under rated steam conditions, turbine in parallel operation with HP-LP bypass with by pass open to full capacity.</p> <p>r) Steam Generator output corresponding to BMCR flow under rated steam condition, turbine under VWO operation, condenser pressure of 77 mmHg, 0% and 3% make up. Difference of BMCR flow and VWO steam flow through turbine shall be assumed</p>			
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CLAUSE NO.	<div style="text-align: center;"> <b>TECHNICAL REQUIREMENTS</b>  </div>			
	<p>to be drawn off from Main steam line. Same quantity of flow to be added to condenser as additional make up.</p> <p>s) 102 % of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation and rated steam temperature at condenser pressure of 77 mm Hg (abs) with 3% make-up with overload valve in closed condition.</p> <p>(t) 20% of rated load under turbine throttle inlet steam conditions corresponding to pure sliding pressure operation at condenser pressure of 77 mm Hg (abs) with 3% make-up with single TDBFP in operation without opening of minimum recirculation valve.</p> <p><b>Note:</b></p> <ul style="list-style-type: none"> <li>– Refer annexure-I for other conditions for computing heat balance diagrams.</li> <li>– Any additional heat balances deemed necessary by the Employer shall be furnished. All the heat balances shall show turbine output, mechanical and electrical losses in turbine and generator and input to shaft driven auxiliaries, if any.</li> <li>– In case of multi-exhaust LPT configuration, the “Condenser pressure”, is the average of all the condenser pressure. HBDs requested are for equipment/system design and may or may not correspond to actual operating condition.</li> </ul>			
1.19.00	Furnish thermal kit data for plant performance by DDCMIS. Furnish turbine clearance diagram indicating values for radial & axial clearances and leakage rate from glands.			
1.20.00	<p><b>Type test(s) to be conducted:</b></p> <p>Life cycle test, meridional yield rupture test and squirm test on one each of following type of metallic expansion joints:</p> <p>(a) Condenser neck (if applicable)</p> <p>(b) Cross-over pipe (largest size)</p> <p>(c) LPH extraction line (highest pressure and temperature)</p> <p>(d) LPT Gland bellows (if applicable)</p> <p>(e) Hot-well interconnecting Bellows (If applicable)</p>			
2.00.00	<p><b>CONDENSING PLANT</b></p> <p>(a) Design manufacturing and testing as per Heat Exchange Institute, USA (latest) with proven design. Bidder to furnish thermal, hydraulic and mechanical design calculation for checking equipment capability.</p> <p>(b) Provision of isolating butterfly valves and expansion bellows at inlets and outlets of condenser cooling water of each half of condensers.</p> <p>(c) Provision of air evacuation pumps. Condenser to be designed for minimum air leakage and under normal operating conditions, the air leakage in condenser not to exceed more than 50% of design value taken for sizing of vacuum pumps. The same shall be demonstrated at site under actual operating condition failing which Bidder shall carryout necessary modifications.</p> <p>(d) Minimum material grade/standard has been specified for the condensing plant. However, bidder may opt for better material.</p>			
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CLAUSE NO.	<div style="text-align: center;"> <b>TECHNICAL REQUIREMENTS</b>  </div>			
2.01.00	<p><b>Condenser</b></p> <ul style="list-style-type: none"> <li>(a) Easily removable/hinged type and refittable type water boxes alongwith suitable handling arrangement, if required, and provision of hinged manholes (of 460mm size) in shell, each water box and each hot well suction.</li> <li>(b) Water box interiors to be epoxy resin coated with suitable corrosion resistant primer of 0.25 mm minimum thickness.</li> <li>(c) Tubes shall be welded type stainless steel as per ASTM-A249-TP 316L and meeting the ASME specification for general requirements for carbon ferritic alloy and austenitic alloy steel tubes SA-450 and continuous without any circumferential joint suitable for intended duty with minimum wall thickness 22 BWG. Top rows of tubes shall be extra thick. Provision for taking care of thermal expansion of tube bundle and proper drainage of tubes during shut down shall be ensured.</li> <li>(d) Corrosion allowance of minimum 3.2 mm for water boxes, tube plates and 1.6 mm for shell, hotwell and condenser neck.</li> <li>(e) Stand pipes with necessary connections for instruments, with water level gauges and isolation valves.</li> <li>(f) Provision of catch trough below tube sheet in hotwell for detection of water leakage into steam side alongwith conductivity measurement instrument.</li> <li>(g) Steam dumping device for dumping of desuperheated steam from LP bypass alongwith all accessories and instrumentation.</li> </ul>			
2.01.01	<p><b>Hydrostatic and Hydraulic Tests</b></p> <ul style="list-style-type: none"> <li>(a) The hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser along with the condenser vacuum system by filling the steam space with water 300 mm above final joint of condenser exhaust neck to turbine. The level of hydraulic test shall be selected such that all the field welding joints are covered in the test. Any leakage detected shall be rectified immediately.</li> <li>(b) The water space shall be tested hydraulically alongwith the circulating water lines, after assembly of the waterbox doors.</li> <li>(c) After the hydraulic testing, the waterboxes tube plates and covers shall be given suitable coatings of anti-corrosive paints. The paints and painting shall meet the approval of the Employer.</li> </ul>			
2.02.00	<p><b>CONDENSER AIR EVACUATION PUMPS</b></p> <ul style="list-style-type: none"> <li>(a) Single/two stage liquid ring type with both stages (if two stage pumps provided) mounted on a common shaft.</li> <li>(b) Heat Exchangers shall be shell and tube type. Material of tube shall be stainless steel type 316 L and material of shell and tube plates as M.S. type ASTM-A285 Gr. C properly coated. Alternatively-plate type heat exchangers with SS 316 plates and 20% area margin on plates also acceptable.</li> <li>(b) No cavitation under all operating conditions without air ejector.</li> <li>(c) Noise levels should not exceed limitations as specified in Section of General Technical Requirements and vibration levels shall be Zone A of ISO 10816.</li> </ul>			
2.02.01	<p><b>Type Test(s) to be Conducted</b></p>			
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3.00.00	Following type tests are to be carried out on one vacuum pump.			
	<div><div>(i)</div><div>Cavitation test</div></div> <div><div>(ii)</div><div>Wet air test</div></div>			
4.00.00	<b>CONDENSER ON LOAD TUBE CLEANING SYSTEM</b>			
	<div><div>(a)</div><div>Provision of separate sponge ball type condenser on-load tube cleaning system for each half of condenser including ball circulation pumps, strainer and ball monitoring system. Sponge rubber ball type tube cleaning system designed for continuous &amp; trouble-free operation with provision of abrasive coated balls cleaning in case of hard deposits inside tubes.</div></div> <div><div>(b)</div><div>Provision of manual and automatic back washing system with automatic collection of balls prior to back washing.</div></div> <div><div>(c)</div><div>Provision of ball monitoring system, which should at least consist of separate ball circulation monitor and ball oversize monitor.</div></div> <div><div>(d)</div><div>The no. of balls in circulation should be at least 10% of nos. of condenser tubes.</div></div> <div><div>(e)</div><div>Bidder should indicate the number of ball losses in 336 hours of continuous operation of COLTCS.</div></div> <div><div>(f)</div><div>Provision to prevent losses of ball during normal and abnormal condition including tripping of CW pump.</div></div>			
	<b>CONDENSATE EXTRACTION PUMP</b>			
	<div><div>(a)</div><div>Vertical, Multistage, Canister type, Centrifugal, diffuser type with double suction first stage impeller.</div></div> <div><div>(b)</div><div><b>Motor bottom level</b> Bottom of motor to be above zero meter by suitably considering the pit level and motor stool dimensions.</div></div> <div><div>(c)</div><div><b>Minimum recirculation flow</b> Individual recirculation line for each CEP shall be provided. Minimum recirculation flow requirements at design speed of the pump shall be not less than 25% of design flow or on set recirculation (discharge/suction) whichever is higher.</div></div> <div><div>(d)</div><div><b>Performance curve</b> Characteristic curve of pumps should be continuously rising type with decrease in flow and shut off head shall be between 115% to 130% of TDH at design point.</div></div> <div><div>(e)</div><div><b>First stage impeller life</b> Life due to wear due to Cavitation of first stage Impeller not less than 40,000 running hours.</div></div> <div><div>(f)</div><div><b>Peripheral speed at the eye of the impeller at design speed</b> Not to exceed 20m/sec.</div></div> <div><div>(g)</div><div><b>Material</b> The material adopted shall not be inferior to those mentioned below:<div><div>(a)</div><div>Suction bell/Pump casing</div><div>-</div><div>cast iron</div></div><div><div>(b)</div><div>Impeller/Wearings/Shaft/ Shaft sleeves</div><div>-</div><div>12% Cr. stainless steel.</div></div><div><div>(c)</div><div>Canister</div><div>-</div><div>Fabricated mild steel.</div></div></div></div> <div><div>(h)</div><div><b>Applicable Code:</b> HIS (Latest edition)</div></div> <div><div>(i)</div><div><b>STRAINERS AT CONDENSER EXTRACTION PUMP SUCTION</b></div></div>			
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4.01.00	<p>The clear area of strainer to be Five times the inlet cross sectional area of the connecting piping. Strainer to be constructed of 11 gauge perforated stainless steel (304 grade) and lined with stainless steel (316 grade) screen. At design flow and clean condition, Pressure drop not to exceed 0.1 Kg/cm2. At design flow and 50% clogged condition, Pressure drop not to exceed 0.15 kg/cm2.</p> <p><b>Type test(s) to be conducted:</b> NPSH (R) test on one CEP, Pressure drop test on one CEP suction strainer</p>			
4.02.00	<p><b>DRIP PUMP (IF OFFERED):</b> Vertical, Multistage, Cannister type, Centrifugal, diffuser type. Alternatively, Horizontal, multistage centrifugal diffuser type. Bottom of motor to be above zero meter by suitably considering the pit level and motor stool dimensions. Individual recirculation line for each Drip pump shall be provided. Minimum recirculation flow requirements at design speed of the pump shall be not less than 25% of design flow or on set recirculation (discharge/suction) whichever is higher. Characteristic curve of pumps should be continuously rising type with decrease in flow and shut off head shall be between 115% to 130% of TDH at design point. Life due to wear due to Cavitation of first stage Impeller shall not be less than 40,000 running hours. Peripheral speed at the eye of the impeller at design point shall not to exceed 20m/sec. Drip pump Impeller/wearings/Shaft/ Shaft Sleeves shall have minimum 12% Cr. stainless steel.</p> <p><b>Applicable Code:</b> HIS (Latest edition)</p>			
4.02.01	<p><b>Type test(s) to be conducted :</b> NPSH (R) test on one Drip Pump.</p>			
5.00.00	<p><b>FEED WATER HEATING PLANT</b></p> <ul style="list-style-type: none"><li>(a) Tube material stainless steel as per ASTM. A 213 Gr. TP 304/304N for seamless tubes without circumferential joints or ASTM A 688 Gr. TP 304/304N for welded tubes. Maximum content of carbon shall be limited to 0.05%.</li><li>(b) Tube sheet material carbon steel as per ASTM. A516 Grade 70 or SA 350 LF-2 or SA-508 Gr 3 Cl-I and shall be welded to shell and water box. Tube support plates of common quality steel of 16mm (min) thickness.</li><li>(c) Water box channels to have access openings of minimum 450 mm dia. or of elliptical shape with minimum size 450 mm x 350 mm. These shall be self sealing type and bolted design is not acceptable.</li><li>(d) Corrosion allowance of 3.2 mm for each heater shell and water box.</li><li>(e) Minimum material grade/standard has been specified for the Feed water heating plant. However, bidder may opt for better material.</li><li>(f) Vent orifice shall be sized to pass one half percent of TMCR extraction steam flow to respective heater under TMCR conditions.</li><li>(g) Stand pipes with necessary connections for instruments with water level gauges and isolation valves.</li><li>(h) Proper drainage of bled steam lines to be ensured. Bidder shall provide Hydraulic/ Pneumatic power operated/ Assisted Quick closing type &amp; ordinary NRVs for each Steam extraction line (except for extractions from LP Turbine) including steam extraction line to BFP drive turbine. For each CRH line and extractions from LP Turbine minimum one hydraulic/ Pneumatic power operated / assisted QCNRV shall be provided, except for heater mounted in condenser neck.</li></ul>			
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5.01.00	<b>Low Pressure Heaters and Drain Cooler</b> Horizontal and U-tube type with integral drain cooler. Duplex type LP heater (two heaters in single casing) installed in condenser neck is also acceptable as per standard practice of the bidder. Shell of rolled steel as per ASTM A-516 Gr. 70 with SS-304 bands at cut points on shell to prevent damage against flame impingement during torch cutting. Water box channel of carbon steel as per ASTM A-516 Gr. 70 and welded to tube sheet. Tubes shall be expanded hydraulically in tube sheet. Tube shall be cold bent for fabrication. Requirement of drain cooler for heaters, installed in condenser neck and heater with drip pump for forward cascading of drains shall be as per standard practice of the bidder and cycle optimisation. If separate drain cooler is offered it shall be of straight or U-tube type.			
5.02.00	<b>DEAERATOR</b> <div><div>(a)</div><div>Horizontal/Vertical, Spray-cum-tray with integral direct contact vent condenser mounted on horizontal storage tank as a separate vessel or Spray cum tray with integral direct contact vent condenser accommodated inside Feed Storage Tank as per standard practice of bidder. In case spray type Deaerator is provided, Bidders to provide Stainless Steel cladding on internal surfaces of storage tank above Low low level to meet HEI requirements.</div><div>(b)</div><div>Alternatively, Spray type STORK or Equivalent with minimum two (2) spray control valves of disc type or equivalent, in order to ensure fine atomisation of incoming condensate and rapid heating up by the steam.</div><div>(c)</div><div>Design and construction as per ASME code for unfired pressure vessels, Section-VIII or any other equivalent code and Heat Exchange Institute Standards.</div><div>(d)</div><div>All pressure parts like shell and heads shall be of carbon steel as per ASTM A-516 Gr. 70. Shell plate min. thickness 15.8mm of welded construction. Nozzles shall of carbon steel as per ASTM A-105.</div><div>(e)</div><div>Hardened 400 series stainless steel impingement plates for flashed drain inlet from HP heaters, BFP recirculation, boiler startup drains etc.</div><div>(f)</div><div>All water spray valves, splash plates, trays, vent condenser and other elements in contact with undeaerated water or non-condensable gases shall be of stainless steel SS-304 or SS-410.</div><div>(g)</div><div>Design for efficient steam distribution and deaeration of condensate under all operating conditions including VWO, 3% m.u., HP-LP bypass, one string/both strings of HPH out of service.</div><div>(h)</div><div>Floating pressure type. Deaerator pegging pressure during cold, warm, hot startup and during HP-LP bypass operation, shall be as optimized by the bidder and shall be suitable to ensure required deaeration and water quality required for boiler. The optimised pressure should be same during warm, hot startup conditions and HP-LP bypass operation. Deaerator pressure shall vary with load when it gets steam from turbine extraction. Design pressure &amp; temp. shall not be less than extraction pressure or worst operating condition with sufficient margin above the same.</div><div>(i)</div><div>Sources for heating:<div><div>(1)</div><div>Extraction steam from turbine IP-LP cross over/ cross-around pipe (normal operation) or as optimized by the bidder.</div><div>(2)</div><div>Steam from CRH till extraction steam (normal source) pressure is available.</div><div>(3)</div><div>Steam from Auxiliary steam header till CRH steam pressure is available.</div></div></div></div>			
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5.03.00	(j)	Design to withstand full vacuum and pressure decay.		
	(k)	Free carbon dioxide as measured by APH method shall be non-traceable at all loads.		
	(l)	Shell thickness corrosion allowance 3.2 mm.		
	(m)	Provision of sparger pipe and nozzle for feed water heating.		
	(n)	Provision of access platforms and ladders alongwith hand rails on deaerator and storage tank. Provision of manholes of 450 mm dia (min) on deaerator and storage tank for access to and removal of internals including trays.		
5.03.00	<b>HIGH PRESSURE HEATERS</b>			
	2X50% capacity HP heaters, horizontal and U-tube type with desuperheating, condensing and drain cooling sections. Shell of carbon steel as per ASTM-516 Gr. 70 and water box channel and channel cover as per ASTM A-266 class-II / ASTM-516 Gr. 70 / SA 533 Type B Cl 2 and shall be welded to tube sheet.Tubes to be welded to tube sheets and then hydraulically expanded.			
6.00.00	<b>BOILER FEED PUMP</b>			
6.01.00	(a)	<b>Construction Requirements</b>		
	(1)	Main Pump: Horizontal, centrifugal type, multistage, outer casing barrel type with end rotor removal.		
	(2)	Booster pump: Single stage, two bearing design and double suction impeller type. Overhung impeller not acceptable.		
	(b)	<b>Performance curve</b>		
		The characteristic curves of booster pump and main pump should be continuously rising type with decrease in flow and combined shut off head of main pump & booster pump shall be in the range of 115% to 130% of combined TDH (booster pump and main pump) at design point.		
	(c)	<b>Minimum recirculation</b>		
	(1)	The minimum flow of the booster pump and main pump shall not be less than 25% of design flow.		
	(2)	Minimum recirculation valve with valve body designed for 40% of design flow.		
	(3)	Seat tightness of recirculation valve shall conform to MSS SP 61		
	(d)	<b>Motor drive start up time</b>		
		Motor shall be able to accelerate the pumps from standby conditions to rated pumping conditions in less than 15 seconds after receipt of starting signal while operating either singly or in parallel with other operating pump and MDBFP and associated auxiliaries to be designed for auto startup on failure of running equipments/auxiliaries.		
	(e)	<b>Critical speed</b>		
	The first critical speed in water with internal clearance being 150% of new clearance shall be more than 130% of design speed.			
(f)	<b>First Stage Impeller life</b>			
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CLAUSE NO.	<div> <b>TECHNICAL REQUIREMENTS</b> </div> <div> </div>		
<div> 6.02.00 </div> <div> 6.03.00 </div>	<div> <p>Life due to wear due to cavitation of first stage impeller not less than 40000 running hours.</p> <p>(g) <b>Dry running</b> Capable of accepting complete loss of water due to incidents such as inadvertent complete closure of suction valve and brought down to rest in controlled manner from design condition with simultaneous closure of suction valve.</p> <p>(h) <b>Diametrical Clearances between periphery of impeller and inside diameter of boiler feed pump casing:</b> Not less than 4% and 6% of impeller outer diameter for diffuser and volute type pumps respectively.</p> <p>(i) <b>Thermal shock withstand capabilities</b> The pump should be designed to with stand thermal shock encountered during the entire operating regime (normal &amp; abnormal) of the unit.</p> <p>(j) Applicable Code : HIS (latest edition)</p> <p><b>Operational and maintenance requirement:</b></p> <p>(a) <b>Warm up arrangement</b> Suitable warm up arrangement (if required) to start the pump rapidly shall be provided. However, pump should preferably be capable of starting from any conditions without having any warm up in emergency.</p> <p>(b) <b>Parallel Operation</b> Response and Performance characteristics of BFP (MD and TD) shall be such that while operating in parallel the difference in flow handled by them and the flow proportionate to their rating corresponding to the load shall not be more than 5% of flow through any one pump.</p> <p>(c) <b>Emergency Lubrication of MDBFP</b> Pressure lubrication (if necessary) of MDBFP at the time of coasting down of the motor driven boiler feed pump set in the event of AC power failure shall be arranged by Bidder.</p> <p>(d) <b>Cartridge Concept</b> The inner pump element comprising shaft, impellers, stage casings capable of being removed and replaced as a unit without disturbing feed piping in not more than 12 hours and shall be demonstrated by Bidder. Suction, discharge and interstage bleed connections need not be broken to dismantle the pumps.</p> <p><b>Mechanical Seals</b></p> <p>(a) Type : Fully cartridge design.</p> <p>(b) Seal face Materials : (i) For Booster Pump: Not inferior to silicon Carbide and Carbon seal face combination (ii) For Main Pump: Superior to silicon Carbide and Carbon seal face combination like Diamond face, suitable to operate with feed water PH of 8 to 8.5 without dosing arrangement.</p> </div>		
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CLAUSE NO.	<div style="text-align: center;"> <b>TECHNICAL REQUIREMENTS</b>  </div>			
	<p>(c) Life : Not less than 20,000 running hours between overhauls and having dry running withstand capability as specified running with the specified feedwater PH of 8 to 8.5.</p> <p>(d) Supporting system Each seal to be provided with 2x100% magnetic filters, 2x100% tubular coolers, Piping, Valves, Control and instrumentation etc. Each cooler to be designed with margin of 20% over worst condition of heat generated in seals. Further in case of AC power failure, seal should be able to withstand without cooling water.</p> <p>(e) Alternatively, bidder can also provide Main pump shaft sealing of throttle type along with all accessories, associated piping, valves &amp; fittings, specialties, instrumentation and control etc. as per standard proven practice of the BFP manufacturer. Throttle type seal (if offered) for main pump shall meet following requirement:</p> <ol style="list-style-type: none"> <li>1. Cold condensate injection flow should not enter the Main pump casing under any condition (including standby condition) to avoid sagging of main pump shaft.</li> <li>2. Withstand capability in case of total AC power failure</li> </ol>			
6.04.00	<p><b>HYDRAULIC COUPLING</b></p> <p>(1) Type &amp; Rating: Combined fluid Coupling/Gear box type. Adequately rated to meet the requirement of pump characteristics while operating in the range of capacities specified.</p> <p>(2) Material and other accessories Complete with stainless steel impellers, bearings, pillow blocks and proven thrust bearing as per bidder's standard practice for input/output with removable Covers, oil sump, duplex filters to remove all particles upto 25 microns, oil temperature and pressure gauges, Control pump for oil regulation if provided, regulating Valves, stainless steel scoop tube, 1x100% lube oil cooler, 1x100% Working oil cooler, one portable type oil purifier per station of adequate capacity to be included to form the centralized lubrication system for MDBFP set. The specification and capacity of portable type oil purifier shall be as specified in drive turbine section.</p>			
6.05.00	<b>DRIVE TURBINE:</b>			
6.05.01	<b>Type:</b> Dual admission type or Single admission type with an external control valve, single cylinder, condensing type.			
6.05.02	<b>Casing :</b> To withstand the maximum pressure and temperature likely to be subjected during normal operation and 25% over rated pressure for short term duration.			
6.05.03	<b>Rotor:</b> Forged steel, heat treated, accurately machined and proportioned in order to keep critical speed away from operating speed.			
6.05.04	<p><b>Drive turbine stop control valve</b></p> <p>(a) Stop Valves to be provided with removable stainless steel steam strainer for normal operation and one additional strainer element shall be provided for initial operation.</p> <p>(b) Valves to be provided with removable internals to allow for steam blowing.</p> <p>(c) Stop valves to have provision for on load testing.</p>			
6.05.05	<b>Turning gear</b>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>(a) Drive turbine to be provided with an adequately sized AC motor driven or hydraulically operated turning gear for rotation of complete TDBFP train i.e. booster pump, gear box, drive turbine and main pump while unit being started or taken out of service.</p> <p>(b) Hand barring gear shall be provided for manually rotating the drive turbine in an emergency. The lube oil shall be made available to the bearing during such operation.</p> <p><b>6.05.06 Drive turbine Lubricating oil system</b></p> <p>(a) Each drive turbine shall be provided with a complete lubricating oil system which shall provide lube oil for drive turbine, main pump, booster pump and couplings and shall also cater the control oil of governing system and turning gear oil requirements. The lube oil system shall consist of</p> <ul style="list-style-type: none"> <li>- One AC motor driven main oil pump</li> <li>- One AC motor driven auxiliary oil pump</li> <li>- An oil purification system of type as specified for Main Turbine elsewhere in the specification.</li> <li>- One DC motor driven emergency oil pump for bearings oil requirements only.</li> <li>- Duplex type full capacity oil filters of cartridge type with bypass facility.</li> <li>- 2x100% AC motor driven oil vapour extractors.</li> <li>- One full capacity AC motor driven jacking oil pump (if required).</li> </ul> <p>(b) All the piping, fittings, valves, Main Oil Tank and complete strainers including body and element shall be of stainless steel. Further all the parts of lube oil coolers (tubular or plate type) which are coming in contact of lube oil shall be of stainless steel.</p> <p>The lube oil for Main Turbine, Drive Turbine, TDBFP and MDBFP shall be kept same in view of ease of operation and maintenance.</p> <p>(c) <b>Type test(s) to be conducted</b> Particle size impurities test and moisture test as detailed out for Main Turbine, is to be carried out on one oil purification system of BFP drive turbine.</p> <p><b>6.05.07 Codes</b> Design of drive turbines generally in accordance with API 612 and 614 and testing in accordance with ASME PTC-6.</p> <p><b>6.05.08</b> Turbine to be designed for protection against water induction. All drains shall consist of motorised/ pneumatic drain valves with isolating valves and drain piping for connection to drain flash tank for warming up drains before and after valve seats, casing drains. Gland steam system drain, IP extraction CRH and auxiliary steam lines alongwith necessary controls.</p> <p><b>6.05.09 Operational Requirement</b></p> <p>(a) Drive turbine of BFP shall get normal motive steam from IP-LP crossover/cross around pipe or from a point as per optimized cycle of bidder during operation of turbine from full load to 60% EMCR load or below, if possible.</p>		
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	<div>(b) During low unit load conditions, turbine bypass operation, shutdown operation when extraction pressure of the normal motive steam source is insufficient to operate the drive turbine, steam from alternate source, from the same unit i.e. CRH, shall be admitted through a separate set of stop and control valves. Both sets of control valve to be controlled by electro hydraulic governing system. Bidder can offer single admission turbine with an external control valve (to be operated from the governing system).</div> <div>(c) An additional alternate source of steam from other unit shall be provided by the bidder for Drive turbine of BFP for cold/ hot start of boiler (in case MDBFP is inoperative). For this additional alternate source during startup, bidder may opt for the auxiliary steam supply, if the auxiliary steam parameter suits the drive turbine requirement. Bidder may however note that it is not envisaged to start the unit with TDBFP when auxiliary steam is available only from auxiliary boiler.</div> <div>(d) In case bidder offer extraction steam to BFPT arrangement as per BOX-B of tender P&amp;ID of extraction steam to BFPT then the pressure regulating valves in the CRH and Auxiliary steam line shall necessarily be electro hydraulically operated.</div> <div>(e) Single Drive Turbine along with corresponding TDBFP shall be capable of operating at unit load corresponding to 20% TMCR without opening of minimum recirculation valve and with FW control in AUTO mode. Corresponding Heat Balance Diagram (HBD) shall be furnished.</div>			
6.05.10	<div><b>STRAINERS AT BOOSTER PUMP AND BOILER FEED PUMP</b></div> <div>Strainer body simplex and cylindrical type. The clear area of strainer to be Five times the inlet cross sectional area of the connecting piping. Strainer to be constructed of 11 gauge perforated stainless steel (304 grade) and lined with stainless steel (316 grade) screen. At design flow and clean condition, Pressure drop not to exceed 0.15 Kg/cm2. At design flow and 50% clogged condition, Pressure drop not to exceed 0.20 kg/cm2.</div>			
6.05.11	<div><b>Type Test(s) to be conducted</b></div> <div>Following type tests to be carried out;</div> <div>(i) NPSH (R) Test on one BFP and one BP</div> <div>(ii) Pressure pulsation test on one BFP</div> <div>(iii) Axial thrust measurement on one BFP</div> <div>(iv) Complete strip down test of BFP which undergone above tests</div> <div>(v) Pressure drop test on one strainer for each type and size</div> <div>Bidder to ensure that after the type test, the pump is properly cleaned and dried so that during transportation there is no damage/rusting in the pump.</div>			
7.00.00	<div><b>EOT CRANES</b></div>			
7.01.00	<div><b>TURBINE HALL EOT CRANE:</b></div> <div><div>(i) <b>RATING</b></div><div><div><div>(a) Capacity</div><div>AS specified elsewhere in specification</div></div><div><div>(b) Auxiliary Hoist Capacity</div><div>Not less than 20 Tonne</div></div><div><div>(c) Total height of crane</div><div>Top most level of crane w.r.t. the top of runway rail level shall be approximately 4.5m</div></div><div><div>(d) Approximate max.</div><div></div></div></div></div>			
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	<div><div><div>full load speeds</div><div><div>- Main Hoist</div><div>1.6 m/min</div></div><div><div>- Auxiliary Hoist</div><div>7.5 m/min.</div></div><div><div>- Trolley travel</div><div>15.0 m/min.</div></div><div><div>- Crane travel</div><div>30.0 m/min.</div></div></div><div>(e) Creep speed of main hook and auxiliary hook</div><div>(f) Creep speed for cross travel and long travel</div><div>(ii) Applicable codes</div><div><div>(a) Design and duty of crane structure, main hoist, auxiliary hoist, cross travel, long travel in accordance with class M5 of IS: 3177 (latest edition).</div><div>(b) All other structure of cranes in accordance with IS-807.</div><div>(c) Main hook Ramshorn type conforming to IS-5749 (latest edition) and auxiliary hook shank type conforming to IS 15560 (latest edition)</div></div><div>In case the load is more than 250 Tonne, Main hook (Ramshorn type) shall conform to DIN-15402 (latest edition).</div><div>(iii) Bridge structure</div><div><div>(a) Vertical deflection caused by safe working load and weight of trolley in central position not to exceed 1/900 of the span.</div><div>(b) Trolley stops of spring type to be mounted independently on bridge rails to prevent trolley from running off.</div></div><div>(iv) Buffer</div><div><div>(a) Suitable buffer to be fitted to each end of carriage assembly and crab.</div><div>(b) Buffers to be designed to bring the loaded crane to rest from a speed of 50% of the rated speed.</div></div><div>(v) End trucks, wheels and axles</div><div>To be designed in accordance to IS: 3177 (latest edition)</div><div>(vi) Bridge and trolley drive Mechanism</div><div><div>(a) One drive at each end of bridge.</div><div>(b) One drive for trolley drive.</div></div><div>(vii) Operator's cabin and platform</div><div><div>(a) Open type for indoor service to be located at B-row column. Cabin shall be designed as per IS3177 so as to have unrestrictive view of load from operator's cabin.</div><div>(b) The area of cabin to be 2500/1850 mm with a head room of 2000 mm.</div><div>(c) A foot operated electric warning horn of double bell type suitable for 240 V AC. of noise level 95 dBA at 3.5 m.</div><div>(d) One brass gong suspended outside the Cabin and operated from inside.</div><div>(e) A distinct type alarm with conspicuous warning lights on either side of the crane bridge to indicate overloading of crane.</div><div>(f) Adequate carbon dioxide gas cylinders of 4.5 Kg.</div><div>(g) One non oscillating ventilating fan.</div></div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div><div>(h)</div><div>Suitable inspection cages to accommodate two persons to facilitate inspection of down shop lead.</div></div><div><div>(i)</div><div>Access walkways of not less than 800 mm (clear) with hand railing of height of 1100 mm along the both side of bridge girder and cross over walkways</div></div><div><div>(viii)</div><div><div>Drums</div><div>To be in accordance with IS-3177 (latest edition).</div></div></div><div><div>(ix)</div><div><div>Wire Rope</div><div><div>(a)</div><div>Wire rope of extra flexible plough steel and of 6/36 or 6/37 construction conforming to IS: 2266 (latest edition)</div></div></div></div><div><div>(x)</div><div><div>Bearings and lubrication</div><div><div>(a)</div><div>The type of bearings for various parts as per IS:3177 (latest).</div><div>(b)</div><div>Bearing life not less than 10,000 working hours.</div><div>(c)</div><div>Centralised grease lubrication with hand operated grease pump for all bearings as per bidder's standard proven practice.</div></div></div><div><div>(xi)</div><div><div>Guarding</div><div><div>(a)</div><div>Suitable guard to push forward or off the rail track any object placed across.</div><div>(b)</div><div>Suitable guards to live electrical wirings downshop lead.</div><div>(c)</div><div>Other guarding as per relevant standard.</div></div></div><div><div>(xiii)</div><div><div>Safety</div><div><div>(a)</div><div>Suitable anti-collision device of two cranes, alongwith stoppers at both the gable ends.</div><div>(b)</div><div>To meet the requirements of Factories Act.</div></div></div><div><div>(xiv)</div><div><div>Runway/trolley Rails and rail joints</div><div>Rails to be as per relevant Indian Standard and joints to be butt welded by thermit welding or fusion welding.</div></div></div><div><div>(xv)</div><div><div>Brakes</div><div>2 X 100 % Brake shall be provided for each motion. Each brake for hoisting motion, cross travel, long travel etc., shall be designed as per following: Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before deaerating.</div></div></div><div><div>xvi)</div><div><div>Storm Brakes:</div><div>2x50% storm brakes, one each at each end of the bridge, shall be provided for each crane. Storm brakes shall be designed for wind velocity as indicated in "Criteria for wind resistant design for structure and equipment", Sub-section – D-01 / Civil Works/ Part-B/ Section-VI.</div></div></div><div><div>(xvi)</div><div><div>Common lifting beam for generator stator</div><div><div>(a)</div><div>Suitable common lifting beam for lifting generator stator by means of two cranes operating in conjunction with suitable swiveling arrangement.</div><div>(b)</div><div>A suitable indicating device to indicate the difference in the lifts of the two cranes, which shall be limited to 500 mm shall be provided on the lifting beam. The level difference indication shall be visible from ground level.</div><div>(c)</div><div>A limit switch shall be provided to give alarm at both the cabins to enable the crane operators to control the level difference within 500mm.</div></div></div></div></div></div></div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>The bidder shall furnish the GA drawing of the beam showing all the dimensions, constructional details, details of crane hooks connection to the beam, lifting arrangement, level difference indicating devices, etc alongwith the bid.</p>			
7.02.00	<b>EOT CRANES FOR BOILER FEED PUMP (if envisaged)</b>			
7.02.01	One (1) no of Electrically operated travelling cranes (Double Girder type) for each unit with associated auxiliaries, alongwith electrical equipment, control & instrumentation as required and specified shall be provided in the BC bay for erection and maintenance of Boiler feed pump and their auxiliaries. The capacity of each crane shall be 10% over and above the heaviest component/equipment (including Drive Turbine assembly) to be handled (including lifting beam and slings etc., if provided) or 25 Tonne whichever is higher.			
7.02.02	The EOT crane shall be pendent operated. The power shall be supplied from a single electrical power supply point at a suitable location on the operation floor of pump house.			
7.02.03	The design code for EOT crane shall be IS: 3177 latest edition.			
7.02.04	However, the speed for the various motions shall be as follows:			
	Main hoist	-	1.6 m/min	
	Trolley Travel (Cross Travel)	-	4.0 m/min	
	Crane Travel (Long Travel)	-	8.0 m/min	
7.02.05	Creep speed drives shall be provided for all the motions viz. bridge motion, trolley motion and hoist motion. This shall be 10% of the rated speeds. (Creep speed to be achieved through pony motor and planetary gear box or through variable voltage variable frequency (VVVF) system. Hoist brake shall not be used for this motion).			
7.02.06	The crane shall be electrically operated, overhead travelling type. Design and duty of crane structure, main hoist, cross travel. Long travel shall be in accordance with class M5 of IS:3177 (latest edition) and shall be suitable for indoor operation.			
7.02.07	The crane shall be complete with trolley and truck, wheels and axles, Drive mechanisms, Hoisting Drums, Brakes, Creep Speed Arrangement, Lifting tackles, Buffers Electric Motors, Controls, Switch Board and cabling, horns, warning lights, Limit switches etc. Any item not mentioned herein but required to make the system complete for the satisfactory performance of the crane shall also be included.			
7.02.08	The main hoist, trolley travel and crane travel for each movement shall be motor driven. Proper allowance shall be made for impact and wear in the design of the crane and the factor of safety shall be as per IS: 3177 based on the ultimate strength of the materials used at design duty. The design duty of crane structure, main hoist, cross travel and long travel shall conform to class M5 of the Indian Standard IS: 3177 (latest edition) or superior. The crane as a whole shall comply with the Indian Standard IS: 3177 / IS: 807 or approved equivalent international standard (latest edition).			
7.02.09	The hoist motors shall be provided with electro-magnetic brakes / Electro Hydraulic Thrust brakes. Electro - Hydraulic Thrust brakes shall be provided for cross travel & long travel. 2 X 100 % Brake shall be provided for each motion. Each brake for hoisting motion, cross travel, long travel etc., shall be designed as per following:			
	Brakes to be as per IS 3177. The Capacity of hoisting motion brakes to be 150% of torque transmitted to the brake drum with full load and that of cross travel and long travel to be 125% of motor rated torque before deaerating.			
7.02.10	Safe means of access shall be provided and to every place of crane where examination/maintenance of any component is involved. A platform shall extend to full length of the crane bridge on both sides of the bridge girder. The platform shall be made of checkered Steel plate. A double tire hand-rail of height 1100 mm shall be provided along the outer edge of the platform and 75mm high toe-guards shall be provided all along the platforms and wherever else required from safety consideration. The width of platform shall not be less than 800mm in width and Guard rails shall be provided on the crab side of the bridge platform.			
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7.02.11	LADDERS : Necessary access ladders shall be provided for access on to crane bridge platform from the gantry girder level, from crane bridge platform to trolley platform and from operating floor of pump to gantry girder level.			
7.02.12	The lifting tackle shall consist of a safety type lower pulley block, hook, necessary sheave and flexible steel wire ropes. The lower block sheaves and ropes shall be of adequate design and size to handle the specified loads. The hooks shall be of forged steel. The main hook shall be of Ramshorn type conforming to IS:5749 (latest edition) for 50 T and above capacity and shank type conforming to IS:15560 (latest edition) for capacity lower than 50 T. The factor of safety for the rope shall be as per IS:3177. The sheaves shall be of heavy duty with deep flanges made of cast steel and shall be properly grooved to fit the rope and adequately guarded.			
7.02.13	Each crane shall be controlled individually for all its motions from the control pendent panel.			
7.02.14	Each crane shall have a permanent inscription of English on each side, readily visible from the ground level, stating the safe working loads in tonnes for both the hooks, year of manufacture, crane serial number and manufacturer's name.			
7.02.15	The vertical deflection of crane girder shall not exceed 1/800 of the span. The girder shall be of box type and construction shall ensure non-accumulation of water/oil inside the box.			
7.03.00	<b>MAXIMUM SPAN/DEPTH RATIO FOR GIRDER:</b>			
	(a)	Plate girders	:	18
	(b)	Lattice girders	:	12
7.04.00	Material			
	(i)	Structural steel plates : rolled section	:	Mild steel, grade 'B' of IS 2062 in 100% killed, normalised and ultrasonically tested quality or high strength steel of IS 8500 as appropriate
	(ii)	Nuts & Bolts	:	As per IS:1363, IS:1364 and IS:1367. High Tension Friction grip bolts as per IS: 3757. High Tension Friction grip nuts as per IS: 6623.
	(iii)	Electrodes	:	Radiography quality, covered electrodes with heavy covering as per IS : 814 and relevant requirements of ASME Sec. IX and IIC. Bare Electrodes as per IS:7280 and flux wire combination as per IS : 3613.
	(iv)	Chequered plates	:	IS: 3502 (Minimum 6 mm thick O/P)
	(v)	Hand rail pipes	:	32 mm NB Medium class of IS : 1161 having top and bottom rail at height of 1050 mm and 600 mm and vertical post spacing not exceeding 1500 mm with provision of kick plate(100 mm high and 6 mm thick).
	(vi)	Crane Rails	:	As per IS : 3443.
7.05.00	<b>Minimum thickness of Structure Members:</b>			
	(a)	Load Carrying members:	:	8 mm
	(b)	Tubes with both ends sealed	:	4.9 mm (6 SWG)
	(c)	Tubes with unsealed ends	:	8 mm
	(d)	Chequered plate	:	6 mm O/P
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8.00.00	<b>PRECOMMISSIONING ACTIVITIES</b> The pre-commissioning activities including some of the important checks & tests for certain major equipment/ systems are mentioned under respective equipments, although it is the Contractor's responsibility to draw up a detailed sequential & systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
9.00.00	<b>COMMISSIONING OF FACILITIES</b> Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.  Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.			
10.00.00	<b>NOISE LEVEL</b> In case the noise level pertaining to equipments covered under the scope exceeds the specified values, as given in relevant clause of General Technical requirement portion of Technical Specification, suitable acoustic enclosures, properly illuminated, having adequate inside space for movement (minimum 500 mm clear space on all sides from last equipment) alongwith all accessories in order to complete the system shall be provided to achieve the specified values. The acoustic enclosures & accessories shall be designed as per internationally accepted standards and shall be subject to Employer's approval.			
11.00.00	<b>AVAILABILITY REQUIREMENTS OF TG AND AUXILIARIES</b> The steam turbine generator unit and auxiliaries shall be designed for maximum reliability and availability, operability and maintainability particularly in respect of the following:			
11.01.00	All equipment and systems shall be of proven design, using proven materials with well established physical and chemical properties and as appropriate to the service as intended.			
11.02.00	The steam turbine generator unit and its auxiliaries shall be suitably designed and provided with required instrumentation for rapid starting, loading and unloading without causing undue vibration, distortion, differential expansion or producing excessive thermal stresses.			
11.03.00	The steam turbine generator unit alongwith auxiliaries is normally expected to operate in sliding pressure mode from rated pressure down to 40% of rated pressure in conjunction with steam generator, HP-LP bypass system and plant instrumentation and control system.			
11.04.00	All stand-by auxiliaries shall be designed for auto start up, on failure of running auxiliaries with minimum time delay and without runback on unit load.			
11.05.00	Adequate maintenance facilities shall be provided as required for assembly, disassembly, alignment work particularly in respect of HP barrel, casing, inner and outer casings, diaphragm glands, steam valves, journal bearings, thrust bearings, turbine rotors, generator			
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	<p>rotor, particularly end rings, shaft seals, generator bearings, hydrogen coolers, Water cooled condenser system, vacuum pumps, condensate extraction pumps and boiler feed pump cartridges, BFP drive turbines, regenerative feed heaters, turbine oil coolers and pumps, etc. The offer shall give details like components requiring replacement or repairs during the life cycle of the plant, meantime between failures and list of tasks to be carried out during major overhauls.</p>			
12.00.00	<b>TYPE TESTS</b>			
12.01.01	<p>The contractor shall carry out the type tests as listed in the <b>"TYPE TEST(S) TO BE CONDUCTED"</b> on the equipment mentioned therein. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's Engineer.</p>			
12.01.02	<p>The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.</p>			
12.01.03	<p>Irrespective of the requirement of conducting the type tests under this contract, the Contractor shall submit the reports of the type tests listed in the <b>"TYPE TEST(S) TO BE CONDUCTED"</b> and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment same (model / type / size / rating) to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all of the specified type tests under this contract, in which case the type test charges shall not be payable for the type tests waived by the Employer.</p>			
13.00.00	<p>All the Turbine &amp; Auxiliaries equipments shall be designed following "Fail Safe" concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.</p>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	ANNEXURE-I			
	Other conditions for computing heat balance diagrams:			
	1.	Throttle steam pressure	Kg/cm2(abs)	270
	2.	Throttle steam temperature	deg. C	600
	3.	Reheat steam temperature	deg. C	To be optimized by the bidder between 600 and 610 deg.C (both values inclusive) but not less than 600 deg.C
	4.	Worst condenser pressure	mmHg(abs)	89
	5.	Condenser Pressure	mm Hg(abs)	77
	6.	Make up water (as applicable)	% throttle flow	3.0
	7.	Quantity of steam tapped off from cold reheat line for meeting normal auxiliary steam requirement	t/hr.	15 (normal)
	8.	Final feed water temperature optimised at 100% TMCR	deg. C	To be optimised by the bidder but not less than 305 deg C
	9.	Pressure drop in the reheat circuit (from HP turbine exhaust flange to IP turbine inlet)	% of HP turbine exhaust pressure	To be optimised by the bidder
10.	Design pressure drop in :			
	(i) All extraction steam lines except to the deaerating heater	% of the pressure (abs) at the turbine extraction flange	5 (max)	
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	(ii)	Steam extraction line to deaerator	-- do --	8 (max)
	(iii)	Steam extraction line to boiler feed pump drive turbine	-- do --	12 (max)
	<b>Note :</b>			
	(1)	The above mentioned values of pressure drop in reheater circuit and extraction lines shall be at the heat rate guarantee point of 800 MW output at 77 mm Hg (abs) condenser back pressure and 0% make-up.		
	(2)	During H.P./L.P. bypass operation, the source of steam supply of deaerator shall be from cold reheat line and the deaerator shall be pegged at pressure as optimized by the bidder. For heat balance diagrams and for sizing of the HP-LP bypass system, no steam shall be tapped off for any of the feed water heaters other than the deaerator.		
	(3)	The heat balances with zero percent make up shall be computed without any auxiliary steam tapped off from CRH line. Other heat balances with 3% cycle make-up shall be computed with 15 T/hr. of steam tapped off from CRH line for meeting auxiliary steam requirements of the unit.		
	(4)	The auxiliary steam drawn off from CRH line shall be treated as loss from the cycle which in turn shall be made up in the condenser hot well..		
	(5)	The temperature of make up water shall be taken same as that of the hot well condensate under any load condition.		
	(6)	In the sliding pressure mode of operation the throttle pressure will slide down from rated pressure to a value corresponding to 40% of rated pressure. For computing heat balance for sliding pressure mode of operation at 80%, 70%, 60%, 50% & 30% of Unit rated load, rated temperature shall be used for main steam and hot reheat steam respectively. However in case the temperature control range of the steam generator is above 30% of unit rated load, the maximum temperature attainable by the steam generator shall be used for development of heat balance diagram at 30% of unit rated load.		
	(7)	Tentative figures wherever indicated are for the purpose of preparing heat balance diagrams.		
	(8)	The 3% make-up to the cycle will be 3% of the main steam flow at HP turbine inlet. For the purpose of computation of heat and mass balance with 3% cycle make-up the difference of the mass flow between the make-up and the mass of steam drawn from CRH for auxiliary steam shall be assumed to be lost from the cycle as feed water down stream of the top HP heater.		
	(9)	It may be noted that the heat balance diagrams and guarantees shall be furnished considering the quantities of water for superheater and reheater sprays with any mill combination in service to the Employer's choice. For superheater and reheater, the spray quantities used shall not exceed the limits specified elsewhere in the specification. During Performance Guarantee Testing in case the spray quantity used are at variance from the values used in the heat balance diagrams, the actual values will be used for calculation of heat rate and no correction shall be allowed.		
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	<div>(10) However, correction on account of variation in supper heater and Reheater spray quantities with respect to values used for the purpose of guaranteed heat rate values shall be permitted only to the extent that such variations are solely attributable to the change in coal properties with respect to those specified for the design coal. Bidders shall necessarily include the correction curves for variation in superheaters and reheater spray quantities with coal properties in his bid proposal, failing which no corrections shall be permitted.</div>			
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# **SUB-SECTION–A-15**

