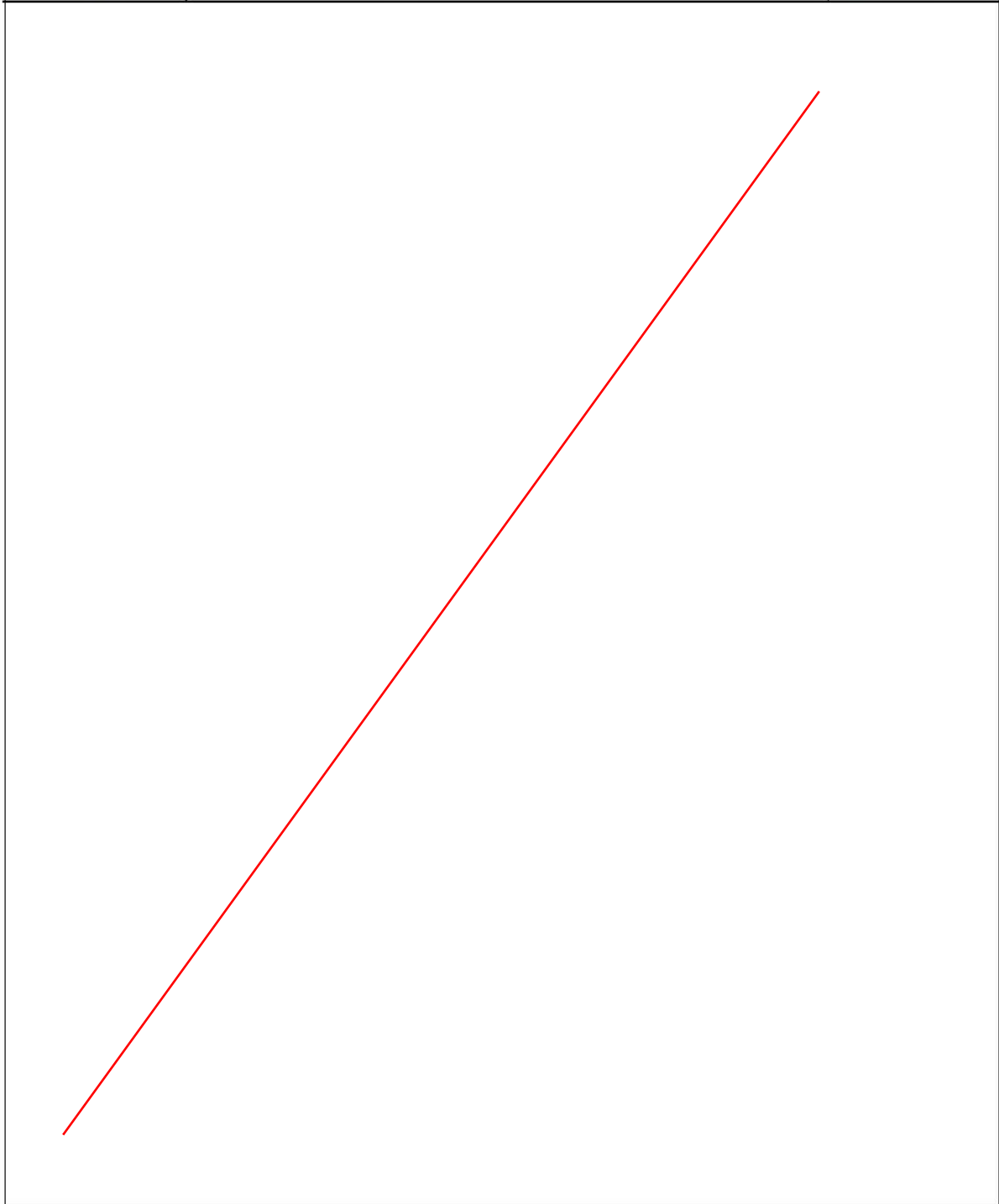


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1.0 <u>PROJECT MANAGEMENT SERVICES</u> 1.1 <u>RESPONSIBILITY</u> The Bidder shall identify a separate and independent Project Management Team headed by a Project Manager for the execution of this project. Responsibilities of this Project Management Team shall cover the areas listed below: (a) Planning and Monitoring (b) Engineering Management (c) Contracts Management (d) Quality Assurance, Inspection & Expediting (e) Construction Management (f) Spares Management (g) Commissioning Management Detailed responsibilities in the above areas are discussed below: 1.2 <u>ORGANISATION</u> 1.2.1 Headquarters The headquarters of the Project Management Team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. He should have adequate financial power and authority to give decision. Separately, designated leaders shall be identified for each of the areas mentioned under 1.1, who, in turn, will report to the Project Manager for all matters relative to this contract.		

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1.2.2	Central Co-ordination Cell The central coordination cell shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.	
1.2.3	Site Organisation The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.	
1.2.4	Organisation Chart The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.	
1.3	<u>DETAILED RESPONSIBILITIES</u>	
1.3.1	Planning & Monitoring (a) Planning The Bidder shall prepare a Master Network Schedule in the form of PERT network consisting of at least 500 activities. The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/ package in the areas of engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third	

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tier execution plans. The master network shall conform to the overall schedule prescribed by Owner. The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised. (b) Monitoring & Progress Reporting The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections: (i) Report on key milestones. (ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project. (iii) Action needing attention of the Owner/Consultant. (iv) Detailed package wise status of engineering submissions, quality plan submissions and approval, procurement manufacture and despatch. The monthly report generated from the site office should necessarily include: (i) Report on key milestones. (ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.		