## **CW SYSTEM**

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<b>(A) CW Pumps</b>			
	This Chapter describes the System description, Basic Design Criteria and Minimum Technical Requirements of the Circulating Water (CW) System and associated equipment. The minimum technical requirements and equipment shall include, but not be limited to the following:			
1.01.00	<b>System description</b>  CW system shall be Re-circulating type with Cooling Towers. Each unit shall be provided with its own dedicated cooling tower and CW System. Water from CW sump will be pumped out into steel lined concrete ducts. The duct shall be connected to the pump discharge flange through a carbon steel pipe, hydraulically actuated butterfly valve, expansion joint and distance piece (if applicable). From the ducts, steel pipes shall carry water to and from the condenser. The outlet pipes from condenser shall be joined to ducts which shall lead hot water up to the base of cooling tower. From base of the cooling tower, steel pipes shall take water up to the hot water distribution system of the cooling tower. The cold water shall flow back to the CW sump through open channel by gravity. For each unit, individual intake ducts from the CW pumps to the condenser and discharge ducts from condenser to cooling towers shall be provided. However, the supply ducts of all the modules shall be interconnected by means of motor actuated butterfly valves at the CW pump house end. Clarified water would be given as make up water to CW system from the Water Pre-treatment Plant. The CW blow down water shall be used for filling of Fire water tank, Ash Handling system, FGD process water, and any other requirement envisaged by the bidder and as per system requirements. Provision shall be provided for excess CW blow down water to the Central monitoring basin of Effluent Treatment plant. Chlorine di-oxide shall be dosed in the fore-bay of CW pump house as a biocide agent. The common re-circulation line shall be led up to the CW channel through an inching type Butterfly valve which shall be provided with a motor actuator. CW pumps shall be located in CW pump house with shed.			
1.02.00	<b>General design &amp; construction requirements of CW pumps</b>  <div><div>1)</div><div>The pump shall be directly driven by a constant speed squirrel cage induction motor coupled with suitable coupling and shall be designed for 25 years of life to withstand the seismic loads as specified elsewhere in specification.</div></div> <div><div>2)</div><div>The "suction specific speed required" i.e. specific speed calculated with NPSH required, shall not exceed 12,000 (US Units).</div></div> <div><div>3)</div><div>The system suction specific speed (i.e. specific speed calculated with NPSH available) shall not be greater than 8500 US units at minimum water level. Pump speed shall be based on the above suction specific speed available. "Net Positive Suction Head (NPSH) Required" shall be less than "NPSH Available" during all operating conditions including run-out condition.</div></div> <div><div>4)</div><div>The pumps shall have stable head capacity characteristic continuously rising towards shut off conditions. The design shall ensure equal load sharing among the pumps operating in parallel. All pumps shall be identical having identical characteristic curves and shall be capable of running in parallel continuously without any restrictions. The pump shall operate satisfactorily in single pump operation as well as in parallel with all other working pumps. Pumps shall be able to operate satisfactorily and continuously at run out capacity conditions as determined with the help of system resistance curve.</div></div> <div><div>5)</div><div>The pump and motor (complete assembly) should be designed for withstanding the run-away speed attained with reverse rotation caused by reverse flow continuously even when all the remaining pumps are in operation. Necessary speed switches to detect reverse rotation shall be provided with indicator.</div></div> <div><div>6)</div><div>The system resistance curves shall be provided to indicate the approximate system resistance for each Unit. Range of operation of pumps shall be so selected that it can accommodate the following modes of operation at maximum water level in sump (Run-out Condition) and as well as at minimum water level in sump.</div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<div><div><div>a) One (1) pump in operation with 1 Unit in service</div><div>b) Two (2) pumps in operation and one (1) Unit in service</div><div>c) Three (3) pumps in operation for Two (2) Units in service, during tripping of anyone (1) pump of any Unit (with duct interconnection valves open).</div></div><div>The predicted performance for various operating conditions specified above shall also be furnished by superimposing the system resistance curves (both at minimum water level and maximum water level conditions) over the characteristics curves of the pump. It shall be confirmed that the NPSH and submergence requirements are satisfied, and pump shall be capable of sustained running in a trouble-free manner at any water level between minimum and maximum.</div><div>7) The pump shaft shall be designed such that the complete pump and motor assembly satisfies the following: The operating speed shall not be too close to the first critical speed, i.e. <math>N</math> should be less than <math>0.8 NC_1</math> or <math>N</math> should be more than <math>1.3 NC_1</math> Where <math>N</math> is the Operating Speed and <math>NC_1</math> First Critical speed. Critical speed of pump-motor assembly shall be more than the maximum reverse run away speed.</div><div>8) A ladder and platform arrangement shall be provided for each CW pump &amp; motor for thrust bearing and for approach to any other part of pump/motor.</div><div>9) <b>Thrust Bearing</b><div>Pump design with single thrust bearing at motor top or separate thrust bearings for pump and motor (as per proven design &amp; standard practice) is acceptable and shall be designed for starting without cooling water for thrust bearing. The bearings shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application. Water required for cooling of thrust bearing shall be taken from main pump discharge. The thrust bearings shall be rated for continuous operation with thrust as developed when impeller clearance is worn out up to four times the clearance when pumps is new and working under shut off condition.</div></div><div>10) <b>Pump motor rating</b><div>Continuous motor rating (at 50 deg C ambient) for pump shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range (including run-out condition of the pump and shut off condition in case pumps are envisaged to be started with the discharge valve closed) to take care of the system frequency variation.</div></div><div>11) <b>Hydraulic transient analysis</b><div>For complete CW system, Contractor shall carry out a detailed hydraulic transient analysis to decide pump discharge-valve opening/closing sequence and rate of opening/closure for pump operations at different conditions.</div><div>Based on the recommendations of such a study, Bidder shall provide suitable surge suppression devices like ARVs etc. in the complete CW System.</div></div><div>12) <b>Model test of CW pumps</b><div>For the offered pump, contractor should have carried out the model test. Contractor shall furnish the above test results. The model test should have been conducted as per Japanese standard JIS-B-8327 and specific speed of the model tested pump shall lie within <math>\pm 5\%</math> of the specific speed of the pump offered.</div><div>If the contractor has not conducted such a model test (including cavitation &amp; NPSHR test) for the offered pump, contractor shall conduct the test (homologous model of the CW Pump) as per Japanese standard JIS-B-8327 in the presence of owner's representative at no extra cost to the Employer. Contractor shall demonstrate the similarity of the impeller vane profile/volute profile for the model pump &amp; the prototype.</div></div><div>13) <b>Intake and sump</b></div></div>			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	<p>Sump Model study to be carried out by the contractor for finalization of CW intake system including fore bay complying to Civil technical requirements.</p> <p>The pump house including pump installation shall be designed as per HIS, USA (latest). However, submergence from minimum (design) water level shall have minimum 1-meter margin over the recommendations specified in HIS, USA (latest).</p> <p>14) <b>CFD modeling</b></p> <p>The Contractor shall engage developer of CFD code (which is proposed to be used for CFD modeling) or reputed institutes like IITs, etc. who have previous experience of conductance of CFD modeling studies. The CFD modeling shall configure CW sump including forebay, transition zone, CW channel from cooling tower to CW pump house. The computer model shall incorporate details of CW channel, pump sump, stoplog, trash rack etc. In this process the modeling shall investigate the flow characteristics and suggest modification to achieve the desired flow pattern.</p> <p>The results of CFD modeling shall be validated with the physical model test results and any correction/updation in the CFD model to establish validation of CFD results shall be carried out.</p> <p>15) <b>Physical Modelling</b></p> <p>Contractor shall carry out a physical sump model study at a recognized Institute /Hydraulic research laboratory. Scale of the model shall be minimum 1:12. The physical sump model study shall be conducted to study flow conditions for different discharges and different depths of water, different combinations of pump operations and to study velocity distribution in approach channel, forebay area, pumps bays, draft tubes etc. The model shall be based on Froude's law of similitude and shall be tested for following two more flow conditions, viz.</p> <ul style="list-style-type: none"><li>- At twice the prototype maximum Froude number, i.e. the Froude number of the model is two times that of prototype.</li><li>- At equal velocity criterion, i.e. the velocity is same both in the model and prototype.</li></ul> <p>Reports of the model studies incorporating the recommendations of both CFD &amp; physical model study shall be submitted for Employer's approval.</p>			
3.00.00	<p><b>Air Release Valve</b></p> <p>A suitably sized automatic air-release-cum-vacuum breaker valve(s) shall be provided on discharge pipe of each pump. Further, automatic air release valves shall be provided on the CW duct based on transient analysis study. The number and size of air release valves shall be based on transient analysis study. In the CW duct, isolation gate valve (CI/CS body with SS trim) shall be provided by the bidder below the air release valves to isolate the air release valves. The air release valves (as per IS: 14845) double air valve / kinetic air valve with two orifices &amp; two floats. The float shall not close the valve at higher air velocities</p>			
4.00.00	<p>Contractor shall provide the necessary vibration monitoring system. Instruments shall be provided as per Control philosophy for Circulating water pumps &amp; pump system, however, the instruments like Pressure gauge(s), Temperature gauges, level gauges, RTDs (Pump, motor bearings, motor winding) temperature, Pressure transmitters Ultrasonic type level transmitters (Pump sump, Forebay, Overhead tank, drainage pit (for CV pump), Reverse Rotation Indicator, Electronic flow meters (CW pump discharge &amp; Seal/Lub water pumps) shall be provided for each pump/system as a minimum.</p>			
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**PART- 1**
**TECHNICAL REQUIREMENTS OF CW PUMPS (VERTICAL WET PIT TYPE)**
**1.00.00 CODES AND STANDARDS**

1.01.00 The design, manufacture, inspection, and testing shall comply with all currently applicable standards.

**2.00.00 DESIGN AND CONSTRUCTION REQUIREMENTS**
**2.01.00 Design Criteria**

2.01.01 The pumps shall be vertical, constant speed, wet pit, mixed flow design, with single stage impeller, suitable for continuous heavy duty with flanged discharge connection. The pumps shall be suitable for handling water having chemical analysis and turbidity as per specifications requirements.

2.01.02 Suitable arrangement shall be provided to take care of the discharge hydraulic thrust due to an untied expansion joint. However, for above floor discharge, thrust block assembly is not acceptable.

2.01.03 The length of shaft & column sections shall not exceed 3.0 meters. The column pipe shall have a wall thickness of not less than 12 mm.

**2.02.00 Constructional Features**

2.02.01 The materials used in construction of the various components shall not be inferior to those given below:

a.	Suction Bell & Casing	2% Ni Cast Iron, IS:210 Grade FG 260; S-0.1% max. P-0.15% max.
b.	Casing Liner	Stainless steel
c.	Impeller, Impeller Guide (if applicable)	Austenitic stainless-steel ASTM A743 / CF8M
d.	Wearing rings	Stainless steel of suitable grade as per manufacturer's proven practice.
e.	Pump & Line shaft	Hardened stainless steel conforming to ASTM A276 Gr.410
f.	Shaft coupling & Shaft Sleeve	Stainless steel type 410, ASTM A276, Heat treated & hardened
g.	Line shaft bearing	Cutless rubber with bronze retainer/Thordon type bearing.
h.	Bearing guide spider	Fabricated Steel
i.	Column Pipe	Fabricated Steel as per IS-2062 with 2 coats of epoxy coating
j.	Shaft Enclosing Tube (If Applicable) etc.	Fabricated Steel as per IS-2062
k.	Thrust pads	Carbon steel with white metal lining
l.	Fasteners	Stainless steel AISI type 316 for fasteners in contact with water. Others shall be of high-tension carbon steel.
m.	Gaskets	Wire Reinforced Rubber Gasket / Neoprene rubber / Compressed asbestos fibre (CAF)
n.	Gland packing	Impregnated teflon



**PART- 2**
**TECHNICAL REQUIREMENTS OF CW PUMPS**
**(CONCRETE VOLUTE/ METALLIC VOLUTE WITH CONCRETE ENCASEMENT)**
**1.00.00 CODES AND STANDARDS**

1.01.00 The design, manufacture, inspection, and testing shall comply with all currently applicable standards.

**2.00.00 DESIGN AND CONSTRUCTION REQUIREMENTS**
**2.01.00 Design Criteria**

2.01.01 The CW pumps shall be of concrete volute/ metallic volute with concrete encasement, concrete draft tube, vertical shaft, constant speed, single entry, centrifugal or mixed flow design, with single stage impeller, suitable for continuous heavy duty.

2.01.02 The motor shall be mounted on the operating floor which is above maximum water level.

2.01.03 The pump shall have a flanged discharge connection. Further, the pumps shall be provided with the following parts as per the standard practice of the manufacturer:

Concrete Volute or metallic Volute, Concrete Draft tube or metallic draft tube embedded in concrete, A casing cover bolted to the upper part of the pump, A replaceable type sealing wearing ring bolted on to the suction part, Anchor bolts on the embedded parts, Steel set ring/ puddle flanges anchored in concrete and locked with reinforcements on the discharge side.

Embedded parts (cast or fabricated) in the concrete (i.e. cut water, suction part and upper part) shall be suitable for the quality of water being pumped.

**2.02.00 Constructional Features**

2.02.01 For concrete volute type design, the suction draft tube and pump volute casing shall be of cast-in-situ concrete construction. The draft tube and volute construction with prefabricated concrete elements are also permissible. For Metallic Volute type design, the Volute and the draft tube can either be cast steel/cast iron or fabricated carbon steel construction as per the standard practice of the manufacturer. The metallic draft tube shall be embedded on concrete.

2.02.02 The inner side of the pre-cast elements must be smooth & have a high degree of water tightness and shall confirm to following:

a)	Reinforcing Steel	Fe-415 conforming to IS:1786
b)	Concrete Quality	M25 / M30 conforming to IS:456-2000
c)	Cement	As per Civil Works sub-section
d)	Concrete cover	Minimum 50mm inner side and minimum 25mm outside
e)	Wall thickness	According to structural calculation. Minimum 125 mm

Cast iron trays of anchor bolts at suction side with steel anchors for suction wear ring and One steel foundation ring on discharge side for fixing the discharge wear ring must be integral part of the prefabricated elements.

2.02.03 Final finishing of the surface of the draft tube and volute shall be carried out by the bidder with epoxy paint or mortar so as to meet the surface finish as required by the pump manufacturer.

**2.02.04 Materials of Construction**



Material & construction of the pump & column shall be such as to resist corrosion & erosion and give a long and satisfactory life to the plant. The materials used in construction of the various components shall not be inferior to those given below:

a)	Casing and draft tube	Cast in situ concrete / Pre-cast concrete elements for concrete volute type pumps <b>OR</b> Cast steel/Cast iron or Fabricated carbon steel for metallic volute type pumps
b)	Impeller	Austenitic stainless-steel ASTM A743/CF 8M grade or Equivalent.
c)	Wearing rings	Stainless steel of suitable grade as per manufacturer's proven practice.
d)	Pump shaft	Hardened stainless steel conforming to ASTM A 276 Grade 410
e)	Shaft sleeve	Stainless steel ASTM A276 grade 410 hardened as per manufacturer's proven practice.
f)	Cut water	Ni resist Cast Iron
g)	Casing cover	Fabricated steel or 2% Ni cast Iron, D2 type
h)	Shaft coupling	Stainless steel ASTM A 276 grade 410.
i)	Bearing	Babbited with oil lubrication.
j)	Bolts, nuts, and lock washers	Stainless steel AISI type 304 coming in contact with water and others of high-tension carbon steel.
k)	Gland packing	Impregnated Teflon.
l)	Stuffing box housing	IS: 210 grade 260, 2% Ni C.I.

2.02.08

#### Wearing Rings & Shaft Sleeves

Replaceable wearing rings/ liners shall be provided between impeller and casing. The suction wearing ring /liner shall be bolted in a holder which shall be grouted in concrete with non-shrinking mortar.-During grouting of this ring, the top section shall be grouted with two pack moulding mass of synthetic resin, minimum layer thickness 3 mm to provide watertight finish.

The diametrical clearance between casing and impeller wearing ring(s) when the pump is new shall not be less than 1.2 mm.

Casing wearing ring at suction shall be held in a metallic carrier grouted in concrete and wearing rings shall be removable from the carrier. Suitable shaft sleeves shall be provided between the shaft and impeller to protect the shaft.

2.02.09

#### Sealing Arrangement

A mechanical seal or stuffing box with packing flushed with water shall be provided in line with the standard practice of the manufacturer. A seal flushing system shall be provided which will supply the glands with flushing water both during pump start-up / shutdown and while the pump is running.

The seal flushing water shall be filtered by the provision of 2x100% basket type strainers with isolation valves for each pump set. Bidder shall make necessary arrangement for proper drainage of the seal area by providing drainage pumps. Mechanical seal (if provided) of cartridge construction type, shall be of approved design. 2x100% capacity seal water pumps shall be provided for each CW pump.

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2.02.10	<div>Journal Bearings</div> <p>The guide bearings for CW pump shall be of journal bearing type with babbit lined bronze bearing sleeve located as close to the impeller as possible. The guide bearing &amp; thrust bearing shall be protected against water splashes and gland packing leaks. The bearings housing shall be of axially split design and designed to exclude the ingress of dust and water and shall have suitable provision for breathing and be adequately sealed to prevent leakage of oil. It shall be out of water, cooled &amp; lubricated by self-circulated oil. The bush bearings (if provided) shall be lubricated with filtered pump fluid.</p>			
2.02.11	<div>Pump Shaft</div> <p>The shaft shall be designed to transmit the maximum rated power at the pump operating speed and shall be of ample stiffness to minimize deflection of the shaft during starting conditions or any other operating condition. Where the pump shaft is exposed to water (i.e.) to effects of corrosion, it shall be adequately protected by replaceable sleeves.</p>			
2.02.12	<div>Lubrication System</div> <p>Material of construction of Cooling coils if fitted shall be of Stainless steel. All associated pipe work shall be of stainless steel. Required level sensors shall be provided for measurement/interlock &amp; alarm purpose.</p>			
2.02.13	<div>Gland Drainage</div> <p>Four (4) numbers of drainage pumps (draining for the gland area) shall be provided in the CW pump house. The minimum capacity of each pump shall be 50 m<sup>3</sup>/hr &amp; the corresponding head shall not be less than 10 MWC.</p>			
2.02.14	<div>Manhole</div> <p>Each pump shall be equipped with an inspection manhole (Minimum diameter of 1000 mm) with steel cover plate at discharge side. Suitable access provision shall be made for the manhole from the operating floor.</p>			
2.02.15	<div>Vibration limits</div> <p>The maximum vibration limits of the pumps set when measured at locations as indicated in HIS shall not exceed 25 microns.</p>			
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1.00.00	PART- 3			
	TECHNICAL REQUIREMENTS OF ELECTRO-HYDRAULIC ACTUATORS			
	DESIGN CRITERIA			
	<div>a. Each electro-hydraulic actuator shall be provided with its own power pack. Each actuator shall consist of a double acting cylinder, control cabinet and accessories to cater for following operational requirements.</div> <div>2) In the closed position the valve shall be held closed by a substantial counterweight or by any other mechanical device. Valve shall remain open during normal running of the pump.</div> <div>3) A limit switch be provided (set at about 3 deg from open position) to sense the creeping. Switch shall start the oil pump and return the valve to the fully open position.</div> <div>4) When the valve is fully open and electric supply in the valve control system fails the butterfly valve shall remain open while the CW pump continues to deliver water.</div> <div>5) In case of any fault causing pump motor trip the corresponding butterfly valve shall start closing at a fast rate initially and thereafter at a slow rate. The emergency closing facilities shall be duplicated each with its own solenoid valve in the hydraulic circuit.</div> <div>6) Provision for local manual operation shall be made. A locking device shall be provided.</div> <div>7) The hydraulic controls for each valve shall be housed in independent cabinet located on an operating floor near the valve. This shall consist of pumping unit, oil tank, and accumulator of adequate capacity to hold the valve disc at any position and to prevent any surge including disc flutter during valve travel and to fully open position. Accumulator will also have enough capacity for one cycle (open &amp; close operation) of operation without external electric AC power. The hydraulic power pack will consist of all its associated equipment/system.</div> <div>8) The electrical controls shall be housed in the common control panel (local) for CW pumps or in a separate panel. Reversible starters for the valves shall also be provided.</div> <div>9) Each butterfly valve shall have four limit switches, each capable of being set of at any point between full open to full close position. In addition, one more extra limit switch to be set at an intermediate position shall be provided. each limit switch shall have 2 NO and 2 NC contacts. Limit switch enclosure shall conform to NEMA 4 x standard.</div> <div>10) Each butterfly valve shall have Two nos. non-contact type 24 V DC 4-20 mA output position transmitters.</div>			
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3.10.00

Contractor shall submit, performance test reports of similar towers installed by them. Such reports shall include the details of packing arrangement and must have been duly approved by the purchaser. Contractor may note, the calculations specified above must be submitted. The contractor shall show, explain, and prove the validity of the basis, procedures and methods used in these calculations.

**4.00.00**
**Thermal Design Criteria**

4.01.00

The thermal design of cooling towers shall fulfil following design criteria. The thermal design of cooling towers shall fulfil following design criteria. Sensible heat of evaporated water shall be taken into consideration in the thermal design of the cooling tower. The air flow requirement shall not be less than that worked out by the formula given below:

$$GH = L(TI - T2) + EvT2$$

Where

- L = Water flow rate in kg/hr.
- TI = Water inlet temperature to the tower in deg C.
- T2 = Water outlet temperature to the tower in deg C.
- EV = Evaporation loss in kg/hr at ambient RH
- G = Air flow rate in kg/hr.
- H = Change in enthalpy of air in kcal/kg.

4.02.00

For the specified design conditions of water rate, range, approach, wet bulb and dry bulb temperatures Bidder shall calculate and furnish the duty coefficient 'D'. A nomogram indicating the ratio of water rate and duty coefficient, recooled water temperature and other thermal conditions specified shall be furnished with the bid. The monogram shall cover the entire operating range and shall extend up to a wet bulb temperature of 30°C.

4.03.00


Based on the duty co-efficient and performance characteristics of the fill the bidder shall furnish an equation expressing the relationship between the plan area of packing and the square root of tower height.

**5.00.00**
**Constructional Features**

Wood/timber shall not be used as construction material in any part of the cooling tower.

S N	Description	Material
1	Hot water inlet pipes	Mild steel to IS :2062 tested quality / GRP
2	Hot water distribution system	HDPE (IS 4984 PN 6 GRADE PE 80) / PVC (IS 4985 Class 3) / FRP (Fiber reinforced plastic) pipes or RCC/pre-cast open trough.
3	Cooling tower basin, shell structure, Louvers, internal support structure for distribution basin, distribution trough. staircase	RCC
4	Drift Eliminators, Water stops	PVC
5	Fill	PVC/PP/ prestressed precast concrete
6	Fill supports	RCC/SS-316
7	Stop logs, Misc. steel structure	Refer civil specifications.

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	8	Hardware– All parts and embedment coming in direct contact with water/water vapor	SS 316	
	9	Mild steel parts or structures used in cooling tower or its vicinity	Heavily galvanized (610 gm/sq m) in accordance with IS- 2629	
	10	Nozzles/splash cups/orifice	PVC/ Polypropylene / Gun Metal as per IS 318 Gr VI	
<b>6.00.00</b>	<b>Cooling Tower Basin and Shell Structure</b>			
	The basin shall be designed for a water depth of at least 1.0 m from Normal Water Level with free board of at least 0.3 m above maximum water level, Cooling tower basin shall be divided into two equal parts by water tight RCC partition for cleaning and maintenance of one half while the other half is in service arrangement for drainage of water shall be provided			
	Cold water from cooling tower basin shall flow by gravity to open approach channel wherefrom it shall be led to the intake of CW Pump House. Two (2) Nos. Cold water channel from each compartment of basin shall be provided i.e. one each on one part of basin. Each cold-water channel shall be provided with a stop log. Suitable handling arrangement with a monorail and a chain operated hoist with a traveling trolley for the stop log shall be provided.			
<b>7.00.00</b>	<b>Drainage of Basin</b>			
	Each half of the basin shall be sloped from center towards periphery which in turn shall be sloped towards a collecting sump to be provided on the opposite side of outlet channel. From the collecting sump, the water will be drained into a sludge sump outside the tower basin. Sludge pumps of suitable head shall be provided in the sludge sump to discharge up to clarifier sludge pit.			
<b>8.00.00</b>	<b>Inlet Louvers</b>			
	The water loss in the inlet air openings shall be prevented with provision of adequate number of louvers of proper slope, width and spacing or alternatively by over dimensioning the cold-water basin by minimum 1.0 meter all-around. Louvers, if provided, must be properly designed to give uniform distribution of air with minimum pressure drop and must be able to withstand the corrosive atmosphere.			
<b>9.00.00</b>	<b>Fill and Fill Supports</b>			
	<ol style="list-style-type: none"> <li>1) The fill shall be of non-clogging type fills like modular splash/trickle grid/turbo splash or splash type fills like V-bar splash/splash grid and easily installable. The fills shall be adequately supported to prevent sagging and damage. The tower shall be levelled so that water will be uniformly distributed over the fills and does not cause channeling. The splash type fills shall be placed horizontally.</li> <li>2) The non-clogging type fills shall be in modular form. These fills are to be mechanically assembled without any use of adhesives. Assembling by other proven method is also acceptable. The fill shall be freely rested, and bottom supported to prevent any sagging and damage.</li> <li>3) The fill material shall be highly resistant to deterioration and shall be fire retardant. PVC/PP fill shall be of proven quality. The Properties of PVC/PP material for the fills shall be in line with CTI-136 2010.</li> <li>4) The type of fill to be supplied for this package shall be of proven design. The performance of the fill should have been established for the specified/higher duty conditions.</li> <li>5) Type Test of PVC/PP Material</li> </ol> <p>In addition to the routine tests specified in this Technical specifications, ultra-violet exposure for 500 hours on the PVC/PP material shall be carried out for this contract</p>			
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10.00.00	<p>once as per ASTM-G155, Test Method 3 and Impact resistance test before and after UV exposure shall be conducted as per ASTM D-256. The above type test shall be carried out by the Contractor at reputed third-party laboratory.</p> <p>Offered fills shall be tested by an independent reputed laboratory approved by NTPC to validate thermal characteristic and pressure drop correlation of the offered fill. In case the bidder has their own established test facility where such tests have been conducted for other reputed clients in the past, the same is also acceptable subject to owner's approval.</p> <p>Test bed shall have fill height same as the offered fill height. During testing water and air loading as well as the air velocities shall be maintained same as the duty conditions and in the range of performance guarantee conditions for which tower is designed.</p>			
	<p><b>Water Distribution System</b></p> <ul style="list-style-type: none"><li>1) The water should be distributed across the plan area of the fill so that no point varies more than <math>\pm</math> 5% of the average water flow.</li><li>2) Provision shall be made for easy flushing or cleaning of all troughs/pipes. These hot water pipes shall be properly embedded in the flume or shell, as the case may be, taking into account the forces coming on them.</li><li>3) The distribution troughs/pipes shall not be laid on top of walkways.</li><li>4) All section of the water distribution system shall have adequate flow capacity to meet the maximum requirements of the thermal design of the tower.</li><li>5) The water shall be discharged throughout the plan area of the packing. Sufficient head room shall be provided between the water distribution system and packing for inspection and maintenance. Fill cone down spray / up spray water distribution system should be provided so that there is no interference between the nozzle exit and top of fill.</li><li>6) All distribution pipe work shall be adequately supported to-accommodate thermal movement while ensuring the pipe joints do not fail when subjected to pressure surges.</li><li>7) <u>Type Test requirements of distribution Nozzles</u><ul style="list-style-type: none"><li>a) The Nozzles shall be arranged in a uniform pattern with proper distance to produce 15% overlapping of the individual sprays. Selected nozzle characteristics like 'Head vs Flow' and 'Head vs Spread area' at three or four distances from nozzle bottom to fill top shall be furnished based on the 'Single nozzle test' and 'Four nozzle test'. Previous test reports are to be furnished covering all tests along with the offer. In case the test was not conducted in the past, the above tests shall be carried out in presence of the Employer.</li><li>b) Single Nozzle Test: The nozzle shall be placed at the bottom of the overhead tank. The head in the tank can be maintained at different head of 0.1 m, 0.2 m and 0.3 m by adjusting the inlet flow. The water spread area for different heads and flow can be measured with the help of spread measuring instrument (scale) in LHS and RHS.</li><li>c) Four Nozzle Test: The nozzle shall be placed at the bottom of tank. The water-collecting compartment shall be placed at the bottom and center of spray nozzles. For different head, the quantity of water collected in the collecting compartments for 30 seconds/ 60 seconds shall be measured and this shall be verified with the design prediction/ assumption.</li><li>d) Nozzle connection with hot water distribution pipes shall be preferably by fasteners. Fasteners shall be of stainless steel. Push on fit type connection is not acceptable.</li></ul></li></ul>			
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11.00.00	<b>Drift Eliminators</b>  The maximum drift loss shall be limited to 0.001% of total water in circulation. Contractor shall demonstrate during performance test as per relevant test codes that drift loss is limited to 0.001%. The drift eliminators shall be of profile type and gluing is not allowed.			
12.00.00	<b>HOT WATER PIPING, VALVES, ACCESSORIES</b>  Main header shall be branched into two (02) nos. for feeding to each section of cooling tower. Two (2) nos. manually operated butterfly valves of suitable size shall be provided in branch pipe of each cooling tower. These valves shall be in the vertical section of hot water piping and shall be overground.			
13.00.0	<b>STOPLOG GATE AND HANDLING FACILITY</b>  For isolation of the cold-water basin of the tower, groove for steel stop log gate shall be provided in the cold-water outlet channel of each tower.  The minimum thickness of skin plate shall be 8 mm. The structural design of the stop log gate shall generally conform to relevant IS codes. The gate shall be painted with corrosion resistant paint-  To handle the stop log gate a monorail beam at sufficient height shall be provided across each cold-water channel. A hand operated chain pulley block with travelling trolley of adequate capacity to handle the stop log gate shall be provided for each tower. The capacity of the hoist however shall in no case be less than 125% the weight of the stoplog gate.			
14.00.00	<b>MISCELLANEOUS</b>			
14.01.00	Necessary stub connections for pitot tube shall be provided in the hot water header of cooling tower for measurement of flow.  Any special equipment tools and tackles required for the successful completion of the Performance & Guarantee Test shall be included by the bidder in his scope.			
15.00.00	<b>TESTS AT SITE</b>  After Installation at site, the complete systems/equipment will be operated at site to show satisfactory performance as required by the applicable clauses of the specification. Further, all piping shall be hydraulically tested at site.			
16.00.00	<b>PG Test</b>  Ref PG test chapter. In addition, PG test shall be carried out by the contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified, preferably in the period from May to September.			
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	<b>(B-2) AUX. COOLING TOWER – INDUCED DRAFT (MECHANICAL)</b>		
<b>1.</b>	<b>GENERAL</b>		
<b>1.1.</b>	This specification covers the design, engineering, manufacture, shop fabrication, testing at works, transportation to site, unloading and storage at site, fabrication at site, Installation, testing and commissioning of Aux.induced draught RCC/ Pultruded FRP cooling towers for raw water cooling system.		
<b>2.</b>	<b>CODES AND STANDARDS</b>		
<b>2.01.00</b>	The design, manufacture, inspection and testing shall comply with all currently applicable standards. The equipment shall also conform to the latest applicable British/American standards. In particular, the equipment shall conform to the latest edition of the following standards:- <ol style="list-style-type: none"> <li>Cooling Tower Institute Publications.</li> <li>BS 4485 – Specification for Water Cooling Towers.</li> </ol>		
<b>2.02.00</b>	<b>CODES AND STANDARDS FOR FRP COMPONENTS</b> <p>The design of FRP components of cooling tower shall comply with the requirements stipulated in CTI STD- 131, CTI STD -137, and CTI ESG-152. The cooling tower and its components shall be designed to withstand the most onerous loading case / combination resulting from the various loading cases / combinations stipulated in CTI ESG 152. All material properties, stresses and their reduction factors, deflection criteria, material service factors, connection details and their tolerances etc., as applicable as per CTI codes CTI STD- 131, CTI STD -137, CTI ESG-152, shall be so considered such that the cooling tower and its components withstand the severest temperatures in the place of installation and application and serve a reasonably long life not less than CTI indicated life expectancy.</p>		
<b>3.</b>	<b>DESIGN REQUIREMENTS / CRITERIA</b>		
<b>3.1.</b>	Cooling tower shall be complete with tower, basin, foundations and mechanical equipment as described below. The tower shall be of single inlet or double inlet, cross flow or counter flow type with type of fill as specified in technical data sheets. The tower shall be of induced draught type with the fan located on top of the tower.		
<b>3.2.</b>	The cooling tower shall be designed to meet the duty conditions as specified elsewhere in this specification. Employer may get the verification and review of contractor's design done through third party (who can be employer's consultant/reputed designer/ National or International Technological Institute/National or International body on cooling tower & it's components), if required (during detailed engineering). All necessary data/ details/ drawings shall be provided by the contractor to get the same carried out.		
<b>3.3.</b>	Bidder shall provide spare cells minimum one (1) number per tower configuration to facilitate maintenance without affecting the tower performance.		
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3.4.	The water distribution basin and piping system shall be so designed that when any one cells are out of operation for maintenance etc. the remaining cells shall be capable of handling the full quantity of water as indicated in technical data sheet.			
3.5.	All cells of the tower shall be identical. Thermal design of the cooling towers shall be such that the guaranteed performance is met without operating spare cells.			
3.6.	Not Used			
3.7.	For counter flow tower the area covered by the projected circle at 45 deg. angle from the fan cylinder opening on the drift eliminator plan area shall not be less than 80% of the drift eliminator plan area.			
3.8.	The layout of the cooling tower in the plant area and the wind rose is indicated in the drawings titled “General Layout Plan”. The Bidder shall examine the proposed layout of the tower and accordingly determine the recirculation, which must be taken into consideration for the purpose of design of the tower to ensure that the design parameters of the tower are maintained when all the cooling towers in the plant are operating simultaneously. Bidder must apply a correction factor to the design wet bulb ambient temperature to accommodate the recirculation effect. Minimum value of this recirculation correction factor shall be as given in technical data sheets.			
3.9.	The length of the cooling tower shall be decided based on plant layout to be optimized by the bidder.			
3.10.	<p>Thermal Design Criteria</p> <p>The thermal design of cooling towers shall fulfil following design criteria. Sensible heat of evaporated water shall be taken into consideration in the thermal design of the cooling tower. The air flow requirement shall not be less than that worked out by the formula given below:</p> <div><div>GH = L(TI-T2) + EvT2</div><div>Where</div><div><div>L = Water flow rate in kg/hr.</div><div>TI = Water inlet temperature to the tower in deg C.</div><div>T2 = Water outlet temperature to the tower in deg C.</div><div>EV = Evaporation loss in kg/hr at ambient RH</div><div>G = Air flow rate in kg/hr.</div><div>H = Change in enthalpy of air in kcal/kg.</div></div></div>			
3.11.	Calculations justifying the selected airflow and evaporation loss shall be enclosed with the bid. International/National standard table of properties of air shall be used and a copy of the table clearly indicating the standard used shall be enclosed with the bid.			
3.12.	<p>The bidder shall furnish in his bid the following :-</p> <p>i)Heat balance calculations and air requirements for cooling tower as per format given elsewhere.</p>			
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	<p>ii)Available tower characteristics (KaV/L - as a function of air &amp; water rates, fill geometry, hot water temperature, air velocity etc.) based on field performance tests. The relationship shall be of general form of equation given below and shall include values of the constants “C” and “n”. The equation shall cover range of L/G values from at least 20% above to at least 20% below design.</p> $KaV/L = C(L/G)^n$ <p>The bidder shall also submit an equation and / or curve defining the demand requirement at design approach, range and wet bulb temperature. The design L/G value shall be identified.</p> <p>iii)Various pressures drop in the air circuit of the cooling tower to arrive at discharge pressure of fan.</p> <p>iv)Calculations for arriving at the design power consumption.</p> <p>v)Calculations for pumping head in the format given in elsewhere.</p> <p>vi)Tower Performance curves (for both ambient and inlet WBT.)</p> <p>Bidders may note that the calculations/curves specified above must be enclosed with the offer without which bids run the risk of rejection. In case, these calculations are based on the collaborator's design, then these calculations should be duly vetted by collaborator. The Bidder shall show/explain and prove the validity and the basis of procedures and methods used in the calculations.</p>			
3.13.	The tower configuration shall be such that it shall offer minimum restriction to air flow.			
3.14.	To ensure uniform and stable distribution of entering air, the velocity pressure ratio shall not be less than 5 (Five). Velocity pressure ratio is defined as the ratio of system pressure drop (i.e. from air inlet to the drift eliminator) to the velocity pressure at the inlet. For counter flow towers, the velocity at air inlet shall be calculated based on the clear air entry area available in vertical plane at the inner face of cooling tower wall. For purpose of calculating the velocity pressure ratio, the air velocity shall be computed considering the total airflow entering the individual cell and the total gross inlet air area of the individual cell. This will be calculated independently for each cell and the value calculated for each cell shall not be less than 5. For towers provided with over-dimensioned cold-water basin, the inlet air area shall be computed considering the water level in the cold-water basin at normal water level.			
3.15.	The exit air velocity of the fan recovery stack outlet shall not be less than 6m/s.			
3.16.	Maximum air Inlet velocity should be 5m/s.			
4.	CONSTRUCTIONAL FEATURES			
4.11.	Material of Construction			
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4.01.00 Wood/timber shall not be used as construction material in any part of the cooling tower. Bidder may offer MOC of components different than that specified below based on his proven practices, however allowing of such MOC shall be under employer's discretion.