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(iii) Action needing attention of the Owner/Consultant. (iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning. In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract. 1.3.2 Engineering Management Based on the master network for the project (L-1), the Contractor shall prepare an exhaustive list of engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for engineering activities. Based on (L-2) network, the Bidder shall further develop the Level-3 (L-3) network for engineering activities which will indicate schedule for data availability, drawing release date and document submission dates. Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter. All such networks shall be provided in PRIMAVERA software, supported by back ups (schedule of predecessor/successors as well as floats for activities). The Engineering Management Team should also co-ordinate all interface engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Owner.		

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1.3.3 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor shall also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the Customer Hold Points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacture can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of boughtout items, detailed shipping schedule and cash flow statement for Owner's approval.

1.3.4 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacture is commenced. The list of major suppliers shall be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be

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binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list shall be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list, Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further. Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping. The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.4.3 above. 1.3.5 Construction Management The bidder shall specifically ensure smooth management of site activities with adequate planning keeping in view the quantum of parallel activities as the project picks up. Towards ensuring orderly movement of construction vehicles and unhindered access to all construction fronts, the following activities shall be accorded priority: (a) Completion of all arterial roads in and around the construction fronts. (b) Compound wall for securing site.		

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(c) Requisite drainage (d) All temporary buildings for office and stores. A detailed schedule of the above activities shall be submitted to the Owner within 15 (fifteen) days of the receipt of Letter Of Intent. Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction / erection / commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets. The L-3 programme would be jointly finalised by the site incharge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme shall also identify the sequential erectable tonnages that are required for various equipments which shall be taken care of in the despatch programmes. Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier. 1.3.6 Spares Management Alongwith the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following: (a) Mandatory spares (b) Recommended spares		

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While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised within twelve (12) months thereafter.		
1.4	<u>PROJECT PROGRESS REVIEW MEETINGS</u> Keeping in mind the overall responsibility of the Contractor, it is intended that periodic progress reviews on the entire activities of execution in respect of Bhusawal Thermal Power Plant will be held initially at least once in two (2) months at Mumbai/site or in the country of the Contractor depending on the circumstances and mutual agreement. During peak period, it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings. In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.	
1.5	<u>OWNER'S CONSULTANT</u> The Owner would appoint a Consultant to assist him in some of the areas mentioned above. The details of interaction and procedures for coordination between Owner/ Owner's Consultant and Contractor/Contractor's Project Management Team shall be finalised during contract negotiations.	
1.6	<u>COMMISSIONING MANAGEMENT</u>	
1.6.1	For commissioning of the various equipment/system covered under the scope of contract, Owner shall form an organisation structure which may	

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consist of the following committees. The Contractor shall nominate his representative on one or more of the committees as decided by the Owner: (a) Steering Committee (b) Commissioning Panel (c) Working Parties (d) Testing Teams 1.6.2 Commissioning documents shall be prepared by the Contractor in the following manner and submitted for Owner's approval: (a) Field Quality Plan This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning: (i) Establish design data against which Plant Performance will be compared. (ii) Set-out the testing objectives and proposals. (iii) Define the documentation required. (b) Testing/Commissioning Schedule: These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results. (c) Standard Check Lists Standard check lists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.		

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1.6.3 Test Reports

After the completion of commissioning activity of equipment / systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-a-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

SITE SERVICES

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following:

- 1.7 Arranging material despatch from the shop by rail/road and/or sea as applicable.
- 1.8 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc from the time of despatch F.O.R. works/F.O.B. port of shipment by Contractor till receipt of the same at site.
- 1.9 Unloading of materials at Railway Station/Railway Siding inside project area, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Engineer a report detailing all the receipts during the week.
- 1.10 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.

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1.11	Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.	
1.12	Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests. Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning (a) Deaerator (b) Boiler feed suction, recirculation leak-off lines (c) Boiler Feed discharge line by passing heaters (d) Attenuation lines (e) Condensate suction & discharge piping upto de-aerator by passing the feed water heaters. (f) Fuel oil lines. Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc as necessary shall also be in the scope of the Bidder. Safe disposal of effluent after chemical cleaning shall be done by the Contractor.	
1.13	Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lubricating oils upto COD.	
1.14	For the purpose of erection and commissioning, the Contractor's scope of work shall include but not be limited to the following :	
1.14.1	Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.	

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1.14.2	Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.	
1.14.3	Supply of commissioning spares.	
1.14.4	Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.	
1.14.5	Construction of all civil / structural / architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.	
1.14.6	All structural steel fabrication and erection work as detailed elsewhere in the specification.	
1.14.7	Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.	
1.14.8	Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.	
1.14.9	The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in the regard.	
1.14.10	The successful Bidder shall arrange for Tower cranes (400 Tonnes capacity) as per requirement for speedy erection activities.	

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1.15 SITE ORGANISATION

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

1.16 GENERAL GUIDELINES FOR FIELD ACTIVITIES

1.16.1 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

1.16.2 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.

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1.16.3	The Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Engineer may call for other meetings either with individual Contractors or with selected number of Contractors and in such a case the Contractor, if called will also attend such meetings.	
1.16.4	The Engineer 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.	
1.16.5	The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.	
1.16.6	Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.	
1.16.7	The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.	
1.16.8	All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as	

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may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work. 1.16.9 In case of any class of work for which there is no such specification as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer. 1.16.10 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor. 1.16.11 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if : (a) Product groups under which these items are re-leased are not covered in the scope of this tender. (b) Items are supplied by an agency other than the Contractor. 1.16.12 Preservation of all materials / equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints etc shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/ paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub oil system, carry out the hydraulic test of oil coolers etc.		

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1.16.13	It is responsibility of the Contractor to do the alignment etc if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackles, manpower etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also, the Contractor should ensure that the alignment is not disturbed afterwards.	
1.16.14	Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.	
1.16.15	Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.	
1.16.16	Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc	
1.16.17	Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.	
1.16.18	It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.	
1.16.19	Structural materials required for the supporting/operating platforms required for the valves at various levels for the same operation of valves will be arranged by the Contractor.	
1.16.20	For civil, structural and architectural works, Volume VI-A/B may be referred. For Electrical and Instrumentation works, Volume IV-A/B and Volume V may be referred.	

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1.17 <u>SAFETY</u> Safety and overall cleanliness of work site shall be given top priority. 1.17.1 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception. 1.17.2 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner. 1.17.3 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor. 1.17.4 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources. 1.17.5 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load. 1.17.6 All combustible waste and rubbish shall be collected and removed from the worksite at least once in a day. Use of undercoated canvas paper, corrugated paper, and fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed. 1.17.7 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour		

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colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.		
1.17.8	All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.	
1.17.9	All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.	
1.17.10	All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.	
1.17.11	All safety precautions shall be taken for welding and cutting operations as per IS-818.	
1.17.12	All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.	
1.18	<u>TAKING DELIVERY & STORAGE</u>	
1.18.1	The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.	
1.18.2	The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.	
1.18.3	All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.	

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1.19 SITE WELDING & HEAT TREATMENT

- 1.19.1 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/ International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ ASME Section-IX for high pressure welds, shall be employed in the job.
- 1.19.2 All welders shall be tested and approved by Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Engineer shall be stamped by the welder on each joint done by them. The Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.
- 1.19.3 The Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 1.19.4 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 1.19.5 All welded joints shall be subject to acceptance by Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 1.19.6 Preheating/postheating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements,

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thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Engineer prior to the commencement of each cycle and handed over to Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo- charks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition. 1.19.7 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations. 1.19.8 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means of electric induction coil or electric resistance coil. 1.19.9 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work. 1.19.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm, the entire welding has to be carried out by TIG welding. Fillet weld shall be made by shielded metal arc process as per applicable codes.		

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However, the Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times the diameter of the electrode.

In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.

- 1.19.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 1.19.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 1.19.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 1.19.14 Each layer of welding shall have an even and smooth appearance.
- 1.19.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further, any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 1.19.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.
- 1.19.17 Following shall be stages of inspection during welding :
 - (a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Engineer.
 - (b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.

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- (c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run

1.19.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

2.0 PROTECTION AND CARE

2.1 All construction and erection activities for this project are to be carried out in the plant premises with proper protection and care of personnel and equipment. All safety norms have to be followed.

2.2 Generator Stator Lifting may be considered by either of the two options as mentioned below :

- (a) With the help of Turbine room cranes.
- (b) With the help of separate lifting arrangement to be provided by the Bidder from outside the TG building A-row column before the construction of A-row building wall.

Bidder shall indicate necessary price implication between these two modes of Generator Stator lifting arrangement.

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1.0 GENERAL

- 1.1 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all engineering co-ordination. The Owner/Consultant/ Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Contractor or on matters involving the Contractor, his manufacturing units and sub-vendors. For the purpose of expediting, the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the contractors. However, such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract.
- 1.2 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor.

2.0 DESIGN COORDINATION MEETING

The Contractor and his sub-vendors will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Mumbai or at Bhusawal site or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.0 GUIDELINES FOR ENGINEERING SERVICES

- 3.1 Prior to commencement of the engineering work as part of design submissions, all aspects of design viz criteria for selection and sizing of all equipment and systems, design margins etc including that for structural steel

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and civil work shall be outlined and these shall form the basis for the detailed engineering work. 3.2 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor. 3.3 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to any unit of 660 MW individually or severally, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date (s) or feedback (s) received during execution/operation of similar units. Such changes/modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and scope of the Contractor. 3.4 During the course of review of detailed engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner. 3.5 During the course of review of detailed engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants engineered by the Bidder. In case Owner so desires, the Bidder shall submit such data and information to the Owner. 3.6 It is not the intent to give details of every single task covered in the total engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as		

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specified shall be carried out by the Contractor. Broadly, the following are the minimum requirements in respect of scope of major items of work:		
4.6.1	Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Contractor from time to time, as detailed designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.	
4.6.2	Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items and also finalisation of corresponding sub-contractors.	
4.6.3	Review of sub-contractor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner /Consultant for approval.	
4.6.4	Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments etc required for preparation of civil construction drawings and also as referred at relevant sections of Scope, Terminal Points & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis, as necessary.	
4.6.5	Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.	
4.6.6	Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.	
4.6.7	Sizing of all piping and equipment as per the stipulated design criteria, carrying out the flexibility analysis/dynamic analysis as necessary, hangers & support engineering.	

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4.6.8	Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.0 for the specific requirement in this regard.	
4.6.9	Certification and submission of final as-built drawings for all areas.	
4.6.10	Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.	
4.6.11	All erection and assembly drawings which may be required at site.	
4.6.12	For all bought out item packages, the Contractor shall provide complete material/ component list along with detail specification, drawings, component part number etc during detail engineering stage prior to final approval. Such approved drawing / document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD).	
4.6.13	Preparation of necessary documentation, design calculations etc required for submission to statutory authorities like IBR, Chief Electric Inspector etc.	
4.0	<u>OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS</u>	
4.1	The Contractor shall provide all necessary maintenance manuals and operating instructions at least six (6) months before the time of commissioning and before taking over of the plant and equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.	
4.2	The information provided, which shall be contained in loose leaf stiff backed covers, shall include :	
4.2.1	A complete inventory of all main items of plant, with identification details.	
4.2.2	Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps etc.	