	Component Description	Material of Construction	
		RCC Aux. IDCT	FRP Aux. IDCT
	Hot water header	MS to IS:2062 (around cooling tower)	
	Hot water distribution pipes for counter-flow tower	PVC (IS 4985 Class 3) / GRP / HDPE (IS 4984 PN6, Grade PE 80)/ as per Bidder's proven practice	
	Hot water basin for cross flow	RCC	Pultruded FRP
	Cooling tower shell/ structure	RCC	Pultruded FRP
	Cooling tower basin	RCC (Refer Civil specifications)	
	Drift Eliminators	PVC	
	Louvers	Bidder's proven practice	
	Fill	PVC/ PP/ as per Bidder's proven practice	
	Fill supports	SS:316 grid	
	Fan blades	Fiber glass reinforced polyester/ Epoxy (hollow cast)	
	Fan Hub	Heavily Galvanized M.S	
	Fan Deck	RCC	Pultruded FRP
	Drive shaft and coupling	Stainless steel conforming to AISI 304 or Carbon fiber Composite material with SS 304 couplings.	
	Base frame and base plate for gear box and motor/ Torque Tube Support	Heavily Galvanized MS	
	Stair case	RCC	Pultruded FRP

	<b>Component Description</b>	<b>Material of Construction</b>	
		<b>RCC Aux. IDCT</b>	<b>FRP Aux. IDCT</b>
	Recovery Stack	RCC	Pultruded FRP/ GRP
	Stop logs	Refer civil specifications.	
	Any other hardware such as fasteners, clamps, supports etc. in direct contact with water	1. Stainless steel conforming to AISI: 304 or equivalent. 2. Suitable mechanism should be provided to avoid CT debris / foreign debris flow to pump suction.	
	Any other mild steel parts used in cooling tower or its vicinity	Heavily galvanized (610 gm/m <sup>2</sup> ) in accordance with IS:2629 with corrosion resistant protective coating Surface preparation in accordance with IS:6129	
	Hand Rails	Refer civil specifications.	Deck Level – Pultruded FRP  Others – Refer civil specifications.
	Misc. Structure(s)	Refer civil specifications.	
	Nozzles/ Splash cups	PVC/ PP/ Gun metal as per IS:318 Gr. VI	
	Cladding Sheets	RCC	FRP

4.02.00

**Pultruded FRP structural components**


The Pultruded FRP structural members shall be proven for use in Cooling Towers application. Documentary evidence about past experience of parties in respect of design, manufacture, supply, erection & satisfactory operation of Pultruded structure shall be submitted to the employer.


4.02.01

**Manufacturing Process**

- a) Pultrusion:** The process of pulling continuous forms of reinforcing materials, such as glass-fiber rovings, glass-fiber mats and various surfacing veils through a bath of liquid resin. The mass of fully wetted-out material then continues to a performer and directly into a heated forming and curing die where a chemical reaction is initiated which causes the thermosetting resin to harden and the composite structural shape is formed. An optional method of cure is to pass the wetted-out composite through a radio frequency (RF) preheated. The RF preheat initiates the cure process prior to entering the heated forming die. This process is particularly useful for heavy section processing. The hardened (or cured) shape is cooled in line by water or air and then enters a pulling device where continuous pulling is maintained. Both caterpillar type


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	<p>and reciprocating pullers are used in pultrusion. Upon exiting the puller, the composite structural shape is cut to the desired length.</p> <p>b) Definition of terms relative to pultrusion can be found in ASTM D-883 and ASTM D-3918.</p> <p>c) Other forms or combinations of reinforcements such as carbon fiber, aramid fiber, etc. can also be utilized when different mechanical and physical properties are required. Specific mechanical and physical properties should be negotiated between the pultrusion supplier and cooling tower</p>			
4.02.02	<p><b>Design Temperature</b></p> <p>For members in cooling towers which are subjected to extended periods of operation in temperatures greater than 77°F, the pultrusion suppliers published allowable design values for flexural and compressive loads shall be reduced to account for reduced properties at the higher temperatures. These correction factors are published in Table II of CTI STD-137. For Type IV products, pultrusion suppliers are to supply the cooling tower manufacturer with temperature-moisture correction factors. All structural components for the tower should be selected to account for maximum expected hot water temperature including any upset conditions as a minimum (i.e., maximum hot water temperature +10°). This will account for the possible the effects of fan off operation, tower idle in hot weather and load excursions. A statement indicating the design temperature should be included as part of the cooling tower manufacturer's proposal.</p>			
4.02.03	<p><b>Materials</b></p> <p>a) Glass fiber-reinforcements may be either continuous roving's, continuous strand mats, woven or non-woven fabrics, uni-directional fabrics or combinations of these. Glass fibers shall be made for A, C, E or S-type glass. Other reinforcements may be specified for custom applications.</p> <p>b) The resin grade shall either be a Grade I isophthalic polyester resin or Grade 3 vinyl ester resin as per Section 4.2 of CTI Std. 137. The resin may contain additives for various purposes such as flame retardancy. UV stabilization, pigmentation or smoke reduction. These additives should be selected so as to add to the overall performance of the product without affecting the structural properties, chemical resistance an/or longevity of the part.</p> <p>c) Surfacing veils shall be used to improve surface appearance, assistance in chemical resistance, improved weatherability and to prevent glass fibres from coming to the surface as a result of wear or UV attack. Surfacing veils are thin tissue-type products incorporated during the pultrusion manufacturing operation as the outermost surface layer of non-resinous material. All exterior surfaces of Pultruded members shall have a minimum surface veil of 10mil and shall have UV inhibitors to protect against UV degradation. Heavier surface veils may be provided on supplier's discretion. The final degree of UV protection is a function of the total manufactured thickness of the surfacing veils and/or surface coatings. Glass fibres exposed during fabrication process and/ or installation shall be gel coated and sealed to prevent wicking</p>			
4.02.04	<p><b>Physical Properties</b></p> <p>Physical properties should be in line with CTI specifications, CTI-STD-137. Moreover, the pultruded FRP structural components shall be fire retardant with the resin composite having a flame spread rating less than 25 as per ASTM E 84 standards.</p>			
4.02.05	<p><b>Mechanical Properties from Coupons</b></p>			
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	Minimum mechanical properties (taken from coupons) shall be as per CTI specifications CTI-STD-137			
4.02.06	<b>Applicable Documents</b>  a) CTI STD-137: Fiberglass Pultruded Structural Products for use in Cooling Towers  b) CTI STD-152: Structural Design of FRP components  c) ASTM D-4385 Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products.  d) ASTM D-3647 Practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition.  e) ASTM D-3917 Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Putlru ded Shapes.  f) ASTM D-3918 Definitions of Terms Relating to Reinforced Plastic Pultruded Products.			
4.02.07	Ultraviolet exposure test for 300 hours to be carried out at reputed third party laboratory once as per ASTM G-154 and Impact resistance test before & after UV exposure shall be conducted as per ASTM D-256. This will be applicable to Pultruded as well as moulded FRP components.			
4.02.08	FRP tower shall be with proper sealing/isolation between cells to avoid short circuiting of air between adjacent cells of Cooling Tower and ensure that there is no reverse rotation of fan.			
4.3.	<b>Cooling Tower Basin and Super Structure</b>  The material of cooling tower basin and super structure shall be as mentioned above. The depth of basin shall be free board of at least 0.3 m above maximum water level.			
4.4.	<b>Cold Water Basin Drainage Arrangement</b>			
4.4.1.	Cold water from the basin shall flow by gravity to cooling water channel/pipe which will provide flooded suction to all connected pumps.			
4.4.2.	Provision shall be made to completely drain the basin. For this purpose, the basin floor shall slope towards the drain sump in the Cooling Tower. Water shall flow from the drain sump into an external sludge sump through a 300 mm NB GRP pipe 12mm thick and a gate valve of size 300mm NB with extended spindle. One sludge sumps shall be provided for each tower. The sludge sump shall be at least 2m x 2m plan area and minimum 2.5m deep. One number sludge disposal pump of capacity 150 cum/hr and suitable head shall be supplied for each sludge sump. Sludge Pumps can be of fixed type or submersible type with proper handling arrangement.			
4.5.	<b>Inlet Louvers</b>			
4.5.1.	Refer (B-1) COOLING TOWERS - NATURAL DRAFT (MECHANICAL) clause 8.00.00 of this sub section.			
4.6.	<b>Cooling Tower Fill and Fill Supports</b>			
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4.06.01	Refer (B-1) COOLING TOWERS - NATURAL DRAFT (MECHANICAL) of clause 9.00.00 of this sub section.			
4.7.	<b>Water Distribution System</b>			
4.7.1.	Refer (B-1) COOLING TOWERS - NATURAL DRAFT (MECHANICAL) clause 10.00.00 of this sub section.			
4.7.2.	<u>Specific Requirements for cross flow towers:</u>  The hot water distribution basin shall be provided with a suitable cover to avoid direct sun rays falling on the distribution trough/basin to minimize algae growth and to prevent choking of distribution nozzles. The covers provided shall be easily openable for inspection and maintenance of the distribution system.			
4.7.3.	<u>Specific Requirements for counter flow towers:</u>  All distribution pipe work shall be adequately supported. The pipe supports shall accommodate thermal movement while ensuring the pipe joints do not fail when subjected to pressure surges. The Bidder shall submit the details of the proposed method of supporting distribution system. The design calculations for sizing of the system shall be furnished by the Bidder for Employer's approval during detailed engineering stage.			
4.7.4.	<u>Specific Requirements for Pultruded FRP Cooling Towers:</u>  Each riser pipe in case of Pultruded FRP Cooling Towers shall be connected to the Cooling Tower shell through a rubber expansion joint of the diameter same as that of the riser pipe and meeting the requirement of REJ as specified elsewhere in this specification.			
4.8.	<b>Drift Eliminators</b>  Refer (B-1) COOLING TOWERS - NATURAL DRAFT (MECHANICAL) clause 11.00.00 of this sub section.  <b>HOT WATER PIPING, VALVES, ACCESSORIES</b>  Manually operated butterfly valves of suitable size shall be provided in branch pipe of each cooling tower. These valves shall be in the vertical section of hot water piping and shall be overground.			
4.9.	<b>Recovery Stack</b>  Recovery stack shall be of proper shape to improve the fan performance. The height of the stack shall be sufficient to recover the velocity and discharge the humid air to a sufficiently high level to minimize recirculation. The maximum efficiency of the stack for velocity recovery to be considered for calculation of fan power consumption shall be 75%. <b>No credit shall be given during bid evaluation for efficiency of the stack for velocity recovery beyond the specified efficiency. In case, Fan power consumption figure (quoted by</b>			
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	<p>the bidder) is derived considering higher velocity recovery, the same shall be corrected for evaluation purpose. A minimum clearance between the stack and fan blades shall be maintained along the entire periphery of the stack to prevent the rubbing of fan blades while rotating.</p>			
4.10.	<b>Fan Deck</b>			
4.10.1.	Fan deck shall act as an access platform for the mechanical equipment.			
4.10.2.	Adequate access for roof deck, fan deck, distribution level, and drift eliminators shall be provided. For counter flow towers there shall be provision for access to water distribution level of each cell from tower roof deck or through stair case provided at each cased face of the tower. Walkways with platforms and suitable hand and knee rails and toe guards shall be provided inside towers.			
4.10.3.	Handrails shall be provided all around the periphery of the cooling tower fan deck. Pipes shall be of 32 NB (Medium class). Handrails provided elsewhere should also conform to the above specification.			
4.11.	<b>Internal Walkways.</b>			
	<u>For Cross Flow Towers:</u> Walkways with permanents and suitable hand rails shall be provided inside the towers. The drift eliminators shall be easily accessible from these walkways. One door at each cased face of the tower shall be provided.			
4.12.	<b>Stair Case</b>			
	For access up to the top (roof) of the cooling tower, two numbers of staircases one at each face of the tower shall be provided for cooling tower. The staircases shall be constructed adequately away from the face of cooling tower in order to prevent splashing of water on the stairs.			
4.13.	<b>Gear Box</b>			
	The fans shall be motor driven through suitable reduction gear. Flexible coupling shall be provided both at motor and reducer to minimize the effect of misalignment on account of any setting and/or warping. Flexible couplings should be pin and bush type. The support structure of the reduction gear shall be rigid. The reduction gear shall be heavy-duty type suitable for installation in outdoor and humid environment. The gear drive shall be of spiral bevel or worm type and the reduction may be accomplished in either single stage or multi stages.			
4.13.1.	The gearbox shall be of proven design. Design rating of the gear box shall be arrived at after considering a service factor of minimum 3.0 on motor rating. In selecting the gear box design rating the thermal derating effects at 50 degree C shall also be considered. Gearbox thermal rating shall be calculated considering max. operating Gearbox Oil temperature which should be at least 5 deg C lower than the permissible Gearbox Oil temperature.			
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	<p>Detailed gear box sizing calculation shall be furnished for Employer's approval during detailed engineering. In no case, the design thermal rating of the gear box shall be less than 125% of the name plate kW rating of the selected drive motor. Also, the mechanical rating shall be checked so that minimum 25% margin is available at Pull Out Torque of the motor.</p>			
4.13.2.	<p>The piping for oil level gauge/dipstick and thermometer shall be arranged in such a way that oil can be drained and refilled from outside the stack. This pipe shall have proper supports at frequent intervals and shall be insulated. Further, a breather connection shall be provided in the gear box. The breather provided shall be such that it prevents moisture from entering the gear box. The breather arrangement and details of oil seals shall be to Employer's approval. Oil temperature gauge should be located outside the cell through a capillary tube, which is connected to gear box stub.</p>			
4.13.3.	<p>The gear box design should be such that the temperature of oil shall be within the manufacturer's recommended limits during all operating conditions.</p>			
4.13.4.	<p>The gear boxes shall utilize non-hygroscopic oil for lubrication so that its lubricating properties are not lost if contaminated with water vapor.</p>			
4.13.5.	<p>Each gear box shall be provided with a base plate. The vibration measurement sensors shall be mounted on the gear box. Vibration probe should not be mentioned on the inspection cover of the gearbox.</p>			
4.13.6.	<p>Bidder shall furnish the maximum temperature that the lube oil can withstand and shall guarantee the maximum value of lube oil temperature when the gear reducer is in operation.</p>			
4.13.7.	<p>Offered gearbox (minimum one no.) shall be tested at full load at manufacturer's own or any third party testing facility to demonstrate its thermal performance.</p>			
4.14.	<p><b>Drive Shaft</b></p> <p>The drive shaft shall be of tubular construction. The design of the shaft shall take into consideration a factor of safety of 2 (minimum) over the torque to be transmitted at design duty conditions. The fan shaft shall be designed in such a way that the first critical speed shall be at least 120% of the operating speed of the shaft. Shaft design requiring intermediate bearings are not acceptable. The beams at fan deck level should be designed based on dynamic analysis. The bearings shall be of proven design and shall be suitable for operation in the humid condition prevalent in the fan stack. The minimum life of bearing shall not be less than 30,000 working hours. The drive shaft design shall be such that the fan blades should not be damaged in case of shaft failure.</p> <p>In case of Carbon fiber composite material, drive shaft shall have the following additional requirements.</p> <div><div>1)</div><div>Shaft flanges shall be preferably of Carbon fiber composite material.</div></div> <div><div>2)</div><div>Bonding between shaft and shaft flange shall be done by a proven method.</div></div>			
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	3)	The Carbon fiber composite material should be ultra violet ray stabilized.		
4.15.	Fans			
4.15.1.	Induced draught fans of suitable capacity shall be provided. Fans shall be axial/propeller type with blades, which can be adjusted so that pitch can be altered +/- 5 deg. from the normal setting. For adjusting the fan blades, graduated stop marks with suitable locking arrangements shall be provided on the hub so that all the blades can be set to the same angle accurately. The fan blades shall be easily removable. These shall be of aerofoil section and shall provide uniform air velocity from hub to tip with low noise and vibration. Fan shall be manufactured as per the processes listed below:			
	i)	Hand Moulded Seamless FRP fan blades using ballooning method. The method of hand moulding with parting plane is not acceptable.		
	ii)	Hand moulded FRP fan blades with PU foam core and hot forming.		
	iii)	Pultruded FRP fan blades.		
4.15.2.	Stack shall be provided to eliminate air turbulence in the throat area. Blades, shanks and hubs shall be suitably insulated to prevent electrolytic corrosion.			
4.15.3.	The number of blades shall not exceed twelve (12) and the blade tip velocity shall not exceed 65 m/Sec. Each fan shall be driven by an electric motor.			
4.15.4.	Fans to be supplied for this package shall be of proven design and make and shall be subject to approval of Employer.			
4.15.5.	Fan for each cooling tower cell shall be sized (fan design point at test block) to have at least 5% margin on flow and min 10% margin on total head over and above the maximum cooling tower fan air flow and total head required (cooling tower fan duty point), to meet the specified / guaranteed cooling tower performance. Bidder shall submit detailed cooling tower fan calculation, characteristic curves etc. for the fan sizing as per the above.			
4.15.6	A scaled down model test of the fan offered shall be carried out by the contractor at the fan supplier test facility or at any other identified/recognized fan test facility to establish the rated parameters such as efficiency, power consumption etc. of the fan. Scale of model shall be minimum 1:10. The test should be carried out prior to start of manufacturing of the fan and shall be conforming to requirement of ANSI/AMCA A 210 or equivalent code.			
4.16.	Fan Maintenance Facilities			
4.16.1.	For maintenance of drive equipment (Fan, motor, gear reducer, etc.) following arrangements shall be furnished.			
4.16.2.	cooling tower shall be provided with a monorail. In addition, each cooling tower shall be provided with 3 numbers of manually operated chain pulley blocks along with travelling trolley for cooling towers shall be provided. The capacity of the hoist shall be such as to be able to lift the heaviest portion of the fan motor assembly, but in no case less than 2.0 MT.			
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	<p>Out of these specified numbers of monorail hoists, one will be used to lift equipment from ground level to tower top and accordingly the lift shall be provided. Balance two numbers of hoists shall be used for handling equipment for two (2) numbers of cells simultaneously during maintenance. The lift of these two (2) hoists shall be selected accordingly. In addition to the above a hand trolley which is sized to carry the heaviest and largest single piece of equipment shall also be provided for the cooling tower. This trolley will be used on the fan deck to transport equipment from each cell to and from the end of tower where the monorail hoist is located to lift equipment from ground level to tower top. For cross flow type of tower care shall be taken so that the equipment to be lifted does not need to be carried over the distribution basin.</p> <p>Suitable platforms/ scaffoldings for doing maintenance work in situ for gear reducer, fan and motor shall also be provided in addition to permanent walkways as specified elsewhere in the specification.</p>			
4.16.3.	<p>Alternative arrangements are also acceptable, if the arrangement provided is adequate to carry out maintenance on at least two cells of the tower simultaneously. In such a case, the complete equipment for easy removal of equipment from fan flume and bringing it down to ground level shall be furnished. The arrangement proposed shall be clearly brought out in the offer by the bidder.</p>			
4.17.	<p><b>Fan Motor</b></p> <p>Each electric motor shall be provided with a base plate and a base frame. Fan motor shall have at least 10% margin over the maximum power requirement of the fan when the fan is operating at its test block condition and at 50 deg. C ambient temperature as required at gear box input end.</p>			
4.18.	<p><b>Torque Tube Support (in case of Pultruded FRP Tower)</b></p> <p>The torque tube support shall be designed to stabilize the fan within the fan cylinder and maintain constant alignment between the motor and gear reducer. The pipe, heavy angles and plates shall be hot dip galvanized after assembly. It shall be properly fastened to the structure.</p>			
5.	<p><b>MISCELLANEOUS</b></p> <p>Necessary stub connections for pitot tube shall be provided in the hot water header of cooling tower for measurement of flow using pitot tube as defined in mechanical and C&amp;I chapters.</p> <p>Any special equipment tools and tackles required for the successful completion of the Performance &amp; Guarantee Test shall be included by the bidder in his scope.</p>			
6.00.00	<p><b>TESTS AT SITE</b></p>			
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7.00.00	<p>After Installation at site, the complete systems/equipment will be operated at site to show satisfactory performance as required by the applicable clauses of the specification. Further, all piping shall be hydraulically tested at site.</p> <p><b>PG Test</b></p> <p>Ref PG test chapter. In addition, PG test shall be carried out by the contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified, preferably in the period from May to September.</p>			
8.0	<b>CONTROL &amp; OPERATION PHILOSOPHY</b>			
8.1	<p>This control write-up/ operation philosophy details the control / operation requirements of cooling tower fans as a general guideline only and the contractor shall furnish his proposed philosophy during detailed engineering for approval of the Employer.</p>			
8.2	<p><b>Modes of Operation:</b></p> <p>The fans can be started in SOLO mode or in GROUP mode. The selection for individual and Group operation shall be made from OWS. Further, any of the fan can be put either in STANDBY mode or NOT IN STANDBY mode.</p> <p>(i). Group Mode</p> <p>START In Group Mode:</p> <p>On receipt of the GROUP START command from OWS, all pre-selected fans (except for the fans selected as "STANDBY") would start sequentially one after another after pre-defined time gap between start of the fans.</p> <p>STOP in GROUP Mode:</p> <p>On receipt of the GROUP STOP command from OWS, all the running fans will be tripped simultaneously. GROUP STOP command will have priority over and already executing GROUP START command.</p> <p>(ii). SOLO Mode:</p> <p>In the OWS, for each individual FAN, a separate START/STOP Button will be provided. The START button will be enabled only when the SOLO mode is selected. A fan can be started in SOLO mode immediately by pressing the START button. The fan can be stopped either by pressing the STOP push-button (of the corresponding Fan) or GROUP STOP button.</p>			
8.3	<p>Interlock and Protection</p> <p>Following are the Start-up permissive for the fans:</p> <div><div>1. MCC Healthy</div><div>2. Oil Level Not Very Low</div><div>3. Emergency PB not pressed</div><div>4. Gear box oil Temperature not high</div></div> <p>Following are the protections for Fan tripping:</p> <div><div>1. Oil Level Very Low</div><div>2. Emergency PB Pressed</div><div>3. Vibration Very High</div><div>4. Motor Overload</div><div>5. Gear box Temperature very high</div></div>			
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CLAUSE NO.	<div> <h1>TECHNICAL REQUIREMENTS</h1> </div> <div> </div>		
	<div> <p>Control System shall issue OPEN/CLOSE command for Electrical Breaker operation and monitor status. Necessary interlocks finalized during detailed engineering shall be implemented.</p> </div> <div> <p>The close status of butterfly valves and the ON/ OFF /TRIP status of fans shall be indicated in OWS. Operator shall be alerted through audio visual indication during the condition when the fan of any cell is ON and the corresponding cell isolation valve is closed or vice-versa.</p> </div>		
<div> <p>LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE</p> </div>	<div> <p>TECHNICAL SPECIFICATION SECTION – VI, PART-B</p> </div>	<div> <p>SUB SECTION A-15 CW SYSTEM</p> </div>	<div> <p>PAGE 28 OF 46</p> </div>