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4.2.3	A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.	
4.2.4	A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.	
4.2.5	A lubrication schedule with all necessary drawings, diagrams to identify the lubrication points.	
4.2.6	Manufacturer's literature.	
4.3	The instruction manual shall be subject to the approval of Owner.	
4.4	The contractor shall submit the complete equipment list. The list shall be updated every three (3) months.	
5.0	<u>PLANT HANDBOOK</u> The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems, covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the Letter of Award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD/DVD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.	
6.0	<u>CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE</u>	
6.1	Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:	

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(a) for approval and (b) for information/further engineering and co-ordination by the Owner. This document submission schedule shall require approval by the Owner/Engineer. 6.2 All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English. 6.3 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Engineer. 6.4 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant: 6.4.1 List of sub-vendors (from Owner only) 6.4.2 System scheme and instrumentation diagrams 6.4.3 Design basis justifying selection of equipment & process parameters where not specified in the Contract 6.4.4 Equipment data sheets and general arrangement drawings 6.4.5 Predicted performance curves of equipment** 6.4.6 Materials of construction 6.4.7 Layout drawings		

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6.4.8	Operation logic diagrams	
6.4.9	Typical control circuit	
6.4.10	Drawings of Instrumentation and Control	
6.4.11	Any deviation from contract (by Owner)	
	** For all critical equipments (boiler and turbine auxiliaries etc), submission of this data shall be mandatory for approval of equipment data sheets / GA drawings.	
6.5	Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/Engineer.	
6.5.1	Equipment foundation drawings	
6.5.2	Equipment cross-section drawings, product literature etc which are of proprietary nature	
6.5.3	Various bills of quantity, schedules etc	
6.5.4	Piping fabrication drawings, isometrics etc	
6.5.5	Panel wiring diagrams	
6.5.6	Instruction/Operation manuals	
6.5.7	Service manuals and troubleshooting guide for C & I system including field instruments	
6.5.8	Cable schedule and interconnection chart	
6.5.9	Drive/feeder wise control scheme showing all external interfaces.	

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In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category. 6.6 Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document: 6.6.1 Approved 6.6.2 Approved except as noted, forward final drawing 6.6.3 Approved except as noted, resubmission required 6.6.4 Disapproved 6.6.5 For information/reference only For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner / Engineer. For action stamp in category (b), further review by Owner / Engineer would not be necessary provided the Contractor agrees & incorporates the minor comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer. The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.		

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6.7	Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.	
6.8	For review by the Consulting Engineer, the Contractor shall furnish three (3) prints of each drawing. Two (2) prints of such submission shall also be sent to the Owner. After review, one (1) stamped print will be returned to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CD's of all as built/final drawings for Owner / Consultant site.	
6.9	In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.	
6.10	For details of documentation for Civil, Structural and Architectural works, Volume VI may be referred.	
7.0	<u>TENDER STAGE DOCUMENT SUBMISSION</u>	
8.1	The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following:	
8.1.1	All Bid proposal sheets duly filled up. (The data mentioned in Bid proposal sheets is minimum required only. The Bidder shall submit the additional data asked for at any later stage).	
8.1.2	Detailed experience list and financial resources of the prime bidder, his collaborators/ associates in this bid as well as the sub-vendors proposed.	
8.1.3	Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.	

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8.1.4	List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.	
8.1.5	Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/ literature etc as required for clear understanding of the bid submitted.	
8.1.6	L-1 network indicating target dates for intermediate milestones and final commissioning of equipment supplied. This network shall be supplemented by a detailed write-up on proposal procedure of project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.	
8.1.7	List of suppliers for all bought out items.	

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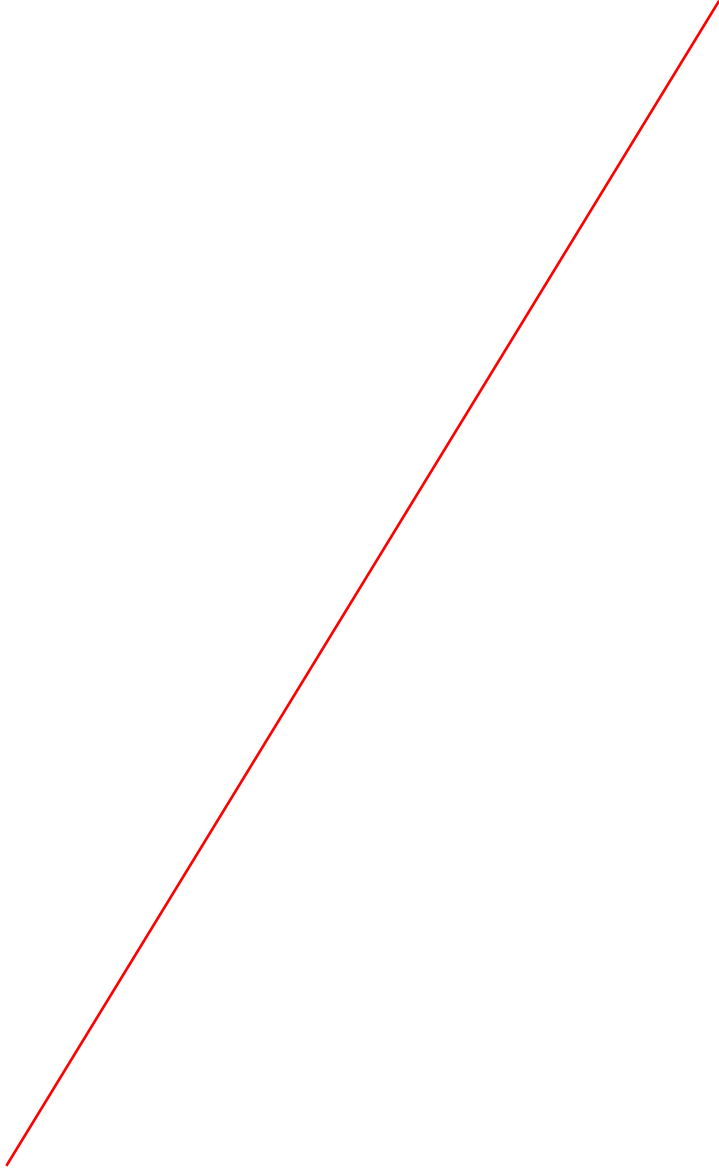
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1.0 QUALITY ASSURANCE PROGRAMME

1.1 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:

1.1.1 His organisation structure for the management and implementation of the proposed quality assurance programme.

1.1.2 Documentation control system.

1.1.3 Qualification data for Bidder's key personnel.

1.1.4 The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

1.1.5 System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

1.1.6 Control of non-conforming items and system for corrective actions.

1.1.7 Inspection and test procedure both for manufacture and all site related works.

1.1.8 Control of calibration and testing of measuring and testing equipments.

1.1.9 System for quality audit.

1.1.10 System for indication and appraisal of inspection status.

1.1.11 System for authorising of release of manufactured product to the Owner.

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1.1.12	System for handling storage and delivery.	
1.1.13	System for maintenance of records.	
1.1.14	Furnishing of quality plans for manufacturing and field activities, detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.	
2.0	<u>GENERAL REQUIREMENTS - QUALITY ASSURANCE</u>	
2.1	All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection /tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder, separately in the format attached at Annexures and shall be submitted to Owner/ Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.	
2.2	Manufacturing Quality Plan shall detail out for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc, during all stages of materials procurement, manufacture, assembly and final testing/performance testing.	
2.3	Field Quality Plans shall detail out for all the equipment, the quality practices and procedures etc to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.	
2.4	The Bidder shall also furnish copies of the reference documents / plant standards / acceptance norms/tests and inspection procedure etc as referred	

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in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc shall be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify Customer Hold Points (CHP), test/ checks which shall be carried out in presence of the Owner's Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised representative for approval and disposal. 2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorised representative and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC). 2.6 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it. 2.7 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record and mechanical property test results shall be furnished. 2.8 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner. All brazers, welders etc employed on any part of the contract at Contractor's / Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS- 4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.		

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For welding of pressure parts and high pressure piping, the requirements of IBR shall also be complied with.		
2.9	All Non-Destructive Tests (NDT) shall be carried out in accordance with approved International Standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for approval.	
2.10	List of all the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/ equipment shall be drawn up by the Contractor and finalised with the Owner. Such list shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.	
2.11	All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.	
2.12	Quality requirements for main equipment shall equally apply for spares and replacement items.	
2.13	Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.	

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2.14	For quality assurance of all civil works refer to the specifications for civil works.	
3.0	<u>QUALITY ASSURANCE DOCUMENTS</u>	
3.1	The Contractor shall be required to submit two (2) copies and two (2) sets of softcopies in the form of CD of the following Quality Assurance documents within three (3) weeks after despatch of the equipment :	
3.1.1	Material mill test reports on components as specified by the specification.	
3.1.2	The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.	
3.1.3	Non-destructive examination results/reports including radiography interpretation reports.	
3.1.4	Factory tests results for testing required as per applicable codes and standards referred in the specification.	
3.1.5	Welder identification list incorporating welder's and welding operator's qualification procedure and welding identification symbols.	
3.1.6	Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.	
3.1.7	Stress relief time temperature charts.	
3.1.8	Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following shall also be recorded :	
	(a) When some important repair work is involved to make the job acceptable.	
	(b) The repair work remains part of the accepted product quality.	

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3.2	Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.	
4.0	<u>INSPECTION, TESTING AND INSPECTION CERTIFICATES</u>	
4.1	The Engineer, his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.	
4.2	The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, shall attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified Six (6) copies of test reports.	
4.3	The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, on any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.	
4.4	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/ Inspector to issue such a	

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certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.		
4.5	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/ Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/ Inspector or to his authorised representative to accomplish testing.	
4.6	To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans shall be made for each three consecutive months and shall be furnished before beginning of each calendar month.	

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FORMAT OF QUALITY ASSURANCE PROGRAMME

ANNEXURE – A

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev. No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remark

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FIELD WELDING SCHEDULE

ANNEXURE - B

PROJECT	:	FWS NO	:
CONTRACTOR	:	REV NO.	:
PACKAGE	:	FIELD WELDING CODE	:
SYSTEM	:	PAGE NO.	:

Sl No	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Preheat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks

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The Field Welding schedule shall be submitted for:

- (a) Pressure Parts
- (b) Tanks/Vessels
- (c) Piping
- (d) Heavy/Important Structural Steel
- (e) Heat Exchangers
- (f) Bus Ducts

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VOLUME II
SECTION – 8
PERFORMANCE GUARANTEES SCHEDULES

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1.0 PERFORMANCE GUARANTEES

1.1 GENERAL REQUIREMENTS

- 1.1.1 The equipment shall meet the ratings and performance requirements stipulated for various equipments. The guaranteed performance parameters shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- 1.1.2 All the guarantees shall be demonstrated during functional guarantee/ acceptance test. The various tests which are to be carried out during performance guarantee/ acceptance test are listed in this Sub-section. The guarantee tests shall be conducted at site.
- 1.1.3 All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, these shall be calibrated in an independent test Institute. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.
- 1.1.4 Tools and tackles, thermowell (both screwed and welded) instruments/ devices including flow devices, matching flanges, impulse piping & valves etc and any special equipment, required for the successful completion of the tests, shall be provided by the bidder.
- 1.1.5 All cost associated with the tests shall be included in the bid price.
- 1.1.6 Detailed Performance/Capability Test procedures containing the following shall be furnished:
- Objective of the test.
 - Various guaranteed parameters & tests as per contract.
 - Method of conductance of test and test code.
 - Duration of test, frequency of readings & number of test runs.