CLAUSE NO.	<div style="text-align: center;"> <b>TECHNICAL REQUIREMENTS</b> </div> <div style="text-align: right;">  </div>		
	<b>(C) EQUIPMENT COOLING WATER SYSTEM</b>		
1.00.00 1.01.00	<p><b>BRIEF DESCRIPTION OF SYSTEM</b></p> <p>Equipment Cooling Water system and Auxiliary cooling system shall be installed on a unit basis. The system shall also have the provision to operate common auxiliaries such as compressor plant, and compressor of mill reject system and FGD auxiliaries even with one unit/ all units are out of operation for which suitable arrangement shall be incorporated in the design and layout of piping system.</p> <p>Two independent primary cooling circuits- one for TG Auxiliaries and another for cooling of Steam Generator Auxiliaries or singly primary cooling water circuit for both TG and SG auxiliaries can be provided. However the Secondary circuit pumps shall be common for both these systems</p> <p>The minimum technical requirements and equipment shall include, but not be limited to the following:</p>		
2.00.00 2.01.00	<p><b>SYSTEM DESIGN (UNIT AUXILIARIES)</b></p> <p>For each Unit, in the primary circuit a set of Demineralized cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE). The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to auxiliary coolers. No booster pumping system shall be provided in the primary system by the bidder. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit. Following coolers/auxiliaries shall be cooled by ECW System (Unit Auxiliaries) of TG System.</p> <ul style="list-style-type: none"> <li>(a) Generator hydrogen coolers.</li> <li>(b) Turbine lube oil coolers.</li> <li>(c) Turbine control oil coolers.</li> <li>(d) Generator seal oil coolers.</li> <li>(e) Stator water coolers.</li> <li>(f) Generator slip ring coolers.</li> <li>(g) Sampling coolers /SWAS coolers (as applicable) in the scope of the Bidder (if any)</li> <li>(h) Water cooled electric motors.</li> <li>(i) BFP turbine oil coolers.</li> <li>(j) Hydraulic couplings of BFP.</li> <li>(k) Condensate Extraction (CEP) bearing oil coolers.</li> <li>(l) Any other unit auxiliary coolers envisaged by the contractor</li> </ul>		
2.02.00	<p>For the primary cooling circuit, for each Unit, an overhead (ECW) tank shall be provided by the bidder. Outlet of this tank shall be connected to the closed-circuit return header.</p>		
2.03.00	<p>The pH of DM water in the closed loop shall be continuously monitored and controlled at around 9.5. The control shall be achieved by dosing sodium hydroxide in ECW/DM water overhead tank &amp; header.</p>		
2.04.00	<p>Normal Make up to the closed loop primary circuit from the discharge of DM water transfer pumps located in DM plant and emergency make up from the discharge of condensate transfer pumps shall be given to overhead storage tank.</p>		
2.05.00	<p>The secondary cooling water system shall operate in parallel to the condenser and shall receive water through a tapping on the CW inlet line to the main condenser. This water will be further pressurized by auxiliary cooling water pumps and fed through the plate type heat exchangers back to the CW discharge line of the main condenser.</p>		
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2.06.00

**Self-Cleaning Filters**

To prevent fouling on the secondary circulating water side of the PHE, self-cleaning type filters with an automatic backwash arrangement to facilitate cleaning of the choked filter while the pumps are in operation, shall be provided by the bidder on the circulating water inlet header to the PHEs. Backwashing shall be actuated and controlled either according to differential pressure and /or by timer.

3.00.00

**CONSTRUCTION FEATURES**

3.01.01

The general design and construction features of various pumps of the Equipment cooling Water System shall be as per the Annexure 1 titled "**General Specification for Horizontal Pumps**" enclosed with this sub-section.

3.01.02

Specific features of pumps, plate type heat exchangers and other equipment of ECW system shall be as follows:

**A) Pumps (primary side & secondary side)**


- 1) The pumps shall be of horizontal centrifugal type provided with closed type impeller and axial split casing.
- 2) The pumps shall be designed as per requirements of Hydraulic Institute Standards (HIS), USA.
- 3) The pumps shall have stable head- capacity characteristic with head rising continuously towards the shut off. The shut off head of the pump shall be in the range 115-130% of the rated head. The power characteristics shall be of non-overloading type.
- 4) The pumps shall be suitable for continuous operation and shall operate satisfactorily in the range 40% to 120% of the rated flow.
- 5) The pump shall be driven by constant speed squirrel cage induction motor with speed not exceeding 1500 rpm (synchronous).

SN	Description	Primary Cooling Water Pumps	Secondary Cooling Water Pumps
1	Casing	ASTM A 351 CF8M	2.5% Ni CI, IS 210 Gr FG 260
2	Impeller	ASTM A 351 CF8M	Bronze to IS 318 Gr. I/II or SS 316/ ASTM A 351 CF8M
3	Shaft	SS 316	EN-8 (BS-970)
4	Shaft Sleeve	SS 410	SS 410
5	Impeller Wearing rings	SS 316	High leaded bronze to IS-318 Gr. V / SS 316 in case of SS impeller
6	Lantern ring	SS 316	Bronze
7	All fasteners of SS 316 grade		

**B) Plate type Heat Exchangers**

- 1) The heat exchangers shall be of plate type with single pass design.
- 2) The heat transfer plates shall be of SS-316 of thickness not less than 0.6 mm and the thickness of pressure and frame plates shall be as per ASME Sec. VIII Div. I.




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5.00.00	<div><div>3) The corrosion allowance for carbon steel parts of the heat exchanger which are in direct contact with water such as support plates, nozzles shall be 1.6 mm (minimum).</div><div>4) All the plates shall be tested by light box/ vacuum/ air chamber test as per manufacturer's standard practice.</div><div>5) Double sealing arrangement shall be provided for sealing at outer edges and around ports to avoid intermixing of fluids.</div><div>6) Guide rail shall be IS-2061 with stainless steel cladding and Tightening rods shall be as per IS-1367 or equivalent. Nozzle flange gasket shall be 3 mm wire inserted Red Rubber.</div></div>			
	<div><div>C) Piping, Valves /Tanks</div><div>Construction features of Piping, Valves and tanks shall be as per the sub-section titled "Low Pressure Piping" of this Technical specification.</div></div>			
	<div><div>D) Self Cleaning Filters</div><div>Body of filter shall conform to IS:210 GR FG-260 or ASTM-A-515 GR 75 / IS-2062 and internally painted with epoxy. Strainer shall be SS-316.</div></div>			
	<div><div>E) ECW (DM water) overhead tank</div><div>The overhead DM make- up tank shall be Horizontal dished end type of MS construction with plates conforming to IS 2062/ ASTM A 36 and minimum thickness of shell shall be 6 mm, epoxy coated or rubber lined (4.5 mm). Accessories such as vents, overflow and drain, CO<sub>2</sub> absorber for vent, seal for overflow, manhole &amp; staircase, level indicator, level transmitter and level switch etc. shall be provided. Design standard shall be ASME Boiler and Pressure Vessel code section-VIII/IS:2825 (Class 3).</div></div>			
	<div><div>F) Alkali dosing tank</div><div>Alkali preparation/ dosing tank (Vertical cylinder, dished bottom) shall be provided for gravity feed of alkali solution to overhead DM tank and suction piping of ECW system. The tank shall be of MSRL (MS plates to IS 2062 &amp; 6 mm thick with 4.5 mm thick rubber lining) or SS (6 mm thick) construction with SS 316 basket, SS-316 agitator etc. Alternatively, dosing system comprise of one no. alkali preparation/ dosing tank along with 2x100% dosing pumps in SS 316 construction for dosing of alkali solution may be provided.</div></div>			
	<div><div>CONTROL / OPERATION PHILOSOPHY</div><div><div>1) Complete Operation and Control shall be provided as described in relevant Subsections of Control &amp; Instrumentation System.</div><div>2) The pump suction valves; re-circulation valves and discharge valves shall be motor actuated type to enable remote operation.</div><div>3) Pump suction valves shall be provided with required limit switches for interlock &amp; control.</div><div>4) The pumps shall be designed to operate under discharge valve open and as well as in close condition.</div><div>5) Wherever more than one sump/tank is provided, Suction header shall be interconnected such a way that any of the sump/tank may be selected from the panel for operation.</div><div>6) Any of the pump shall be selectable as standby duty. Standby pump shall come into operation whenever tripping of working of working pump or inadequate pressure in the discharge header.</div><div>7) Suction and Discharge valves of pumps to interlock with start/stop of respective pumps.</div></div></div>			
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	<div><div>8)</div><div>Local emergency stop provision of each pump shall be kept.</div></div> <div><div>9)</div><div>All the working pumps shall be interlocked with the suction level or suction pressure condition. Pumps operation shall be interlocked with the high discharge condition so that the pump may not operate at shut-off pressure.</div></div> <div><div>10)</div><div>Automatic inlet valves at supply line to each of the tank/sump shall be provided so that the valves shall open and close at low-level and very high-level respectively.</div></div> <div><div>11)</div><div>A control valve shall be provided to maintain a constant pressure differential between the main supply and return headers of DM water (primary circuit of ECW system of unit auxiliaries). The valve will bypass flow to maintain a constant return header pressure to compensate for fluctuations in coolant flow to the process heat exchangers due to modulating control valves on the process coolers or if any cooler goes out of service in DM circuit</div></div> <div><div>12)</div><div>Alarm to indicate high differential pressure across self-cleaning filter strainers, heat exchangers.</div></div> <div><div>13)</div><div>Manually operating globe/regulating valves shall be provided in the water side of each of the cooler outlet for control of flow as specified in respective equipment specification.</div></div> <div><div>14)</div><div>Detailed Interlock &amp; protection logic shall be as finalized during detailed engineering.</div></div> <div><div>15)</div><div>Contractor must conduct Performance Guarantee (PG) Test of Plate Heat Exchangers (PHEs) in accordance with the procedure attached as Annexure II with this sub section.</div></div>			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 32 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<div>(D) CW CHEMICAL TREATMENT</div>			
1.00.00	<p>The minimum technical requirements and equipment shall include, but not be limited to the following:</p> <div><div>a) Complete Sulphuric acid handling, storage, unloading and dosing system.</div><div>b) Chemical day tanks shall be of MSRL construction with stirrer (SS/FRP lined) and Chemical adding facility from top. Dosing pumps compatible with handling of the chemicals shall be provided.</div><div>c) Acid (H<sub>2</sub>SO<sub>4</sub>) tanks shall be MS construction, horizontal, with dished (Toro spherical) ends.</div><div>d) The design C.O.C of the CW System shall be 5.0 (minimum) for design of Chemical Treatment program. Contractor shall include chemicals required (other than H<sub>2</sub>SO<sub>4</sub>, HCl &amp; NaClO<sub>2</sub>) for passivation of metals during commissioning also. Chemicals required after a major shutdown for re-commissioning the system shall also form part of the bidder's scope of supply.</div><div>e) Design of all vertical and horizontal cylindrical atmospheric storage tanks containing water, acid, alkali, and other chemicals shall conform to IS: 803 and BS: 2594 respectively. However, dished ends shall be of Tori spherical type.</div></div>			
2.00.00	<p>The bidder shall perform the <b>performance &amp; guarantee test</b> regarding the performance of chemical treatment program for complete CW system to meet the guarantees. The performance guarantee test will be carried out along with the initial operation.</p> <p>The O&amp;M for complete CW Treatment System shall be for one (1) year operation after PG test of complete CW System. The entire system responsibility and maintaining the guaranteed parameters of the system along with supply of chemicals shall rest with contractor during this period. The contractor shall depute his engineer(s) (as required by Owner) to continuously monitor the system and take corrective measures in this period. Complete chemical analysis and micro-biological analysis of water is to be carried out by the bidder periodically at least once in a fortnight. Periodic report on the performance of the treatment program along with analysis report chemical consumption pattern and observation/recommendation shall be furnished by bidder to site. At mutually agreed intervals, the performance and guarantee of the scale, corrosion, fouling and biofouling shall be monitored and verified.</p>			
3.00.00	<p>The Bidder shall offer proven type of chemical treatment program for CW system. Reference list of previous contracts for similar CW chemical treatment program which includes supply of chemicals, operation and maintenance of the system, shall be furnished to the employer during detailed engineering.</p>			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 33 OF 46



CLAUSE NO.	TECHNICAL REQUIREMENTS			
2.06.00	<b>CW Blow Down System</b>  The CW blow system shall be designed so that total quantity of CW blow down water can be led up to the Central monitoring basins of Liquid Effluent Treatment Plant for use in service water system in case of fluctuation of requirement of these consumers during operation of the plant.			
2.07.00	<b>Demineralized (DM) Water Make-up System</b>  a) DM water make-up system shall supply DM water to- <div>1) Cycle Make-up to the condensers 2) Make-up to the ECW System (Primary circuit) overhead tank, 3) Any other system envisaged by the contractor in design</div> b) The main storage for DM Water shall be provided in Water Treatment plant area.  c) A DM water makeup pump house shall be provided near the main DM Water Storage tanks of Water Treatment Plant. All the pumps and associated pumps, drives, Valves etc. shall be located indoor in this pump house.  d) For meeting above mentioned makeup requirement, a set of DM water pumps and one number pipe shall be provided by the Contractor. Pump re-circulation system shall be provided for the DM water pumps from the discharge to the DM tanks.  e) The makeup to the various tanks shall be controlled through the respective motor actuated inlet control valves based on the level in the respective Tanks.			
2.08.00	<b>Boiler Fill System</b>  Set of pumps and piping shall be provided in DM Water makeup pump house to meet the requirements of Boiler filling system. Pump re-circulation system shall be provided for the Boiler fill pumps from the discharge to the DM tanks. The filling operation to Boiler and Deaerator shall be controlled through the respective motor actuated inlet valves.			
2.09.00	<b>Potable Water System</b>  Potable water system shall meet the drinking water required for all the plant facilities/ buildings included in Contractor's scope and supply potable water up to the specified terminal point.  Potable water shall be pumped from the filtered water storage tank in Water Treatment Plant. Near the filtered water tank, one set of pumps and pipes shall be provided for supplying potable water to the plant facilities. The pumps, drives & associated valves, controls shall be located in the pump house (viz) filtered water pump house. Pump re-circulation system shall be provided for the potable water pumps.  The plant potable water network shall supply potable water required for all the facilities/ buildings/ areas included in Contractor's scope except make up water pump house & ash water recirculation pump house and shall fill the potable water tanks provided on roof top of each building to supply drinking water (PVC tank of capacity as specified in Civil Works sub section) to drinking water point /water coolers inside the building.			
2.10.00	<b>Air Pre-heater wash water System</b>  The system is required for washing of Air pre-heater.			
2.11.00	<b>Condensate Transfer System</b>  The system shall be able to supply emergency make up water to condenser from condensate storage tanks.			
2.12.00	<b>Various Sump Pumps, Drainage Pumps and Submersible Pumps</b>  1) For de-watering of drain pits in TG Hall, boiler area, transformer yard, cooling tower basins, underground pump sumps of raw water pump house, CW pump house, other			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 35 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<p>pump houses, pipe /cable trenches etc. sump pumps, drainage pumps and submersible pumps shall be used.</p> <p>2) Each pit shall be provided with two numbers (2 x 100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through with level measurements devices to be installed in the pit/sump.</p>			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 36 OF 46

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>									
	Annexure-1												
	HORIZONTAL CENTRIFUGAL PUMPS												
1.00.00	<b>SCOPE</b>  General requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of Horizontal Centrifugal Pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:												
2.00.00	<b>CODES AND STANDARDS</b>												
2.01.00	Design, material, construction manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Indian standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.												
2.02.00	<b>List of Applicable Standards</b>  i) IS : 1520 - Horizontal Centrifugal Pumps for clear cold fresh water. ii) IS : 5120 - Technical requirements of roto-dynamic special purpose pumps iii) API - 610 - Centrifugal pumps for general refinery service. iv) IS : 5639 - Pumps Handling Chemicals & corrosion liquids. v) IS : 5659 - Pumps for process water vi) HIS - Hydraulic Institute Standards; USA vii) ASTM-I-165-65 - Standards Methods for Liquid Penetration Inspection.												
3.00.00	<b>DESIGN REQUIREMENTS</b>												
3.01.00	The maximum efficiency of pumps shall be preferably within + 10% of the rated design flow indicated in data sheets.												
3.02.00	Total head capacity curve shall be continuously rising from the operating point towards shut - off without any zone of instability and with a minimum shut off head of 15% more than design head.												
3.03.00	Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble-free operation throughout the range. Components of identical pumps shall be interchangeable.												
3.04.00	Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation. <table><tr><td><b>Speed</b></td><td><b>Antifriction bearing</b></td><td><b>Sleeve bearing</b></td></tr><tr><td>1500 rpm and below</td><td>75.0-micron</td><td>75.0 micron</td></tr><tr><td>3000 rpm</td><td>50.0-micron</td><td>65.0 micron</td></tr></table> The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.				<b>Speed</b>	<b>Antifriction bearing</b>	<b>Sleeve bearing</b>	1500 rpm and below	75.0-micron	75.0 micron	3000 rpm	50.0-micron	65.0 micron
<b>Speed</b>	<b>Antifriction bearing</b>	<b>Sleeve bearing</b>											
1500 rpm and below	75.0-micron	75.0 micron											
3000 rpm	50.0-micron	65.0 micron											
4.00.00	<b>DESIGN CONSTRUCTION</b>												
4.01.00	Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature. The pumps shall be capable of starting with discharge valve fully open and close condition.												
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 37 OF 46									


CLAUSE NO.	TECHNICAL REQUIREMENTS	<div>एन टी पी सी NTPC</div>	
4.02.00	Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.		
4.03.00	<b>Impeller</b>  Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled		
4.04.00	<b>Impeller/ Casing Wearing Rings</b>  Replaceable type wearing rings shall be provided at suitable locations pumps.		
4.05.00	<b>Shaft</b>  The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.		
4.06.00	<b>Shaft Sleeves</b>  Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening		
4.07.00	<b>Bearings</b>  The bearings offered shall be capable of taking both the radial and axial thrust. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed.  Bearings shall be easily accessible without disturbing the pump assembly.		
4.08.00	<b>Stuffing Boxes / Mechanical Seals</b>  Stuffing boxes of packed ring construction type or mechanical seals shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements. If external gland sealing is required, it shall be done from the pump discharge. The Mech sealing face should be low frictional co-efficient & resistance to corrosion against the liquid being pumped.		
4.09.00	<b>Pump Shaft Motor Shaft Coupling</b>  The Pump and motor shaft shall be connected with a adequately sized flexible coupling of proven design with a spacer		
4.10.00	<b>Base Plate</b>  A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.		
4.11.00	<b>Assembly and Dismantling</b>  Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.		
4.12.00	<b>Drive Motor (Prime Mover)</b>  The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 10% above the maximum load demand of the driven equipment in the complete range.		
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM
			PAGE 38 OF 46



5.00.00

## Technical Data sheet of Pumps

No	Designation\Application	Clarified/Raw/ Treated water	DM water
1)	Operating Speed	1500 rpm (nominal)	
2)	Pumps and drives to be designed for	Outdoor duty & Continuous Operation	
3)	Type of lubrication	Grease	
4)	Suction condition	Flooded Suction	
5)	Type of Shaft Sealing	Gland packing	Mechanical Seal
6)	Type of coupling (motor & pump)	Flexible	
11)	Material of Construction		
i)	Casing, Stuffing Box, Gland	2.5% Ni CI IS210 Gr FG 260	ASTM A CF8M
ii)	Impeller	ASTM A351 CF8M	
	Wearing rings (if applicable)	SS – 316	
iii)	Shaft, Shaft Sleeves	SS-410	
iv)	Bolts & nuts	SS 316 for those encountering water and for others, material shall be high tension carbon steel.	
v)	Base plate (min 12 mm thick)	Carbon Steel (Epoxy Painted)	
7)	Accessories	a. Required Instrumentation b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts. c. Internal piping with valves, filters & Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc. d. Positioning dowels, Eye bolts, lifting etc. e. Ladders, Platforms & Other accessories	