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(e) Method of calculation. (f) Correction curves (g) Instrument list consisting of range, accuracy, least count and location of instruments. (h) Scheme showing measurement points. (i) Sample calculation. (j) Acceptance criteria. (k) Any other information required for conducting the test. 1.1.7 The test procedure for all conditions shall be furnished one year before the scheduled commissioning date. Heat balance diagram shall be furnished for all test conditions. 1.1.8 In case during performance guarantee test(s), it is found that the equipment/ system has failed to meet the guarantees, all necessary modifications and/or replacements shall be carried out to make the equipment/system comply with the guaranteed requirements & the same shall be demonstrated by conducting another performance guarantee test. However, if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified, the equipment will be accepted after levying liquidated damages. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed, after the tests have been completed, the Owner will have the right to either of the following : (I) For Category-I Guarantees Reject the equipment/system/plant and recover from the contractor. OR		

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Accept the equipment/system/plant after levying Liquidated Damages (II) For Category-II Guarantees Reject the equipment/system/plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category II' Guarantees. Conformance to the performance requirements under Category-II is mandatory. (III) For Category-III Guarantees Reject the equipment/system/plant and recover from the Contractor. OR Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Owner. Such damages shall however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. The P. G. test shall be carried out within four (4) months after first synchronisation. If the P.G. test is conducted beyond four (4) months from first synchronisation due to any reason attributable to Owner, the deterioration in performance shall be increased by the following amount for each month or part of the month by which the period between the first synchronisation and PG test exceeds four (4) months. (i) 0.1 % for the following eight (8) months (ii) 0.06 % for the period following thereafter.		

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1.2 <u>GUARANTEES UNDER CATEGORY-I</u> The performance guarantees which attract liquidated damages are as follows: 1.2.1 Efficiency of the steam generator at 100% TMCR while firing the design coal at rated steam parameters, rated coal fineness and rated excess air. 1.2.2 Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working) with the coal being fired from within the range specified. 1.2.3 Guaranteed Turbine Cycle Heat rate in kCal/kWh under rated steam conditions, design condenser pressure with zero make up at 100% and 80 % rated load. A weightage of 4 (four) and 3 (three) shall be considered for 100 % and 80 % heat rate values for arriving at the net heat rate. 1.2.4 Guaranteed Continuous TG output under rated steam conditions, design condenser pressure with zero make-up. Note: The condenser pressure while conducting the guarantee tests shall be measured at 300 mm above the top row of condenser tubes. 1.2.5 The total auxiliary power consumption for all specified plant auxiliaries (as listed in Volume- I, Section -3) required for continuous unit operation at 100% of rated load under rated steam conditions and at design condenser pressure with 1% make-up. 1.2.6 The particulate emission from ESP as specified. 1.3 <u>GUARANTEES UNDER CATEGORY-II</u> It shall be guaranteed that maximum total NOx emission from the unit will not be more than 260 grams of NOx per giga joule of heat input to the boiler during the entire operating range of steam generator for the range of coals specified.		

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1.4 GUARANTEES UNDER CATEGORY-III

The parameters/capabilities to be demonstrated for various systems/equipments shall include but not be limited to the following:

1.4.1 Steam generator parameters with Blended Coal : The steam generator shall be run continuously for 168 (one hundred and sixty eight) hours with blended coal at 70 : 30 ratio between domestic coal and imported coal for demonstration of stable operation at rated parameters.

1.4.2 Steam turbine generator rated capacity at 89 mm Hg Condenser pressure.

1.4.3 Run back capabilities.

The automatic runback capability of the unit (boiler- turbine-generator) on loss of critical auxiliary equipment (such as tripping of one ID/FD/PA fan/airheater/BFP/ CEP etc) shall be demonstrated ensuring smooth and stable runback operation.

1.4.4 Rate of change of load and sudden load change withstand capability

The capability of boiler-turbine-generator in regard to ramp rate and step load change as specified shall be demonstrated.

1.4.5 Mill capacity at rated fineness

Performance testing shall be done on coal mills toward establishing its capacity specified at the rated fineness, applying corrections for the variation in coal characteristics i.e. HGI (Hardgrove Grindability Index) and total moisture. Capacity demonstration test shall be carried out for the following conditions:

- (a) Capacity output of one coal pulverizer (of Owner's choice) shall be demonstrated for establishing its capacity at 100% mill loading, at rated pulverized coal fineness with specified design coal with new set of grinding elements.

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- (b) Capacity output shall also be demonstrated on four coal pulverizers (of Owner's choice) of Steam Generator, not less than the 90% of guaranteed value of (a) above, at 100% mill loading with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier.

Capacity test as mentioned at (a) & (b) above shall be demonstrated at the following conditions occurring simultaneously during testing:

Coal fineness	Not less than 70% through 200 mesh and not less than 99% through 50 mesh screen
Test Coal	Any available coal from the specified range

In case the guaranteed capacity of coal pulverizers as stated above are successfully demonstrated, remaining coal pulverizers will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the coal pulverizers not meeting the guarantee test, all the coal pulverizers will have to be tested to demonstrate guaranteed capacity.

1.4.6 Life of mill wear parts

Life of mill wear parts, in hours of operation, for the entire range of coal characteristics specified.

1.4.7 No fuel oil support above 30% BMCR load

It shall be guaranteed that oil support for flame stabilization shall not be required beyond 30% of BMCR load when firing the coals from the range identified. It shall be demonstrated that with any combination of mills/ adjacent mills in service, the steam generator does not require any oil firing for stable and efficient boiler operation at and above 30% BMCR loads.

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1.4.8 Performance characteristics of fans The performance characteristics of FD, ID and PA fans including their capacity, head developed, power consumption and margins envisaged on capacity and head shall be demonstrated. 1.4.9 Equal load sharing of pumps/fans while running in parallel shall be demonstrated. 1.4.10 Steam temperature imbalance It shall be demonstrated at SH and RH outlets (in case of more than one outlet) that the temperature imbalance between the outlets does not exceed 10⁰ C under all loads including transients. 1.4.11 It shall be guaranteed and demonstrated that the spray water flow to SH attemperation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. It shall also be guaranteed and demonstrated that the RH temperature is maintained at the rated value without any spray water requirement, at all loads for which the specified RH steam temperature is required to be maintained at the rated value. 1.4.12 Furnace Exit Gas Temperature (FEGT) It shall be demonstrated that maximum furnace exit gas temperature (FEGT) shall be minimum 60⁰C below the minimum initial deformation temperature (IDT) of ash. A comprehensive thermal performance test (TPT) shall be conducted for this purpose. FEGT shall be demonstrated through such TPT by indirect measurement. 1.4.13 Air Heater exit temperature. 1.4.14 Air heater air-in-leakage It shall be demonstrated that the air-heater air-in-leakage and maximum drift in air leakage do not exceed the specified value.		

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1.4.15 Electrostatic Precipitator

- (a) The performance/acceptance tests shall be carried out in accordance with method-17 of EPA (Environmental Protection Agency of USA) code ASME PTC.
- (b) The ESP air in leakage shall not be more than 1% of total gas flow at ESP inlet at the guarantee point condition and shall be demonstrated.
- (c) The maximum pressure drop through the ESP at the guarantee point flow condition shall not exceed 20 mmWC which shall be demonstrated.
- (d) The gas distribution in the various stream and fields shall be demonstrated.

1.4.16 Turbine-Generator set capability

The steam turbine generator shall be capable of delivering at generator terminals the output as indicated in the heat balances under the following conditions:

- (a) Continuous TG output corresponding to VWO condition under rated steam conditions with 1% make up. While conducting this test, the condenser pressure measurement shall be done at 300 mm above the top row of condenser tubes.
- (b) Maximum continuous output at generator terminals corresponding to all HP Heaters out of operation under rated steam conditions with 1% make up.

1.4.17 Start-up, Loading, Unloading and Shutdown capabilities (For Turbine Generator)

- (a) Unit Start Up

Start-up time (upto full load) and loading capabilities for Turbine Generator together for cold start condition (greater than 36 hrs

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shutdown), warm start conditions (between 8 and 36 hrs shutdown) and hot start conditions (less than 8 hours shutdown) as indicated by the contractor in the offer and accepted by the Owner shall be demonstrated ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc are within design limits. (b) Sudden Total Loss of External Load On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity. The same shall be demonstrated. (c) Steam Metal Temperature Mismatch Limitation The steam-metal temperature differential for cold, warm and hot start up, loading/unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Owner. 1.4.18 Constant Pressure and Sliding Pressure Operation The constant pressure operation from 0 to 35/40% of TMCR & 90% TMCR to VWO condition and sliding pressure operation from 35/40% to 90% TMCR in conjunction with the steam generator, HP-LP bypass system and Instrumentation & Control system shall be demonstrated. In sliding pressure mode of operation, during quick load increase, the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5%.		

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C.W. flow. The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips. (b) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads. (c) Oxygen content in condensate at hotwell outlet shall not exceed 0.015 cc/litre over 50-100% load range and shall be determined according to calorimetric Indigo-Carmine method. (d) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system. (e) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under TMCR conditions. (f) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17°C below the temperature corresponding to absolute suction pressure shall be demonstrated. Correction curves for establishing the capacity at site conditions shall also be furnished. (g) The air and vapour mixture from air cooling zone of condenser shall be 4.17°C below the saturation temperature corresponding to 25.4 mm Hg (abs) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished. 1.4.24 Condensate Extraction Pumps (a) Each CEP set shall be capable of delivering flow and total dynamic head corresponding to run out point as specified. (b) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated.		

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1.4.25 Vacuum Pump (a) Each pump shall be capable of meeting functional requirements. (b) The vibration, noise level and parallel operation of the pumps shall be demonstrated. 1.4.26 Boiler Feed Pumps (a) Each Boiler Feed Pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere. (b) The vibration, noise level and parallel operation of the pumps shall be demonstrated as per specification requirements. (c) Cold startup/hot startup of the unit using TDBFP with motive steam from auxiliary steam header shall be demonstrated. 1.4.27 Drip Pumps (if envisaged) (a) Each Drip Pump shall be capable of delivering flow and total dynamic head corresponding to design point as specified. (b) The vibration, noise level shall be demonstrated. 1.4.28 Lube Oil Purification system capacity and purity (a) Lube Oil Purification system capacity and purity shall be demonstrated (with requisite correction curves for variation in inlet oil purity). (b) The maximum solid particle size and free moisture in the purified oil shall not exceed the specified values and quality of oil shall confirm to class 15/12 (as per ISO 4406) when centrifuging oil is heated to a temperature of not more than 65°C.		

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1.4.29 Auxiliary/Equipment Cooling Water system (a) Vibration, parallel operation and noise level of all pumps at the rated duty point shall be demonstrated at site. (b) Design heat load of plate type heat exchangers and inlet and outlet temperatures of the plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the plate type heat exchanger on the primary and secondary water circuit to be demonstrated at site. 1.4.30 Condenser Cooling Water Pumps (a) Each Condenser Cooling Water pump set shall be capable to deliver flow and total dynamic head corresponding to runout point as specified elsewhere. (b) Vibration, parallel operation and noise level of all pumps shall be demonstrated at site. 1.4.31 HP/LP Bypass capabilities The HP/LP Bypass system shall satisfy the following functional requirements under automatic interlock action. It shall come into operation automatically under the following conditions: (a) Generator Circuit breaker opening. (b) HP/IP stop valves closing due to turbine tripping. (c) Sudden reduction in demand to house load Under all these conditions while passing the required steam flows as per the relevant heat balances, the condenser shall be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the BIDDER in his offer and accepted by the OWNER.		