CLAUSE NO.	TECHNICAL REQUIREMENTS			
	Annexure-2			
	VERTICAL PUMPS			
1.00.00	SCOPE			
1.01.00	This specification covers general requirements in respect of design, construction features, manufacture, inspection, and performance at Vendor's / sub-vendor's works delivery to site, erection field testing and commissioning of Makeup Water & Raw Water Pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:			
2.00.00	CODES AND STANDARDS			
2.01.00	The design, material, construction, manufacture, inspection, testing and performance of Vertical Pumps shall comply with all currently applicable statutes, regulations, and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Standards listed below. Other national standards are acceptable, if they are established to be equal or superior to the listed standards.			
2.02.00	List of Applicable Standards			
	IS: 1710	:	Vertical Turbine Pumps for clear cold fresh water.	
	IS: 5120	:	Technical requirement of rotor dynamic special purpose pumps.	
	HIS	:	Hydraulic Institute Standards U.S.A.	
	PTC 82 :	Centrifugal pumps-power test code		
	API 610:	Centrifugal pumps for general refinery purposes.		
3.00.00	DESIGN AND PERFORMANCE REQUIREMENTS			
3.01.00	The maximum efficiency point of the pumps shall preferably lie within 10% of the rated design flow.			
3.02.00	Pumps of a particular category shall be identical, suitable for parallel operation and provided with interchangeable components. Head vs. capacity and BHP vs. Capacity characteristic should match to ensure even load sharing and trouble-free operation throughout the range.			
3.03.00	The pumps shall have stable Head vs. Capacity characteristic continuously rising towards shut-off with the highest at shut-off and with an approximate shut-off head of 15% or more than the design head for radial flow pumps and 50% more than the design head for mixed flow/ turbine type pumps.			
3.04.00	The operating range of operation of pumps shall generally be 40% to 120% of rated flow for sustained period of operation.			
3.05.00	The power requirement of the pump shall be non-over loading type for mixed flow/ turbine type pumps.			
3.06.00	The critical speed of the pump shall be less than 80% of the rated speed or more than 130% of the rated speed. Also, the critical speed of the pump-motor assembly shall be more than the maximum reverse run-away speed.			
3.07.00	Pump shall run smoothly without undue noise and vibration. The vibration limit measured at motor end shall not exceed the limit specified in Hydraulic Institute Standards. The noise level shall not exceed 85 dBA overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.			
3.08.00	The base plate, foundation bolts, motor stool and other components shall be designed to take the full force coming on the discharge elbow under shut-off condition.			
3.09.00	Water for motor cooling and thrust bearing cooling, if required, shall be tapped from the discharge of the pumps and/or fed from an over-head tank. All piping, valves, strainer,			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	instruments etc. required for this purpose and line shaft bearing lubrication (if required) shall be provided by the Contractor.			
3.10.00	<b>Reverse Rotation</b>  a) The pump shall be provided with an approved mechanical device to protect reverse rotation on loss of drive motor power and failure of discharge valve to close.  b) a reverse rotation detection switch shall be provided to prevent starting of motor while rotating in reverse direction.			
3.11.00	<b>Motor Rating</b>  The pumps shall be capable of starting with discharge valve fully closed as well as fully open conditions. Motors shall be selected to suit to the above requirements. Continuous motor rating (at 50°C ambient) for all pumps shall be at least ten per cent (10%) above the maximum load demand of the driven equipment in the complete operating range (including run out condition) to take care of the system frequency/voltage variation.  Drive motors shall be connected directly to the line shaft of the pump.			
4.00.00	<b>DESIGN AND CONSTRUCTION</b>			
4.01.00	<b>Pump Type</b>  Pumps shall be of vertical shaft, single stage/multi-stage, submerged suction, complete with bowl, column & head assembly, and drive assembly. The pump design shall be of pullout/non-pull-out type as specified			
4.02.00	<b>Discharge head</b>  The pump discharge shall be of above-floor type/sub-floor type. In certain cases of pump installation where expansion joint is located immediately at the pump discharge, the pump assembly will be subjected to the unbalanced hydraulic thrust. A thrust pad will be built in with the discharge head for transmitting the hydraulic thrust to external structures such that this hydraulic thrust is not transmitted to the foundation bolts for which they may not be designed.			
4.03.00	<b>Column Pipe</b>  Column pipes shall be flanged and bolted and shall be complete with gaskets, nuts, and bolts.			
4.04.00	<b>Impeller</b>  The impeller shall be closed, or semi-open or open as specified elsewhere.			
4.05.00	<b>Wearing Rings</b>  Replaceable type wearing rings shall be provided for both casing and the impeller. For open impellers replaceable casing liners shall also be provided. The difference in hardness of the casing & impeller wearing rings shall be minimum 50 BHN.			
4.06.00	<b>Impeller &amp; Line Shaft</b>  Shaft size selected based on maximum combined shear stress must take into consideration the critical speed as per API - 610.			
4.07.00	<b>Pump &amp; Shaft Bearings - lubrication</b>			
4.07.01	Adequate number of properly designed bearings shall be furnished. The type of lubrication i.e., self-water lubrication or forced water lubrication shall be provided.			
4.07.02	<b>Self water Lubrication System</b>  The line shaft bearings shall be lubricated by the water being pumped. The main pump and line shaft bearings which are above minimum water level shall be of 'Thordon' type/			
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CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>																									
4.07.03	<p>equivalent. For other line shaft bearings located below minimum water level, cutless rubber bearings can be used.</p> <p><b>Forced water lubrication system</b></p> <p>The line shaft shall be provided with shaft enclosing tube to exclude pumped water from shaft and bearings.</p> <p>Lubricating water pumps shall be provided to supply lubricating water for bearings. These lubricating water pumps shall get supply from the overhead water storage tank.</p>																												
4.08.00	<p><b>Thrust Bearings</b></p> <p>Single thrust bearing at motor top or separate thrust bearings at pump and motor shall be provided to take care of hydraulic thrust and weight of the rotating assembly. Thrust bearing shall be spherical roller type or superior, capable of absorbing axial thrust in both directions of rotation. Water required for cooling of thrust bearing shall be taken from pump discharge, wherever applicable.</p> <p>The thrust bearing shall be rated for continuous operation with thrust as developed in shut-off condition with clearance between the wearing rings in worn out condition to be at least four (4) times the clearance between the wearing rings in new condition.</p>																												
4.09.00	<p><b>Pump Motor Supports, Base plate etc.</b></p> <p>The pump and motor shall have a common support. The necessary supporting frame, base plates, mounting plates etc. as required shall be supplied under this specification.</p>																												
4.10.00	<p><b>Stuffing Box</b></p> <p>Gland packing shall be provided at the top-of-the-line shaft. Shaft sleeves shall be provided at the stuffing box.</p>																												
4.11.00	<p><b>Assembly and Dismantling</b></p> <p>Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouted base/sole plate or alignment.</p>																												
5.00.00	<p><b>Technical Data Sheet (if not mentioned specifically elsewhere in the CW System technical specifications) of Pumps</b></p> <table><tr><th>SN</th><th>Description</th><th>Parameters</th></tr><tr><td>1</td><td>Designation</td><td>As applicable</td></tr><tr><td>2</td><td>Total No. of Pumps</td><td>As applicable</td></tr><tr><td>3</td><td>No. of Working Pumps</td><td rowspan="3">As applicable</td></tr><tr><td>4</td><td>No. of Standby Pumps</td></tr><tr><td>5</td><td>Guaranteed Flow &amp; Total Head (Guaranteed)</td></tr><tr><td>6</td><td>Operating Speed (Max.)</td><td>1500 rpm</td></tr><tr><td>7</td><td>Pumps and drives to be designed for</td><td>Outdoor duty &amp; Continuous Operation</td></tr><tr><td>10</td><td>Type of Pump</td><td>Vertical Wet Pit &amp; Non-Pull out type</td></tr></table>				SN	Description	Parameters	1	Designation	As applicable	2	Total No. of Pumps	As applicable	3	No. of Working Pumps	As applicable	4	No. of Standby Pumps	5	Guaranteed Flow & Total Head (Guaranteed)	6	Operating Speed (Max.)	1500 rpm	7	Pumps and drives to be designed for	Outdoor duty & Continuous Operation	10	Type of Pump	Vertical Wet Pit & Non-Pull out type
SN	Description	Parameters																											
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**CLAUSE NO.**
**TECHNICAL REQUIREMENTS**

13	Type of Discharge	Above Floor
14	Type of Impeller	Closed / Semi-open
16	Type of Lubrication	Forced water/ Self lubrication (as specified)
18	Minimum Water Level in sump	Min submergence level of pump plus 0.5.m
19	Maximum Water Level in sump	As per system requirement (Min 0.2 m below FGL)
21	Sump Invert Level	As per HIS
22	Operating Floor Level	Min. 0.5 M above FGL
23	Other dimensions of sump, Fore-bay etc	As per HIS & system requirement
25	Accessories to be provided with each pump	<p>a. Required Instrumentation</p> <p>b. Companion flanges with nuts, bolts and gaskets, Anchor bolts, nuts, sleeves and inserts.</p> <p>c. Internal piping with valves, filters &amp; Instruments for sealing/ cooling/ lubrication system up to and including isolating valve etc.</p> <p>d. Positioning dowels, Eye bolts, lifting etc.</p> <p>e. Ladders, Platforms &amp; Other accessories</p>
26	<b>MOC</b>	
i	Suction Bell, Casing / Bowl	2.5% Nickel Cast Iron, IS: 210 Grade FG 260; S-0.1% max. P-0.15% max.
ii	Casing Liner	Stainless steel (SS)
iii	Impeller	Austenitic SS ASTM A743/ CF8M Grade
iv	Wearing rings	SS-316
v	Impeller Shaft, Pump & line shaft, Pump & Shaft Coupling, Pump & Shaft Sleeves	SS - ASTM A 276 Gr. 410.
vi	Shaft bearings	Cutless rubber with bronze retainer for below minimum water level and Thordon type for above minimum water level.

vii	Column pipe	Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.
viii	Shaft Enclosing Tubes	Fabricated steel as per IS: 2062 (minimum thickness - 6 mm) with 2 coats of epoxy coating inside & outside.
ix	Discharge Head	Fabricated steel as per IS: 2062 (minimum thickness - 10 mm) with 2 coats of epoxy coating inside & outside.
x	Distance Piece (if applicable)	Fabricated steel as per IS: 2062 (min thickness 10 mm) with 2 coats of epoxy coating inside.
xii	Stuffing Box, Gland	2.5 % NI-CI to IS-210 FG-260
xiii	Gland Packing	Impregnated Teflon
xiv	Gaskets	Wire reinforced rubber gasket / Neoprene Rubber / Compressed Asbestos Fibre
xv	Ladders, Platforms & Other Accessories	Fabricated steel as per IS: 2062
xvi	Bolts & Nuts	Stainless Still AISI Type 316 for those coming in contact with water and for others material shall be High Tension Carbon Steel
xvii	Baseplate & Soleplate (min 12 mm thick), Matching flange	Fabricated steel as per IS: 2062

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	Annexure-3			
	SUBMERSIBLE PUMPS			
1.00.00	SCOPE			
1.01.00	This specification covers general requirements in respect of design, material, manufacture, construction, testing & inspection at Vendor's / sub-vendor's delivery to side, of submersible pumps. The minimum technical requirements and equipment shall include, but not be limited to the following:			
2.00.00	CODES AND STANDARD			
	The design manufacture and performance of submersible pumps shall be complied with all currently applicable statues, regulation, and safely codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable Indian standards listed below/equivalent standards.			
2.01.00	List of Applicable Indian Standards			
	IS: 8034 - Submersible pumps for clear cold fresh water			
	IS: 5120 - Technical requirement of Rotodynamic Special Purpose pumps.			
3.00.00	DESIGN AND PERFORMANCE REQUIREMENTS			
	a) The pump shall be of single stage mono - block type with non-clog design.			
	b) Components of Identical pumps shall be interchangeable.			
	c) Pumps shall have continuously rising head characteristics.			
4.00.00	MOTOR RATING			
	Continuous motor rating (at 50 deg. C ambient) for pumps shall be at least ten percent (10%) above the maximum load demand of the driven equipment in the complete operating range to take care of the system frequency variations.			
5.00.00	FEATURES OF CONSTRUCTION			
	a) Pumps shall be of Submersible, wet pit type.			
	b) Pumps shall be able to pass through solids up to 100 mm and capable of handling wastewater which may contain, sludge, plastic solids etc.			
	c) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable pump to be removed from the sumps without the necessity of dismantling any nuts, bolts etc.			
	d) Pumps shall be portable type and capable of using in any sump as and when required. Pump shall be provided with required stool, flexible, hose chain connection etc. for easy installation, removal, and maintenance. Adequate length of chain required for lowering the pump into the sump and flexible type discharge pipe shall be provided.			
	e) Impeller			
	Enclosed impellers shall be equipped with seal rings on their hubs. In case of open impeller, the pump shall be designed to take care of the additional thrust produced.			
LARA SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION – VI, PART-B	SUB SECTION A-15 CW SYSTEM	PAGE 45 OF 46

CLAUSE NO.	<div> <div>TECHNICAL REQUIREMENTS</div> <div>एनटीपीसी NTPC</div> </div>	
<div>1.00.0</div> <div>2.00.00</div> <div>2.01.00</div>	<div> <div>Annexure-4</div> <div> <b>Control philosophy for CW System, ECW and Auxiliary Water Pumps including Aux CT pumps etc.</b> <ol style="list-style-type: none"> <li>The Pumps shall be controlled from the Control Room. The start/stop commands of these pumps, all associated auxiliaries/drives including all the motor operated discharge valves, shall be routed through control system where all interlocks &amp; permissive shall be implemented and start/stop signals shall be issued to MCC/Switchgear. The operation of interconnecting valve and any other common drive shall be possible from pump house as well as DDCMIS. The exact details of the same shall be finalised during detailed engineering.</li> <li>A local push button switch shall be used for emergency tripping of the motor. The pump can be started either with pump discharge valve partially open or in closed position depending upon contractor's standard practice.</li> <li>Applicable for CW Pumps- The CW Pumps shall be controlled as specified in relevant chapters of Control &amp; Instrumentation. Pump can be started only when either at least one of the flow circuits through the respective condenser to the discharge duct and cooling tower is established or re-circulation line to pump sump is open.</li> <li>As applicable, an interlock shall prevent the starting of pump unless bearing lubricating water flow and motor bearing cooling water flow has been established over a period. Low flow of either pump or motor bearing cooling water when the pump is running will give alarm(s) and trip the pump with alarm in case of sustained low value over a preset time.</li> <li>Low flow of either pump or motor bearing cooling water when the pump is running will give alarm(s) and trip the pump with alarm in case of sustained low value over a preset time.</li> <li>In case of high pressure at pump discharge due to accidental closure of any of the butterfly valves, an alarm shall be generated.</li> <li>In case of normal stopping, when a pump control switch is turned 'OFF', the butterfly valve at its discharge shall first close (25-30) % before the respective pump motor is de-energized. On tripping of motor due to any reason, the butterfly valve at the discharge shall close fully automatically.</li> <li>If water level in pump sump is low, an alarm shall be initiated. Pump shall be tripped in case of very low level of water in the intake sumps and very high discharge header pressure.</li> <li>Regulating the CW system makeup valve shall control the water level in the sump/fore bay.</li> <li>Pump shall be tripped from very high winding temperature of motor and very high metal temperature of thrust bearings. Alarm shall be provided for high motor winding temperature and high motor/ pump bearing temperature.</li> <li>The operation philosophy as detailed above is suggestive only and <b>shall be finalized with the successful bidder after award of contract and shall be subject to Employer's approval.</b></li> </ol> </div> <div> <b>Instrumentation for CW System, ECW and Auxiliary Water Pumps including Aux CT pumps.</b> <p>Vibration monitoring system, if necessary, shall be provided. The alarm and trip signals from vibration system shall be connected to the Control system. Bidder shall provide Duplex temperature elements for bearing &amp; winding temperature monitoring points if specified. The excessive bearing/winding temperature shall be used for alarm and tripping of pumps/ motors. Further, Bidder shall provide required level &amp; pressure sensing instruments as specified elsewhere in relevant Subsections of Control &amp; Instrumentation and/or tender drawings.</p> </div> </div>	
<div>LARA SUPER THERMAL POWER PROJECT</div> <div>STAGE-II (2X800 MW)</div> <div>EPC PACKAGE</div>	<div>TECHNICAL SPECIFICATION</div> <div>SECTION – VI, PART-B</div>	<div>SUB SECTION A-15</div> <div>CW SYSTEM</div> <div>PAGE 46 OF 46</div>



# **SUB-SECTION–A-18**

## **FIRE PROTECTION AND DETECTION SYSTEM**

**FIRE PROTECTION AND DETECTION SYSTEM**
**1.00.00**
**GENERAL DESCRIPTION**

1.01.00

A comprehensive fire detection and protection system covering all the equipments/system/ buildings/areas of entire power plant under scope of the Bidder.

1.02.00

The complete Fire Detection and Protection Systems shall be as per the guidelines/ codes/ standards / rules of TAC/ NFPA / IS: 3034 /OISD, etc.

1.03.00

**Fire Water Source**

Water for the Fire Protection system shall be drawn from fire water storage tanks to be provided by the Bidder. Water for filling up the fire water storage tanks shall be drawn from the following two sources:

- a) From Circulating System blow down
- b) From raw water header as second source.

Fill in line from above two sources shall be in the scope of Bidder. Bidder shall interconnect the same to each of the fire water tank through individual motorized isolation valve. Raw water make-up line to tanks shall be provided with Basket strainer & an isolation valve (Gate Valve) of suitable size.

1.04.00

**Pressurization System**

This system consists of electric motor driven jockey pumps.

1.05.00

Minimum pipe size to be considered for hydrant and spray mains/ring headers shall be as follows:

Area	Minimum Pipe size in
Along CD bay hydrant/spray	300NB
Along A row hydrant/spray	300NB
Between boiler &ESP hydrant/spray	300NB
Main ring from switchyard to ESP hydrant/spray	300NB
CHP area main ring hydrant/spray	300NB

**2.00.00**
**HYDRANT SYSTEM**

Hydrant system shall consist of hydrant pumps, pressurization arrangement, water mains network, hydrant valves, landing valve, water monitors, hoses, branch pipes, nozzle, hose boxes, central hose houses etc.

**3.00.00**
**HVW AND MVW SPRAY SYSTEM**

3.01.00

**General**

It shall consist of spray pumps, pressurization arrangements, water mains network, deluge valves, alarm valves, flow switches, isolation valves, Y-type strainers, spray nozzles/projectors, spray nozzles piping network, detection system, instrumentation, local control panels, cables etc.

3.02.00

Spray system shall mainly comprise of the following:

- Automatic deluge valve (DV) assembly suitable size and trims
- Isolation Valve (Gate Valve) with limit switch at the upstream & downstream of each DV.
- Y-strainer of suitable size at upstream of each DV
- S.S Spray nozzles
- QB Detectors

CLAUSE NO.	TECHNICAL REQUIREMENTS	
<p>3.03.00</p> <p>3.04.00</p> <p>3.05.00</p> <p>3.05.01</p> <p>4.00.00</p> <p>4.01.00</p> <p>5.00.00</p> <p>5.01.00</p>	<ul style="list-style-type: none"> <li>Solenoids valve for each DV</li> <li>One (01) no. pressure switch each in detection line &amp; spray discharge</li> <li>One (01) no. limit switch for each isolation valve</li> <li>Local control Panel with relays and interface units for each DV</li> <li>GI piping for spray network at downstream of DV</li> <li>25NB M.S. Black wet detection piping network.</li> </ul> <p><b>For Stacker-Reclaimer machines:</b> Water for spray system shall be tapped from hydrant header running along the stock-yard. For this, combination of butterfly valves &amp; quick cam couplings (SS-304 construction) with one end flanged shall be provided at every 20M interval in the hydrant header running along the stock yard. Whenever, stacker-reclaimer is in stationary condition, a flexible hose (SS-304 construction) with suitable end coupling shall be connected to quick cam coupling installed on hydrant header. The other end of flexible hose shall be permanently connected to deluge valve.</p> <p>Criteria for taking two (2) spray pumps in service: While designing the HVW/MVW spray system for crusher house, LDO tanks, cable galleries TG Building &amp; ESP Building where flow of one spray pump of 410m<sup>3</sup>/hr may not be adequate, operation of two (2) spray pumps shall be considered.</p> <p><b>BLADDER TYPE FOAM PROTECTION SYSTEM</b></p> <p><b>GENERAL</b></p> <p>The fixed foam system of bladder tank foam proportioning type consist of skid mounted foam bladder tank assembly, foam makers, discharge outlets, interconnection piping, valves, fittings and instrumentation. Semi-fixed system consisting of a separate foam solution ring main around the tank with foam hydrant valves at regular intervals shall also be provided in addition to the water hydrants.</p> <p>The operation of the fixed foam system shall be automatic with the aid of dedicated fire detection system provided in the tank. The semi-fixed system shall be operated through the foam hydrants/ monitors, portable type foam water monitors (wheeled type with in-built foam maker), hoses and nozzles for extinguishing spill fire in and around the tank area.</p> <p><b>FIRE EXTINGUISHERS</b></p> <p>As indicated in Bidder's Scope (Refer Relevant Sub-section, Part A, Section VI).</p> <p><b>FIRE DETECTION, ALARM AND CONTROL SYSTEM</b></p> <p><b>Codes and Standards</b></p> <ol style="list-style-type: none"> <li>The design, manufacture, testing, performance, etc. of the various components of the analog addressable Fire Detection and Alarm System shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.</li> <li>Unless otherwise specified, the Fire Detection and Alarm System and the components shall conform to the latest applicable Indian or IEC Standards. Equipment complying with any other authoritative National Standards such as British, USA, VDE, etc. will also be considered, provided the parameters specified are equivalent or better than the corresponding IS.</li> <li>The Contractor shall be solely responsible for obtaining the required approval and clearance for the different components and systems of the Fire Detection and Alarm System from the following authorities, as applicable:</li> </ol>	
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B	SUB SECTION-A-18 Fire Detection & Protection System  Page 2 of 16

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	<div><div><div>i. Department of Atomic Energy (Certification of safety from Radioactivity).</div><div>ii. Central Building Research Institute, Roorkee.</div><div>iii. Central Mining Research Station, Dhanbad.</div><div>iv. Local Fire Authorities.</div></div></div>													
5.02.00	<div>The equipment and the system shall be of types approved by any of the following bodies, as applicable:</div> <div><div>a. Loss Prevention Council, (LPC), U.K.</div><div>b. National Fire Protection Association, (NFPA), USA</div><div>c. Under-writers laboratories, (UL), USA</div><div>d. Factory mutual (FM)</div></div>													
5.03.00	<div>General requirements for all types of Detectors</div>													
5.03.01	<div>Detectors shall be provided with the necessary compression type cable terminating glands for the incoming cables of flameproof type or PVC/metallic flexible/rigid conduits.</div>													
5.03.02	<div>The detector shall be located where the largest combustion gas concentration can be expected.</div>													
5.03.03	<div>Adequate compensation and considerations shall be made for effects for wind velocities such as air-conditioning system and exhaust fans where dilution of particles of combustion is greater.</div>													
5.03.04	<div>The exact location of detectors shall be coordinated with other services like air-conditioning grills, light fittings, cable trays etc. to provide aesthetically pleasing appearance. The return air paths of air-conditioning shall be avoided for detector location.</div>													
5.03.05	<div>The detectors shall not be affected by temperature, humidity; air flow or by drift failures and shall not give any false alarm due to above.</div>													
5.03.06	<div>The detectors shall not be sensitive to vibrations. Any special mounting arrangements required to counteract vibration shall be included in the contractor scope.</div>													
5.03.07	<div>The quantity of multi- sensor detectors in each zone shall be based on the coverage factor of 25-sq. meter per detector. However, the actual quantity of detectors required, taking into consideration obstructions due to floor beams, ventilation, doors, windows etc., shall be worked out and supplied (based on the actual layout) and installed by the contractor.</div>													
5.03.08	<div>The detectors shall not give false alarm due to high humidity, temperature, and velocity of air in the surroundings and static electricity conditions.</div>													
5.03.09	<div>Process actuated switch devices such as pressure switches, flow switches, level switches, etc. shall be provided with suitable individual addressable interface (local or remote) units or modules so that these devices are addressable from the panel.</div>													
5.04.00	<div>Infra-red Detectors</div> <table><tr><td>Application</td><td>Detection of Moving Fire on Coal Conveyors/Biomass conveyor as well as hot spot beneath the surface</td></tr><tr><td>Sensor type</td><td>Infrared</td></tr><tr><td>Working voltage(detection)</td><td>24 V DC</td></tr><tr><td>Working voltage(purging)</td><td>230 V AC / 24V DC as applicable</td></tr><tr><td>Purging type</td><td>Air purging</td></tr></table>				Application	Detection of Moving Fire on Coal Conveyors/Biomass conveyor as well as hot spot beneath the surface	Sensor type	Infrared	Working voltage(detection)	24 V DC	Working voltage(purging)	230 V AC / 24V DC as applicable	Purging type	Air purging
Application	Detection of Moving Fire on Coal Conveyors/Biomass conveyor as well as hot spot beneath the surface													
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Working voltage(detection)	24 V DC													
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5.05.00	Purging Unit		Either inbuilt blower or separate blower for purging			
	Location		Head of the conveyor			
	Features		1.	Ability to detect both black body and diffusion flame radiation.		
			2.	Reject electric arc, heaters, artificial light sources and sunlight etc		
			3.	Ability to function in heavily coal-dust prone atmosphere without regular maintenance		
			4.	Insensitive to vibrations		
	Annunciations		Trouble in purging, Fault Alarm, Trip LED, Power supply ON			
	Output Controls		Two nos. Change over contacts for Alarm & Trip			
	Accessories		Air purge unit including blowers, starter for blowers, hose pipe etc			
	<b>Linear Heat Sensor Cables</b>					
Application		Detection of Stationary fire				
Type		Digital				
Operating voltage		24 V DC				
Operating Temperature (Alarm):		70 Deg C for cable gallery				
		90 Deg C for conveyors				
Approval		FM/UL				
Conductor material		Steel				
Insulation		Heat sensitive polymer				
Outer Sheath		Black or colored PVC or flouropolymer suitable for the application environment				
5.06.00	<b>Installation features for LHSC/IR detectors</b>					
	1.	Mounting arrangement have been indicated in tender drawing.				
	2.	The detection zone/loop divisions of LHSC system shall match with MVW spray zones. Conveyors where LHSC shall be installed shall be divided into no. of various zones whereas conveyor for which IR detector is installed shall be considered as one zone.				
	3.	Linear heat sensing cable detector shall run in a zigzag fashion (with an included angle of 90 deg) on each top cable tray, bottom tray and every alternate intermediate trays of each section of cable tray without undue sagging and interfering the normal operations. All supporting materials for mounting of LHSC shall be provided by the bidder.				
	4.	Further, linear heat sensing (LHS) cable detector shall run in a zigzag fashion (with an included angle of 90 deg) in all vertical trays.				
	<b>Addressable Analog Intelligent Detectors</b>					
	In addition to the features specified under the item General requirements for all types of Detectors, the Addressable Analog Intelligent Detectors shall be provided with the following features:					
	a) Detectors not specifically listed for sensitivity testing from the control panel are not acceptable due to the expense involved with manual testing as required by NFPA 72E.					
	b) Each detector in a loop shall have short circuit isolator suitable for style-7 wiring as per NFPA-72.					
	c) The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system.					
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
5.07.00	<b>Multi sensor Detectors</b>	
5.07.01	Multi sensor detectors shall incorporate a heat detection element and a photoelectric detection element. Both the elements shall be incorporated in a single unit. Both the elements shall be operative at all times and the fire signal shall be available from any or both elements combined together.	
5.07.02	The detectors shall be sensitive to very low smoke densities of the order of say 0.05 g/m <sup>3</sup> . Also it shall be possible to adjust this sensitivity on a step less basis over a range so that the optimum sensitivity could be selected at site to suit the conditions of installations. The coverage area of the smoke detection under standard NFPA test conditions shall not be less than 80-90m <sup>2</sup> .	
5.07.03	In areas such as false ceiling where detectors themselves are not easily accessible, the remote response indicators outside the enclosed areas shall be provided to indicate the fire condition.	
5.08.00	<b>System Configuration</b>	
5.08.01	Each of the Addressable Fire Alarm panel shall be able to communicate with one another as well as with repeater annunciation panel and PLC based control panels located at different places. The detectors or other devices of any other unit/area shall be addressable only from the respective Addressable Fire Alarm Panel, so that each of the Addressable Fire Alarm Panel is under the control of designated operating personnel at that location. Facility to operate pumps of booster pump house and fire water pump house shall be provided from PC based monitoring station.	
5.08.02	At least one spare loop shall be provided in each of the addressable type fire alarm panel located in control equipment room and in CHP control room with complete loop card and all other accessories so that Employer can expand the system in future. Further, at least 10% of loop capacity be left free in each of the connected loop in all the panels, so that, additional devices may be connected to the system in any of the loop by Employer in future.	
5.08.03	Fire system (as a whole including PLC control systems) shall be provided with necessary interface hardware and software for dual fibre optic connectivity & interconnection with station wide LAN for two –way transfer of signals for information sharing. The information shall be made available through Ethernet link following TCP/IP standard. The system shall be OPC compliant. All required plant data shall be transferred ensuring complete security. The exact number of points shall be finalized during detailed engineering.	
5.09.00	<b>Analog Addressable Fire Detection and Alarm System</b>	
5.09.01	General Requirements	
5.09.02	This specification in general covers the functional requirements, and general design aspects of Microprocessor based, Analog Addressable Fire Detection Alarm / Annunciation and Control System.	
5.09.03	<p>The following description intends to describe only the brief hardware and functional requirements, scope of hardware requirements etc. but the actual configuration of the system shall be in line with the prevalent normal practices in the industry and shall conform to latest product range of selected manufacturer.</p> <p>The fire detection and control system offered shall be complete in all respects for the safe and reliable operation of the entire system. Any additional hardware/software than those</p>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS	
	mentioned herein required to make the system complete shall be included in the scope of the Bidder.	
5.09.04	Conventional detectors with interface modules are not acceptable. Each zone of LHSC detector and each IR detector shall be provided with interface module.	
5.09.05	All the fire detection systems, process actuated switch devices such as pressure/flow/temperature switches and relays of control functions shall be hooked up with the analogue addressable fire detection and alarm system. Required addressable interface units shall be provided for various switch devices by the bidder to make them addressable.	
5.09.06	Bidder shall provide isolators at the start & end of the loop.	
5.09.07	<p>The complete system shall include, but not be limited to the following:</p> <ol style="list-style-type: none"> <li>Master system CPU.</li> <li>Analog Addressable Fire Detection and Alarm System panels including alarm modules, system supervisory control modules, auxiliary output control modules etc.</li> <li>PC based monitoring station with colour graphic display terminal with programming and historical archiving facility along with laser printer.</li> <li>Power supplies, batteries and battery chargers.</li> <li>Analog addressable type smoke detectors.</li> <li>Non addressable type conventional detectors (Linear heat sensing cable detector/infra red type heat detector) and switching devices each with its own addressable interface modules.</li> <li>Software and hardware as required for complete operation of the system.</li> <li>Complete Wiring/cabling including its conduits/trays/fixtures etc.</li> </ol>	
5.10.00	<b>System Functional Requirements</b>	
5.10.01	<p>The fire alarm panel shall evaluate the signals received from the detectors and shall handle the following functions:</p> <ol style="list-style-type: none"> <li>System self monitoring and fault signaling.</li> <li>Transmission of alarm and fault signals to the respective fire alarm panels and as well as in the repeater panel in fire station. Further, the panel shall activate a hooter/sounds in each of the area locally provided with fire/smoke detection system. Further, the system shall enable operation of spray system from the panel through monitoring station when the system operation is selected under remote, manual mode.</li> <li>Initiate control functions like stoppage of conveyor, closure of fire doors, shutdown of draft fans, air-conditioning and ventilation plant/ equipment, opening smoke extraction vents, switching on smoke extraction equipment, emergency lighting etc.</li> <li>Triggering stationary extinguishing systems such as clean agent system.</li> <li>Supervising of unauthorised removal of a detector head from its base and giving a fault alarm on the control panel.</li> <li>Supervising and monitoring the detection cabling, to indicate fault conditions in case of open/short circuit in the wiring.</li> <li>Supervising by a separate annunciation window, changeover from mains supply to battery supply. "Mains On" indication shall be continuously on, as long as the main supply is available.</li> <li>Facilitating simulation of fire conditions to enable the testing of circuits (without creating actual fire) under the test mode from the fire Alarm panel.</li> <li>The control unit shall contain all the systems main switches lamps and fuses. Switches and lamps shall be easily identified even in closed casings.</li> </ol>	
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
5.10.02	<p>10. All the circuits from the detectors to the panels and the circuits from panels to the actuating/operating devices of the respective extinguishing system shall be of closed loop type and shall be supervised for open-circuiting and short-circuiting of cables. The cable fault shall be audio-visually annunciated on the panels. Separate hooters with different tones shall be provided for 'fault' alarms and 'fire' alarms.</p> <p>11. Actuate solenoid valve in spray system in case of fire from respective fire alarm panel. For achieving this if any additional hardware is required like relays, power supply and cables, the same may be provided.</p>			
	<p><b>Analog Addressable Fire Detection and Alarm System shall also meet the following functional requirements:</b></p>			
	i.	Each of the system shall support analog addressable detectors of all types, non-addressable type detectors/devices along with its addressable interface units/modules, Video display units etc.		
	ii.	Each of the devices and/or detectors shall be individually, uniquely and continuously addressable by the panel to which it is connected.		
	iii.	Detectors shall be interrogated for sensitivity settings from the control panel, logged for sensitivity changes indicating the requirement for cleaning and tested by a single technician using the field test routine. Sensitivity of each of the detectors made available in the panel shall be adjustable from the panel.		
	iv.	The system shall be capable of self-adjustment to compensate for the accumulation of contaminants that would change the detector sensitivity in either a more or less sensitive direction to prevent false indications or failure to alarm in the actual fire conditions. The system shall annunciate a trouble condition when any analog addressable smoke detector reaches 80% of its alarm threshold due to gradual contamination, signaling the need for service and eliminating unwanted alarm.		
	v.	Continuous supervision/monitoring of all the circuits and its components shall be made available from the panel for open, short circuits and grounding.		
	vi.	The system shall be able to recognize and indicate and alarm condition in a degraded mode of operation, in the event of processor failure or the loss of system communications to the circuit interface panels.		
	vii.	The system shall be programmable at site and required hardware shall be included in the scope of supply. The system software Programs shall be password protected and shall include full upload and download capability. During program upload or download the system shall retain the capability for alarm reporting. The system shall download to a PC for program editing. The software shall eligible employer to add the spare loop provided in the fire alarm panel or addition of additional devices/detectors in and of loop in any of the fire alarm panel.		
	viii.	The system shall support the use of color interactive History Reporting video display terminal for the display of information in an appropriate format.		
	ix.	The system shall include software for system database, historical event log, logic and operating system. The system shall require no manual input to initialize in the event of a complete power down condition. It shall return to an on line state performing all programmed functions upon power restoration.		
	x.	Software logic modules and system database shall be programmable using a windows compatible program on PC. It shall be possible to program or edit the system database off site after down loading from the panel.		
	xi.	All detectors shall incorporate internal automatic temperature compensation to overcome the effects of either high or low ambient temperatures in the installed environment on the detector sensitivity. The detectors shall be tested at a specified frequency by raising the detector sensitivity level to the alarm threshold, to check the operation of the detector without system alarming automatically by the control panel.		
	xii.	In an alarm or trouble condition the following shall occur on the monitoring		
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CLAUSE NO.	TECHNICAL REQUIREMENTS												
<div>5.11.00</div> <div>5.13.00</div> <div>5.13.01</div> <div>5.13.02</div> <div>5.13.03</div> <div>5.13.04</div> <div>5.14.00</div> <div>5.14.01</div> <div>5.14.02</div>	<table border="1"> <tr><td></td><td>station:</td></tr> <tr><td></td><td>1. Sound an audible.</td></tr> <tr><td></td><td>2. Write details of the actuation to a system log file on the PC.</td></tr> <tr><td></td><td>3. Print the details of the actuation to the system printer.</td></tr> <tr><td></td><td>4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.</td></tr> <tr><td>xiii.</td><td>System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.</td></tr> </table> <p><b>Panel Display Requirements.</b></p> <p>System display shall consist of minimum 80 character back lighted alphanumeric LCD display readable at any angle. Thirty-two character customer defined custom messages shall describe the location of the active device. In addition to the above, the following features shall be available.</p> <ol style="list-style-type: none"> <li>The system shall be capable of programming to allow troubles occurred and restored in the system to be automatically removed from the display queue, eliminating the necessity for individual acknowledging of these events. This feature shall not affect the historical logging of events as programmed.</li> <li>As a minimum an LED display for “Alarm”, “Audible Silenced”, “Supervisory”, “Trouble”, “Security”, “Power On”, And “Partial System Disabled”.</li> <li>Touch activated membrane switches for “Alarm Acknowledge”, “Audible Silence”, “Supervisory Acknowledge”, “Security Acknowledge”, “Reset”, “Display Hold”, And “Display Next”.</li> <li>All membrane switches shall be tactile with audible feedback when pressed.</li> </ol> <p><b>Power Supply for Fire Alarm Panels &amp; Repeater Alarm Panel</b></p> <p>One set of 24V DC redundant power supply system comprising of 2 x 100% chargers and 1 x 100% batteries shall be provided for each fire alarm panel and repeater alarm panel. The batteries for fire alarm system shall be sealed maintenance free lead acid type. The battery backup for each fire alarm panel and repeater alarm panel shall be 24 hours and 30 minutes (in alarm conditions). At least 25% of the devices shall be considered to be active in alarm conditions. Each of the redundant chargers shall be sized to meet connected load requirements and keep the connected batteries full charged (Float Mode). Furthermore, the charger shall be sized to enable the boost charge of a fully discharged battery in 10 hours while feeding the load.</p> <p>The batteries shall be sized as per relevant IEEE standard. For battery sizing calculation, an aging factor of 0.8, a temperature correction factor (based on temperature of 4 deg. C), voltage drop of 2V in cables. Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering.</p> <p>The battery chargers and batteries shall be placed at a suitable location inside the fire alarm panel with partitions.</p> <p>The detailed specification related to power supply system of fire detection &amp; protection system shall be as specified in other sections of the technical specification.</p> <p><b>Control &amp; Instrumentation requirements</b></p> <p>The specification for PLC control system for fire protection system shall be as specified in other sections of the technical specification.</p> <p>The specification for PC, printer and other HMI items shall be as specified in other sections of the technical specification.</p>		station:		1. Sound an audible.		2. Write details of the actuation to a system log file on the PC.		3. Print the details of the actuation to the system printer.		4. Activate the color graphic display system controls, providing functions such as zooming, scrolling of Alarms, troubles, etc.	xiii.	System configuration shall be menu driven and capable of being operated by a person with no previous computer programming experience.
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SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE	<div>TECHNICAL SPECIFICATIONS SECTION-VI PART-B</div> <div>SUB SECTION-A-18 Fire Detection &amp; Protection System</div> <div>Page 8 of 16</div>												

CLAUSE NO.	TECHNICAL REQUIREMENTS																			
5.14.03	The specification related to Basic design criteria, Measuring Instruments, Process connection & piping, Control panels, Type test requirements etc shall be as specified in other sections of the technical specification.																			
5.15.00	<p><b>Cabling for fire alarm system</b></p> <p>All instrumentation cables twisted &amp; shielded, FRLS PVC insulated and sheathed data highway / fibre optical cables, short term fire proof cables including prefabricated cables (with plug-in connectors) etc shall be provided by Contractor.</p> <p>The contractor shall follow the cable philosophy as below:</p> <table><tr><th colspan="2">Application</th><th rowspan="2">Type of cable</th></tr><tr><th>From</th><th>To</th></tr><tr><td>PLC cabinets</td><td>PC, Printers etc.</td><td>As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is&gt;300 M &amp; coaxial cable if length&lt;300 M</td></tr><tr><td>Detectors (including detectors mounted inside panels) /Any loop device</td><td>Detector (including detectors mounted inside panels) / Isolator/ Interface unit</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr><tr><td>Detectors (including detectors mounted inside panels) / Isolator / Interface Unit</td><td>JB</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr><tr><td>JB</td><td>Fire alarm Panel</td><td>Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.</td></tr></table> <p><b>Notes:</b></p> <ol style="list-style-type: none"><li>10% spare pair shall be provided for all cables having more than four pairs.</li><li>Type "S" cable shall be multicore control cable having overall shielding &amp; specification similar to instrumentation cable except insulation thickness and voltage grade which shall be 1100 V. Type "S" cable shall also satisfy requirements of Article 760 of NFPA 70.</li><li>Over and above, contractor may note that short term fire proof cables shall be provided for coal handling plant and inert gas protected areas. Short term fire proof cables shall be Mineral insulated copper conductor and copper sheathed type satisfying requirements of Fire resistance, safety in the industrial application areas mentioned in the specification and also, shall be approved by UL standards and certified by LPCB. The contractor shall provide all the cables so as to complete the system</li><li>Cable size of 2 core 1.5 sq.mm shall be used for loop wiring in-case of both control cable and short term fire proof cable.</li><li>Cable size of 2 core 2.5 sq.mm shall be used to provide power supply to various devices in the loop in-case of both control cable and short term fire proof cable.</li><li>The detailed specification of instrumentation cables and optical fiber cable shall be as specified in other sections of the technical specification.</li><li>Detector cables outside the building shall be corrugated steel taped armoured laid through cable trays wherever available and for rest of the areas, cable shall be buried at 600 mm depth with sand filling and brick covering at the top.</li><li>Detector cable within the building shall be either unarmoured &amp; laid through galvanized iron (GI) conduits or armoured cables, as per the standard and proven practice of the manufacturer.</li></ol>			Application		Type of cable	From	To	PLC cabinets	PC, Printers etc.	As Mfr.'s Standard. However, connection between PLC and the remote I/Os shall be through fibre optic cable by Bidder if length is>300 M & coaxial cable if length<300 M	Detectors (including detectors mounted inside panels) /Any loop device	Detector (including detectors mounted inside panels) / Isolator/ Interface unit	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.	Detectors (including detectors mounted inside panels) / Isolator / Interface Unit	JB	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.	JB	Fire alarm Panel	Shielded, Twisted, PVC Cu. FRLS cables type "S" Refer Note 2, 3, 4 and 5 below.
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SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION-VI PART-B	SUB SECTION-A-18 Fire Detection & Protection System																	
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CLAUSE NO.	TECHNICAL REQUIREMENTS
5.16.00	<p><b>Detection System for Conveyors</b></p> <ul style="list-style-type: none"> <li>i) <b>Linear Heat Sensor Cables for coal/biomass/limestone &amp; gypsum conveyors:</b> <ul style="list-style-type: none"> <li>a) The LHS cable detector for each conveyor to be provided for both forward and return conveyors and shall be mounted as per the standard practice of the manufacturer/supplier. Suspension of LHSC through flexible chains is a preferred arrangement. Further, LHS cable shall also be provided for return side of conveyors inside the bunker house.</li> <li>b) The detection zone/loop divisions of LHSC system shall match with the MVW spray system.</li> <li>c) Upon detection of fire either by QB detector or LHSC detector, the spray system shall be initiated. It shall also initiate spray system for the two adjacent zones after a time delay settable at site.</li> <li>d) The LHSC detector shall be provided with suitable interface unit, which shall generate/ make the signal compatible with fire alarm panel.</li> </ul> </li> <li>ii) <b>Infra Red Detector for coal/biomass conveyors:</b> <ul style="list-style-type: none"> <li>(a.) The infra red type (IR) detectors shall be suitable for detecting moving fires in conveyors. The IR detector shall stop the conveyor upon detection of fire and give audio-visual annunciation locally and in fire alarm panel.</li> <li>(b.) Each of the IR detector shall be provided with its own purging arrangement using blowers, hoses, etc and required power supply shall be derived from the fire alarm panel. Alternatively, bidder may offer separate blowers (2x100%) for purge air supply for all the detectors and the complete air piping from the blowers to each of the IR detector shall be provided by the bidder.</li> </ul> </li> </ul>
5.17.00	<p><b>Detection System of Cable Galleries &amp; Cable Trestles</b></p> <ul style="list-style-type: none"> <li>i) In cable galleries, MVW spray system shall be actuated either by detection of fire by Linear Heat sensing cable detectors or by fire signal from Multisensor detection system. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously.</li> <li>ii) In cable trestle, MVW spray system shall be actuated by detection of fire by Linear Heat sensing cable detectors. Apart from the automatic operation of spray system in the detected zone, the adjacent two zones shall also be sprayed with water automatically after a set time delay simultaneously.</li> <li>iii) The detection zone/ loop divisions shall match with MVW spray zones.</li> </ul>
5.18.00	<p><b>Multisensor Detection System</b></p> <ul style="list-style-type: none"> <li>i) Upon detection of fire, multisensor detector shall be annunciated in the respective panels and shall activate a local hooter/sounder in the areas where fire is activated and this fire signal shall be employed to initiate the fire extinguishing system of that area such as automatic MVW spray system of cable galleries, fire extinguishing system of Control rooms/Control Equipment Rooms.</li> <li>ii) Cross zoning of the signal from two adjacent multisensor detectors shall be employed to initiate the fire extinguishing system of inert gas protected areas and MVW spray system of cable galleries.</li> <li>iii) Multisensor detector shall be provided for return air ducts of main plant, which shall consist of intake probe, detector housing, and exhaust pipe etc. The detector shall be mounted outside the duct.</li> <li>iv) The design coverage area for detectors (to be considered) shall not exceed 25 Sq.M. for each detector.</li> </ul>
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE	<div>TECHNICAL SPECIFICATIONS SECTION-VI PART-B</div> <div>SUB SECTION-A-18 Fire Detection &amp; Protection System</div> <div>Page 10 of 16</div>



CLAUSE NO.	TECHNICAL REQUIREMENTS	
<p>8.00.00</p> <p>8.01.00</p>	<p>xii) Main fire water storage tanks: Two numbers each of 50% capacity vertical cylindrical column supported fixed cone roof type fire water storage tanks made of MS alongwith foundation shall be provided by the bidder. To avoid vacuum creation inside the tank, two (2) nos. vents each of size 300 NB shall be provided on the roof of the tanks. Bidder shall ensure that the total capacity of fire water storage tank shall be as per the recommendation of TAC with a minimum capacity of each tank equal to 2300 m<sup>3</sup>. Each tank shall be provided with ultrasonic type level transmitter and level indicators, etc.</p> <p><b>PIPING AND VALVES</b></p> <p><b>General Data for Pipes etc.</b></p> <p>i) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) &amp; as per IS:3589 Gr 410 (above 200 NB) or Equivalent for pipes normally filled with water.</p> <p>ii) Mild steel as per IS:1239 (Part-I) medium grade (upto 150 NB) &amp; as per IS:3589 Gr.410 (above 200 NB) or Equivalent and galvanised as per IS:4736 for pipes normally empty and periodically charged with water and foam system application.</p> <p>iii) Pipe protection shall be as follows: To prevent soil corrosion buried pipes / pipes in trench shall be properly lagged with corrosion protective tapes of coal tar type as per IS:15337 or AWWA C 203. The total thickness of protective tapes to be applied on buried pipes / pipes in trench shall be 4.0mm. This can be achieved by using 4.0mm thick tape in single layer or 2.0mm thick tape in double layer.</p> <p>iv) Pipe thickness: a) For Pipe sizes upto 150 NB: As per IS:1239 Part-I medium grade. b) For Pipe sizes 200 NB and above refer <b>Annexure-I</b>.</p> <p>v) All valves shall be as per applicable IS/BS codes &amp; approved by TAC for specific fire protection system and shall be provided with locking arrangement (with locks) in open or close condition. Further, all gate/butterfly valves of size 200 mm &amp; above shall be provided with spur gear reduction unit.</p> <p>vi) All the flanges and counter flanges shall conform to ANSI B 16.5 CI 150.</p> <p>vii) Strainer Body as per IS: 2062 (tested).</p> <p>viii) Pipe Fittings 1) The material shall conform to ASTM A 234 Gr WPB or ASTM A 105 or equivalent and dimensional standard conforming to ANSI B 16.11 (socket &amp; threaded type), ANSI B 16.9 (for butt welded fittings) and ANSI B 16.5 (for flanges and flanged fittings) as the case may be. Further, galvanised malleable cast iron fittings as per IS:1879 in Cast iron fitting as per BS-1641 are also acceptable. 2) <b>Grooved couplings:</b> Vendor may also use mechanical grooved couplings type fittings in GI pipe lines for HVW / MVW spray system. All materials and products shall be either Underwriters Laboratories (UL) Listed or Factory Mutual (FM) Approved and installed in accordance with NFPA Standard 13 / equivalent Standard. 3) The fittings shall be galvanised as per IS: 4736 for galvanised pipe application. In case of branching connections from GI mains for spray piping network, socket may be welded for more than two pipe reduction instead of standard tees. 4) Fabricated fittings shall not acceptable up to pipe size to 300 NB. For sizes 350 NB and above, fittings may be fabricated as per BS: 2633/BS: 534.</p> <p>ix) Welding of galvanised iron pipes/fittings would be permitted provided the same is carried out by means of special electrodes suitable for the above application and the same shall be approved by Employer. After, welding, welded portions shall be applied with three coats of zinc silicate treatment/rich paint over one coat of suitable primer. Further, the Contractor shall provide proper zinc paint at the point of welding.</p>	
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B	SUB SECTION-A-18 Fire Detection & Protection System  Page 12 of 16

CLAUSE NO.	TECHNICAL REQUIREMENTS										
9.00.00	<b>PAINTING</b>										
9.01.00	All the Equipments shall be protected against external corrosion by providing suitable painting.										
9.02.00	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting.										
9.03.00	<b>Fire Water Storage Tanks:</b> <ol style="list-style-type: none"> <li>The Contractor shall clean the tank plates and structure steel before erection by wire brushing and air blowing. After erection of tank and hydro testing, tanks are subjected to surface preparation and painting as per procedure detailed below:</li> <li><b>Surface Preparation:</b> Outside/inside surface preparation shall be carried out by shot blasting as per SA2 ½.</li> <li><b>Inside surface painting:</b> One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of epoxy resin based finish paint with 25 micron as thickness of each coat.</li> <li><b>Outside surface painting:</b> One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of epoxy resin based finish paint with 25 micron as thickness of each coat.</li> <li><b>Outside bottom surface painting:</b> One coat of epoxy zinc phosphate primer of min. DFT of 30-35 micron followed by three (3) coats of coal tar epoxy paint with 25 micron as thickness of each coat.</li> </ol>										
9.04.00	<b>All Steel Surfaces (external) exposed to atmosphere (outdoor installation)</b> <ol style="list-style-type: none"> <li><b>Surface Preparation:</b> The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.</li> <li><b>Painting:</b> One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with three (3) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.</li> </ol>										
9.05.00	<b>All Steel Surfaces (external) inside the building (indoor installation)</b> <ol style="list-style-type: none"> <li><b>Surface Preparation:</b> The steel surfaces to be applied with painting shall be thoroughly cleaned before painting by wire brushing, air blowing, etc.</li> <li><b>Painting:</b> One (1) Coat of red oxide primer of thickness 30 to 35 microns followed up with two (2) coats synthetic enamel paint, with 25 microns as thickness of each coat. For plant at coastal area, epoxy resin based zinc phosphate primer followed by epoxy resin based paint pigmented with titanium di-oxide shall be used in place of enamel paints.</li> </ol>										
9.06.00	<b>Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc.</b> <p>Painting of all equipments/components of FDPS package shall be as per manufacturer's standard practice or as detailed below whichever is superior in quality.</p> <table border="1"> <thead> <tr> <th>Environment</th><th>Paint scheme</th><th>Total DFT</th></tr> </thead> <tbody> <tr> <td>Normal / Mild Corrosive Environment</td><td>Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)</td><td>Min 125 microns</td></tr> <tr> <td>Corrosive Environment</td><td>Primer- zinc filled epoxy</td><td>Min 200 microns</td></tr> </tbody> </table>	Environment	Paint scheme	Total DFT	Normal / Mild Corrosive Environment	Primer- zinc filled epoxy Finish – Aliphatic Polyurethane (shade RAL3000)(P.O Red)	Min 125 microns	Corrosive Environment	Primer- zinc filled epoxy	Min 200 microns	
Environment	Paint scheme	Total DFT									
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SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION-VI PART-B	SUB SECTION-A-18 Fire Detection & Protection System  Page 13 of 16									

**CLAUSE NO.**
**TECHNICAL REQUIREMENTS**

(as in coastal areas)

 Intermediate – Epoxy MIO  
 Finish – Aliphatic Polyurethane  
 (shade RAL3000)(P.O Red)

**10.00.00**

The hydrant and spray lines shall be overground. It shall be laid either on pedestals, trestles etc. However, if the layout does not permit laying of overground pipe in that case it shall be laid underground with the approval of Engineer.

**11.00.00**
**MULTIPURPOSE NOZZLE**

The multipurpose nozzle should be such that water under pressure is applied on fire in the form of a jet, spray or fog. Material of construction for multipurpose nozzle shall be as per manufacturer's standard.

**12.00.00**
**TYPE OF BUILDINGS**


Sl. No.	Area/Facility	Type of building
1.	Fire Water Pump House	The fire water pump house shall be single storeyed and single bay RCC superstructure. The building shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.
2.	Fire Water Booster Pump House	The fire water Booster pump House shall be housed in a shed. Sides shall be fully covered with external brick wall with provision for doors, windows, rolling shutters and supply & exhaust air fans.
3.	Foam System Shed	Shed with roof covering and side walls shall be provided for foam system including associated civil works for foam bladder tank foundations, grade slab, pipe pedestals, etc.

**PIPING THICKNESS:**

Pipes for sizes 200 NB & above shall confirm to IS: 3589 Grade 410. The final thickness shall not be less than that specified as per IS: 3589 as indicated below.

Nominal pipe Size (mm)	Outside Diameter (mm)	Wall Thickness (mm)
200 NB	219.1	6.3
250 NB	273	6.3
300 NB	323.9	7.1
350 NB	355.6	8.0
400 NB	406.4	8.0
450 NB	457	8.0
500 NB	508	8.0
600 NB	610	8.0




CLAUSE NO.	TECHNICAL REQUIREMENTS						
	Annexure-II						
	Technical Data:						
	1. Main Fire Water Pumps						
	Description	Hydrant	Spray	Hydrant Booster	Spray Booster*	Jockey	
	Number of pumps	4(3 motor driven & 1 diesel engine driven)	3 (2 motor driven & 1 diesel engine driven)	2 (1 motor driven & 1 diesel engine driven)	2 (1 motor driven & 1 diesel engine driven)	2 (both motor driven)	
	Design Capacity	410 m³/hr	410 m³/hr	171 m³/hr	410 m³/hr	75 m³/hr	
	TDH of pump (MWC)	105 (min) or as per system reqt.	105 (min) or as per system reqt.	45 (min) or as per system reqt.	45 (min) or as per system reqt.	105 (min) or as per system reqt.	
	MOC	Casing:IS:210 Gr. FG 260 (2.5% Ni), Impeller: Bronze IS:318 Gr.II, Impeller shaft, coupling :SS316					
	2. Hydrant Valve	Oblique female type as per IS:5290					
		MOC: Body/bonnet/stop valve/valve seat/trim : SS304/SS316					
	3. Water monitor	As per IS:8442 Type-I, Size: 75mm, Nozzle dia: 38mm					
		MOC: Water barrel/reducer/elbow: CS (seamless)/SS Nozzle: Copper alloy / SS confirm in to IS:3444					
	4. Water branch pipe & nozzle	As per IS:903 / IS:2871					
		MOC: Branch pipe: SS316 (Gr 4 of IS:3444) (both ends) Nozzle : SS316 (Gr 4 of IS:3444), Size: min 16mm & max 25mm					
	5. Water line Gate / Sluice Valve	- Design Code: a) IS:14846 or BS:5150 (for valves coming inside fire water pump house) b) BS:5150 (for valves at other locations) - Pressure rating: PN1.6 (as per IS:14846) / PN16 (as per BS:5150) -Working Pr. :12Kg/cm2					
MOC: Body/bonnet/Yoke/Wedge: CI to IS:210 FG-200 Spindle: SS to ASTM-A-276 type 410							
6. Check Valve	Below 50NB size			50NB & above			
	Design Code; IS:778 (below 50NB)			IS:5312 / BS:5153			
	MOC: Body/cover/flap: Leadcd tin bronze to IS:318 Gr. LTB-2			CI to IS:210 FG-200			
7. Butterfly Valve	Design Code: Double flanged or lugged wafer type of low leakage rate confirming to BS:EN:593/API-609/AWWA C-504 Pressure class: PN 16						
	MOC: Body & Disc: Cast Iron, Shaft: SS 410 / SS 420 Seat Rings: EPDM						
<b>Note:</b> *In case of front mill configuration, fire water spray booster pumps shall not be provided if found not required during detailed engg. However, in that case, TDH of main spray shall be 120MWC (minimum).							
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## **SUB-SECTION–A-23**

# **LP DOSING AND OXYGENATED TREATMENT SYSTEM**

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	LP DOSING AND OXYGENATED TREATMENT SYSTEM			
1.00.00	General			
1.01.00	Employer proposes to maintain chemistry of boiler feed water using Combined Water Treatment (CWT) using Oxygen Dosing in the feed water, generally as per the guidelines of EPRI, USA / VGB, Germany / CEGB, UK / relevant Japanese standard. The following parameters of feed water are proposed to be maintained:			
	Cation Conductivity	≤ 0.2 micro siemens / cm		
	pH value (25 deg. C)	8-8.5		
	Oxygen	20-200 ppb		
	Iron	≤ 10 ppb		
	Copper	≤ 2 ppb		
	Silica	≤ 20 ppb		
1.02.00	However, during startup or chemistry excursions, <b>All Volatile type of Treatment (AVT)</b> using ammonia dosing shall be used. The following parameters shall be maintained in case of AVT.			
	Cation Conductivity	≤ 0.25 ms / cm		
	pH value (25 deg. C)	9.0-9.6		
	Oxygen	≤ 7 ppb		
	Iron	≤ 10 ppb		
	Copper	≤ 2 ppb		
	Silica	≤ 20 ppb		
1.03.00	Sodium and Chloride limit in case of both CWT & AVT feed water shall be maintained upto 2 ppb each at Condensate Polishing Plant outlet. The proposed design features of the Condensate polishing plant is indicated in clause 3.07.00 of Sub Section A-1 (Equipment Sizing Criteria) of Part B, Section VI, book 1 of 5 of technical specification and considering the above the Boiler Feed Water Treatment System shall be designed, supplied and installed by the Contractor.			
1.04.00	The chemical regime given above is indicative only. Bidder shall furnish in his offer the appropriate chemical regime as per their practice, which shall be discussed & finalised in case of award.			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-B	SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM	PAGE 1 OF 4


CLAUSE NO.	TECHNICAL REQUIREMENTS																		
2.00.00	<b>Oxygen Dosing System</b> <p>Complete Oxygen Dosing System shall be supplied and installed by the Bidder. It is proposed to dose Oxygen at two (minimum) locations in the Condensate and in Feed water circuit of each unit. i.e. one at outlet of condensate polishing Plant and another at the outlet of deaerator (suction line to feed water pumps). Additional dosage points if required as per manufacturer's standard practice shall also be included by the Bidder.</p> <p>Each of the dosing locations shall be provided with a set of Oxygen cylinders with required cylinder isolation/check valves, cylinder manifolds, isolation valves in the common manifold, piping from manifold, dosing (automatic type) valves of regulating valve, check (non-return type) valve, Instruments for measurement of oxygen &amp; conductivity of condensate &amp; feed water lines at the downstream of dosing locations, associated control system etc.</p> <p>The dosing rate shall be regulated automatically by control system based on the quality of condensate water and feed water quality as the case may be. The control system shall facilitate selection of oxygen dosing locations. Regulating type valves shall be provided with isolation valves at upstream &amp; downstream end to facilitate replacement/repair of regulating valve.</p> <p>At each dosing locations, system shall be designed for a maximum dosage rate of 150 ppb and number of oxygen cylinders to supplied and installed by the Contractor shall cater for one-month requirement. However, the dosing facilities shall have redundancy of 100% for each location per unit. for each location per unit, skid containing equipment required for dosing like isolation/ check valves, cylinder manifolds, regulating valves, instruments shall be redundant (2 nos. for each location of one unit), so that problem in one dosing skid of one location shall not hamper dosing process at that location. The condensate and feed water flow shall be of the order of 1500 CU.M/hr for each unit or actual design flow whichever is higher.</p>																		
3.00.00	<b>All Volatile Treatment (AVT)</b>																		
3.01.00	For AVT, Bidder shall include in his scope all necessary hardware including storage tanks, measuring tanks, mixing arrangement, metering pumps, strainers, valves etc.																		
	However, minimum details for AVT are given below:																		
3.02.00	<b>Tanks</b> <p>Vertical and cylindrical design with dished/conical ends, SS-304 material of construction, shell thickness 3 mm for the tanks.</p>																		
3.03.00	<table><tr><td></td><td>Ammonia Measuring tank</td><td>Ammonia Mixing / storage tank</td></tr><tr><td>i)</td><td>Storage capacity (in liters)</td><td>125</td><td>2300</td></tr><tr><td>ii)</td><td>Nos.</td><td>1 No. / skid</td><td>1 No. / skid</td></tr><tr><td>iii)</td><td colspan="3">Concentration of aqueous ammonia solution shall be 29.4%</td></tr></table>					Ammonia Measuring tank	Ammonia Mixing / storage tank	i)	Storage capacity (in liters)	125	2300	ii)	Nos.	1 No. / skid	1 No. / skid	iii)	Concentration of aqueous ammonia solution shall be 29.4%		
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SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-B	SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM	PAGE 2 OF 4															

CLAUSE NO.	<div> <b>TECHNICAL REQUIREMENTS</b> </div> <div> </div>																				
3.04.00	<div> <b>Transfer pumps</b> </div> <div> <table> <tr> <td><u>Item</u></td><td><u>Ammonia pump</u></td></tr> <tr> <td><u>Description</u></td><td></td></tr> <tr> <td>Material (Pump internals in contact with chemicals)</td><td>SS-304</td></tr> <tr> <td>Capacity</td><td>To suit requirement</td></tr> <tr> <td>Nos. required</td><td>1 no. (1x100%) per unit</td></tr> <tr> <td>Concentration</td><td>30% concentration</td></tr> <tr> <td>Type of pump</td><td>Hand pump</td></tr> </table> </div>	<u>Item</u>	<u>Ammonia pump</u>	<u>Description</u>		Material (Pump internals in contact with chemicals)	SS-304	Capacity	To suit requirement	Nos. required	1 no. (1x100%) per unit	Concentration	30% concentration	Type of pump	Hand pump						
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3.05.00	<div> <b>Metering pumps</b> </div> <div> <table> <tr> <td><u>Item</u></td><td><u>Ammonia pump</u></td></tr> <tr> <td><u>Description</u></td><td></td></tr> <tr> <td>Material (Pump internals in contact with chemicals)</td><td>SS-304</td></tr> <tr> <td>Capacity (LPH)</td><td>0-50</td></tr> <tr> <td>Nos. required</td><td>2nos. (2x100%) per skid</td></tr> <tr> <td>Rated pressure</td><td>45 Kg/sq.cm(g)</td></tr> <tr> <td>Type of pump</td><td>Reciprocating Pump</td></tr> <tr> <td colspan="2"><b>CHEMICALS TO BE HANDLED</b></td></tr> <tr> <td>Normal</td><td>3% conc. Ammonia solution</td></tr> <tr> <td>Wet Laying</td><td>15% conc. Ammonia solution</td></tr> </table> </div>	<u>Item</u>	<u>Ammonia pump</u>	<u>Description</u>		Material (Pump internals in contact with chemicals)	SS-304	Capacity (LPH)	0-50	Nos. required	2nos. (2x100%) per skid	Rated pressure	45 Kg/sq.cm(g)	Type of pump	Reciprocating Pump	<b>CHEMICALS TO BE HANDLED</b>		Normal	3% conc. Ammonia solution	Wet Laying	15% conc. Ammonia solution
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3.06.00	<div> <b>MATERIAL FOR PIPING &amp; FITTINGS</b> </div> <div> <table> <tr> <td><u>Item</u></td><td><u>Ammonia pump</u></td></tr> <tr> <td><u>Description</u></td><td></td></tr> <tr> <td>Piping</td><td>SS-304 /316</td></tr> <tr> <td>Fittings</td><td>A 182 GR.F304/316</td></tr> <tr> <td>VALVES</td><td>A182 GR.F304/316</td></tr> <tr> <td>END CONNECTION</td><td>SW / ANSI B16.11</td></tr> </table> <p><b>Note:</b> Capacity of various tanks &amp; pumps etc. are tentative minimum. It is contractor's responsibility to design/size these tanks &amp; pumps depending upon system requirement / design and submit the same to Employer for approval. The minimum storage capacity for storage tanks of Ammonia shall be for 48 hours requirement.</p> </div>	<u>Item</u>	<u>Ammonia pump</u>	<u>Description</u>		Piping	SS-304 /316	Fittings	A 182 GR.F304/316	VALVES	A182 GR.F304/316	END CONNECTION	SW / ANSI B16.11								
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3.07.00	<p>Each unit shall be provided with a skid of ammonia dosing comprising of metering pumps (2x100%), strainer (2x100%), piping, valves, instrumentation etc. for both normal operation dosing as well as dosing required for wet laying of boiler. The capacity of tanks and parameters of pumps given are indicative &amp; minimum. Final parameters shall be as per system requirements.</p>																				
SINGRAULI SUPER THERMAL POWER PROJECT																					
STAGE-III (2X800 MW)																					
EPC PACKAGE																					
TECHNICAL SPECIFICATION																					
SECTION-VI PART-B																					
SUB-SECTION- A – 23																					
LP DOSING AND																					
OXYGENATED																					
TREATMENT SYSTEM																					
PAGE 3 OF 4																					


CLAUSE NO.	TECHNICAL REQUIREMENTS			
3.09.00	<b>Control and Instrumentation Requirements</b>			
3.09.01	The bidder shall supply all necessary Control & Instrumentation for satisfactory operation of dosing system. The control of system shall be through BOP C&I part of DDCMIS.			
3.09.02	The bidder shall supply all field instruments, devices as per the approved schemes as a minimum. These field instruments should confirm to requirements specified in the control and instrumentation section of this volume.			
3.09.03	It is intended to control dosing system from BOP C&I part of DDCMIS, including ON/OFF command of individual pumps. However, Bidder shall provide local prewired control panel complete with i) Start/stop push buttons ii) Indicating lamps iii) Local/Remote selection iv) Stroke position indicator v) Rise/Lower push buttons for stroke position vi) Local LED based annunciation driven by DDCMIS vii) Stroke position indicator on the panel.			
3.09.04	The normal mode of operation of dosing system shall be through BOP C&I part of DDC MIS. Local/Remote selection is to be done from Remote (CR) and indication for the same is to be provided on local panel.			
3.09.05	The ON/OFF commands for individual pumps from local push buttons shall act on the respective drives through BOP C&I part of DDC MIS.			
3.09.06	The stroke position and adjustment will be done by 4-20 mA D.C. signal from BOP C&I part of DDCMIS and the pumps stroke actuation should be suitable for accepting 4-20 mA D.C. signal. The pumps are to be provided with 24 V DC, two-wire LVDT type position feed back transmitter which will generate 4-20 mA signal indicating stroke position.			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-III (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI PART-B	SUB-SECTION- A – 23 LP DOSING AND OXYGENATED TREATMENT SYSTEM	PAGE 4 OF 4


# **SUB-SECTION–A-24**

## **ELEVATORS, CRANES AND HOISTS**

CLAUSE NO.	TECHNICAL REQUIREMENTS																							
1.00.00	SERVICE ELEVATORS, CRANE, HOIST & MONORAIL																							
	SERVICE ELEVATORS																							
	DESIGN CRITERIA AND OPERATIONAL SPECIFICATION																							
	Design																							
	Elevator shall be of conventional type for Service Building and TG building and of panoramic type with five glass panels on rear side for Administration Building. The elevator shall meet the quality of international standard. The quality of glass panel on rear should be of highest grade from safety point of view and should meet the best standard.																							
	No. of floors to be served shall be as per the specification and tender drawing of the Employer. Bidders shall quote variation in price for addition/deletion of one landing level in the relevant schedule of Forms and Procedures. However, bidder shall quote for above indicated landing levels in his base offer. No of floors and landing elevations are tentative only. The final landing elevations for all buildings shall be subject to approval by the Employer after award.																							
	Elevators shall be designed based on following criteria:																							
	<table><tr><td>i)</td><td>Design/construction/installation codes.</td><td>:</td><td>Latest edition of IS: 14665 (all parts)</td></tr><tr><td>ii)</td><td>Load carrying capacity</td><td>:</td><td>884 kgs. (equivalent to 13 persons) for passenger elevator for service building , TG building and Administration Building.</td></tr><tr><td>iii)</td><td>Rated speed</td><td>:</td><td>1.0 m/sec.</td></tr><tr><td>iv)</td><td>Position of machine room</td><td>:</td><td>Directly above the elevator shaft.</td></tr><tr><td>v)</td><td>Machine room</td><td>:</td><td>Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.</td></tr></table>				i)	Design/construction/installation codes.	:	Latest edition of IS: 14665 (all parts)	ii)	Load carrying capacity	:	884 kgs. (equivalent to 13 persons) for passenger elevator for service building , TG building and Administration Building.	iii)	Rated speed	:	1.0 m/sec.	iv)	Position of machine room	:	Directly above the elevator shaft.	v)	Machine room	:	Window air conditioner of minimum 2T capacity per elevator shall be provided by bidder.
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CONSTRUCTION																								
Construction of the elevators shall specifically meet all requirements of the codes indicated and shall have following additional features:																								
<table><tr><td>i)</td><td>Flooring of Cabin</td><td>:</td><td>Vitrified ceramic tiles of mat finish.</td></tr><tr><td>ii)</td><td>Car enclosure &amp; car panels</td><td>:</td><td>Stainless Steel</td></tr><tr><td>iii)</td><td>Handrails on 3 sides</td><td>:</td><td>Mirror Stainless Steel</td></tr></table>				i)	Flooring of Cabin	:	Vitrified ceramic tiles of mat finish.	ii)	Car enclosure & car panels	:	Stainless Steel	iii)	Handrails on 3 sides	:	Mirror Stainless Steel									
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SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B		SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL																				
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	iv)	False ceiling	:	Powder painted
	v)	Car opening & Hoist way opening	:	Protected by central opening sliding Stainless Steel door
	vi)	CABIN ACCESSORIES	:	The following accessories shall be provided : a) Recessed fluorescent light/LED fittings on car ceiling.  b) Car control station  c) Emergency stop switch.  d) 5/15A, 3 pin plug socket with switch on top of lift car. e) Switches with Braille characters.
	1. AUTOMATIC RESCUE DEVICE (ARD) - (BATTERY DRIVE):  Bidder to provide a modern Advanced electronic drive system of “RESCUING Passenger Trapped in a ELEVATOR”.			
	2. EMERGENCY SAFETY DEVICES :  The lift shall be provided with safety Device attached to the lift car frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the lift car up at governor tripping speed with full rated load in car.			
	3. Elevator shall have Floor announcement system & Braille switches			
	1.02.01	All steel embedment for fixing landing doors/indicators etc. to the Elevator well shaft and fascia plate shall be supplied by the Bidder.		
	1.02.02	Guide rails complete with supporting brackets for the car and counter weights. Bidder to take care of granite tiles (approx 80 kg) to be provided for cabin flooring in selecting counter weights.		
	1.02.03	Elevator drive machines complete with electric motor, reduction gear unit, suspension ropes, buffers for the cars and the counter weights and other drive and control mechanism. All foundation anchor bolts, sleeves, anchoring steel and any item required to complete the job satisfactorily shall be provided by the bidder. The bidder shall also provide for the grouting of anchor bolts, sleeves, anchoring steel, etc. and other anchorages		
	1.02.04	Any other steel works as well as all other accessories/components not specified in the specification but necessary for making the Elevator complete.		
1.02.05	All building work including the supply of steel items, associated with installation of equipment in the machine room hoist way, hoist way door, frames and Elevator pit, shall form part of bidders scope of service, Bidder shall also provide the Elevator-well complete with foundation			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B		SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
1.03.00	<p>and brick walls around the lit-well together with overhead machine room. The machine room will be provided with R.C.C. floor slab with necessary pockets for anchor bolts and slots.</p> <p>"Floor of machine room shall be as specified in the chapter "D-1-5" SALIENT FEATURES &amp; DESIGN CONCEPT" of the specification</p> <p><b>OPERATION</b></p>			
1.03.01	<p>Elevator shall have provisions to meet following operational requirements :</p> <p>a) Selective Duplex collective, automatic operation with or without attendant through illuminated push button station located inside the lift car.</p> <p>b) Door operating shall be automatic door operation and electronic door protection system for opening/closing of car and landing doors.</p> <p>c) Bidder shall provide car operating panel with luminous buttons, car position indication in car (both visual and audio) combined with direction arrows, overload warning indicator, battery operated alarm bell and emergency light and fan &amp; hands free speaker telephone set with suitable battery, charger &amp; controls.</p> <p>d) Bidder shall provide emergency indicator to indicate the location of elevator in case of elevator being stuck up between the floors through automatic flashers (both audio &amp; visual)</p> <p>e) Bidder shall provide electronic door detector (Infra red curtain type).</p> <p>f) Two push buttons, one for upward movement and the other for downward movement at each intermediate landing and one push button at each terminal landing shall be provided in order to call the car. Digital hall position indicator at all floors, tell lights at all floors shall also be provided by the bidder.</p> <p>g) For facilitating the movement of visually &amp; hearing impaired persons, hall lantern and car arrival chimes shall be provided.</p> <p>h) All fixtures shall be in stainless steel face plates.</p> <p>i) Push buttons shall be fixed in the car for holding the doors open for any length of the time required.</p> <p>j) All other safety/protection/operation interlocks as required by IS:14665 (latest edition).</p>			
1.04.00	<p><b>Elevator Electricals:</b></p>			
1.04.01	<p><b>Electric motor:</b></p>			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 3 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
1.04.02	<p>The driving motors shall conform to I.S 325 and suitable for the Variable Voltage Variable Frequency (VVVF) application. All motors shall be squirrel cage induction type, suitable for operation at 415V (+/- 10% variation) , 3 phase, 3 wire, 50HZ (+3% to -5% variation) supply. Motors shall be provided with thermal class 130 (B) or better insulation</p> <p>.</p> <p><b>Controls:</b></p> <p>The controls shall be Variable Voltage and Variable frequency type and shall provide smooth and constant acceleration and retardation under all conditions of operation. Suitable control panel shall be provided in the machine room.</p>			
1.04.03	<p><b>Cables and wiring:</b></p> <p>All the cables except trailing cables shall be as per IS:1554-1 or IS-7098-I. the PVC outer sheath of these cables shall be flame retardant, low smoke (FRLS) type with the following FRLS properties.</p> <p>a) Oxygen index of min. 29 (as per IS:10810 Part-58)</p> <p>b) Acid gas emission of max. 20% (as per IEC-754-I).</p> <p>c) Smoke density rating shall not be more than 60% (as per ASTM D-2843).</p>			
1.04.04	<p>The circular trailing cables shall be either in accordance with IS 4289 Part-I (Elastomer insulated) or IS-4289 Part-II (PVC insulated). The flat type trailing cables if offered shall be in accordance with IEC-60227-6.</p> <p>All wiring / cabling between the equipments in the lift machine room and that between the machine room and equipments in the lift well and at the landings shall be wired in HDP conduits/ galvanized steel conduits to be supplied by the contractor. Alternatively armored cables may be used.</p> <p><b>Earthing:</b></p> <p>The elevator structures and all Electrical equipment, including metal conduits shall be effectively earthed with the earth conductors provided in the machine room as per IS: 3043.</p>			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 4 OF 7

CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	<div>DATA SHEET</div> <div><div><div>i)</div><div>Type of services</div><div>:</div><div>Passenger</div></div><div><div>ii)</div><div>Load carrying capacity</div><div>:</div><div>As per specification</div></div><div><div>iv)</div><div>Rated speed</div><div>:</div><div>One (1) m/s</div></div><div><div>v)</div><div>Total Travel</div><div>:</div><div>TG hall- As per layout</div><div>Service Building- As per layout</div><div>Administrative Building- As per layout</div></div><div><div>vi)</div><div>No. of floor to be served</div><div>:</div><div>TG hall, Service Building &amp; administrative building: - To be decided during detailed engineering.</div></div><div><div>vii)</div><div>Method of control</div><div>:</div><div>Variable voltage variable frequency (VVVF)</div></div><div><div>viii)</div><div>Position of M/c room</div><div>:</div><div>Directly above lift shaft</div></div><div><div>ix)</div><div>Size of platform</div><div>:</div><div>As per IS14665 &amp; manufacturer's standard latest.</div></div><div><div>x)</div><div>Size of lift well</div><div>:</div><div>-do-</div></div><div><div>xiii)</div><div>Specification code</div><div>:</div><div>As per IS:14665 (5 parts) (Latest Edition).</div></div><div><div>xiv)</div><div>Design seismic coefficient</div><div>:</div><div>According to the IS 1893-1977</div></div></div>			
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 5 OF 7

CLAUSE NO.	<b>TECHNICAL REQUIREMENTS</b> 
<p>2.00.00</p> <p>2.01.00</p> <p>2.02.00</p> <p>2.03.00</p> <p>2.04.00</p> <p>2.05.00</p>	<p><b>CRANE, HOIST &amp; MONORAIL</b></p> <p>Suitable EOT Crane/HOT Crane/Monorail beams with hoists/Chain Pulley Blocks of adequate capacity, to meet the erection and maintenance requirements are to be provided by the vendor for the various areas/equipment. Some of the areas/equipment not covered by TG hall EOT cranes are indicated below. For balance areas/equipment, not listed hereinafter, the requirements of Specification shall be followed.</p> <ul style="list-style-type: none"> <li>(a) Feed water heaters &amp; deaerator (Applicable Hoists/Chain pully block for maintenance purpose shall be provided).</li> <li>(b) Various pumps &amp; Heat Exchangers.</li> <li>(c) Condenser Water Boxes (front &amp; rear), (Applicable If hinged type water box not envisaged)</li> <li>(d) CW Butterfly Valves</li> <li>(e) Vacuum Pumps</li> <li>(f) Control Fluid Room</li> <li>(g) Auxiliary cooling water (clarified) pumps and DM cooling water pumps of ECW systems.</li> <li>(h) Central Lube Oil System room.</li> <li>(i) Any other equipment.</li> </ul> <p>The above requirement is indicative only, the requirement given in the respective chapter is to be adhered to.</p> <p>The EOT cranes shall be designed as per IS-3177 (Latest edition) class -2 duty and the monorail hoists (hand operated ) shall be designed to duty class 2 to IS 3832. Electrical wire rope hoist shall be designed as per IS:3938 (latest).</p> <p>The design, manufacture inspection and testing of the crane shall comply with the requirement of latest version of IS:3177</p> <p>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.</p> <p>For the hoists with more than 2.0 ton lifting capacity or more than 10.0 M lift, motor operated hoist block for both long travel and lift shall be provided. Other hoist blocks shall be of hand operated type for both travel and lift. However, all monorails coming out of the building shall be provided with electric hoist block, irrespective of load and lift.</p> <p>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.</p> <p>The operator shall be able to control the movement of the monorail hoist with the help of floor operated pendant. The creep speed for vertical movement shall also be provided as per the system requirement.</p>
<p>SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE</p>	<p><b>TECHNICAL SPECIFICATIONS</b> <b>SECTION – VI, PART-B</b></p> <p><b>SUB-SECTION-A-24</b> <b>SERVICE ELEVATORS</b> <b>CRANE, HOIST &amp;</b> <b>MONORAIL</b></p> <p><b>PAGE</b> <b>6 OF 7</b></p>

CLAUSE NO.	<div>TECHNICAL REQUIREMENTS</div> <div>  </div>		
SINGRAULI SUPER THERMAL POWER PROJECT STAGE-II (2X800 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION – VI, PART-B	SUB-SECTION-A-24 SERVICE ELEVATORS CRANE, HOIST & MONORAIL	PAGE 7 OF 7