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1.4.32 Feed Water Heaters and Deaerator

The following parameters shall be demonstrated:

- (a) Dissolved O₂ content in feed water at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 cc/litre determined as per ASTM-D-888 – Reference method-A or Indigo Carmine method.
- (b) Free carbondioxide in deaerator effluent shall be non-traceable at all loads from zero to VWO with 1% cycle make up.
- (c) Continuous and efficient operation and performance of feed heating plant without undue noise and vibrations at all loads and duty conditions.

1.4.33 Automatic on-line Turbine Testing (ATT) system

On-load testing of turbine protective equipments shall be demonstrated without disturbing normal operation and keeping all protective functions operative during the test.

1.4.34 Noise

All the plant, equipment and systems shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. Corrections for background noise shall be considered in line with the applicable standards.

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1.4.35 Condensate Polishing Unit

- (a) Effluent quality at outlet of each vessel at its rated design flow and design service length between two regenerations (with requisite correction curves for variation in the influent quality).
- (b) Pressure drop across the polisher/service vessel, as specified, in clean and dirty condition of resin at rated design flow.

1.4.36 Superheater and Reheater Temperature Control Test

This test shall be conducted to guarantee that SH/RH temperatures are maintained within +/- 5°C of rated temperature condition from 40% to 100% TMCR including conditions: HP Heaters out of operations, HP-LP Bypass operation.

1.4.37 Flue Gas Temperature demonstration

The Bidder shall demonstrate that flue gas temperature at the entry and exit of various Boiler heating surfaces and also the variation across the cross section perpendicular to gas flow do not exceed the values considered for the pressure parts design at all loads of boiler.

1.4.38 Control & Instrumentation System Requirements

Performance guarantee tests for closed loop control system shall be carried out at site to verify the integrated performance of the total plant C&I and to verify as to whether all the important parameters remain within stipulated permissible limits under all the operating conditions. In case during this tests or otherwise it is observed that the behavior/response of Contractor's system (drives actuators/valves etc.) is not satisfactory/acts as a limitation/restriction in achieving the permissible limits, the Bidder shall carry out all required modifications, rectification etc. in his system whatsoever so that the permissible limits can be achieved. He shall also depute his experts for associating in the above tests and also for carrying out the necessary modifications, rectification etc.

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1.4.39 Balance of Plants:

For Balance of Plants, functional guarantees like capacities and parameters (except power consumption at individual system level) shall be demonstrated as per the specification furnished under respective sections forming part of this specification. Wherever applicable, Owner may, at his sole discretion, consider shop test result as primary indicators of the performance.

1.4.40 Utility Consumption

Bidder shall have to indicate and demonstrate utility (e.g. DM Water, Clarified Water etc) consumptions.

1.5 TEST CODES, CONDITIONS ETC

1.5.1 Steam Generator Efficiency

- (a) The steam generator efficiency (by loss method) shall be determined as per the requirements of BS EN 12952- 15, 2003 (by loss method) and other stipulations brought out hereunder.

(i)	Test loads	100% TMCR
(ii)	Test conditions	Boiler operating at rated steam parameter, excess air, coal fineness and firing design coal
(iii)	Ambient conditions	27°C dry bulb temperature and 60% relative humidity. The reference air temperature for the efficiency guarantee/ testing shall be taken as the temperature of air (i.e. 27°C) entering PA and FD fans
(iv)	Number of readings	Two sets of consistent readings for each of test loads. Average of the test efficiencies based on above two readings for each load shall be considered for guaranteed efficiency

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(v)	APH leakages to be considered	Guaranteed or actual whichever is higher
(vi)	Test Duration	Four hours. No soot blowing shall be allowed during the test period or during stabilization period of four hours prior to commencement of the test.
(vii)	Heat Credits	No heat credits allowed. The guaranteed steam generator efficiency shall be without any heat credit.

- (b) The guaranteed efficiency shall comply with following limiting parameters with design coal firing:

(i)	Excess air at economizer outlet at 100% TMCR load	20% (minimum)
(ii)	Corrected flue gas temperature (at 100% TMCR load)	135°C or as predicted by the bidder at air preheater outlet

1.5.2 Auxiliary Power Consumption

The unit auxiliary power consumption shall be calculated using the following relationship.

$$P_a = P_u + P_{bbfp}$$

$$P_a = \text{Guaranteed Auxiliary Power Consumption}$$

$$P_u = \text{Power consumed by the auxiliaries under test.}$$

$$P_{bbfp} = \text{Power consumed by motor drive of turbine driven boiler feed booster pump (in case booster pump is driven by independent motor)}$$

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Note: Pbbfp will be zero if the turbine drive is used to drive both main pump and booster pump).

While guaranteeing the auxiliary power consumption, all continuously operating unit auxiliaries as specified shall be included. (Please refer Volume – I, Section 3)

1.5.3 Performance/Acceptance Test for Steam generator

The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0 except for the specific requirements brought out herein below. This test shall be done simultaneously with P-G test of Turbine Generator set. During this test, Boiler unit shall be fully on automatic control under steady load condition.

The efficiency tests shall be carried out with the steam generator operating at the guaranteed point condition i.e. corresponding to 100%, 75%, 60% TMCR, or at the agreed loads as near these as possible, with the boiler operating at the rated excess air, rated SH/RH attemperation flows, flue gas temperature, coal fineness, etc. corresponding to the loads on boiler. At control load, the stable and efficient operation of the unit with the rated excess air, rated mill outlet coal fineness, while achieving the rated S/H, R/H steam parameters shall be demonstrated by the Contractor to the satisfaction of the Owner.

For finding out the performance values, corresponding code requirements to be fulfilled.

The measurement and computation of heat losses shall be carried out as per the stipulations of ASME PTC 4.0 and shall include but not be limited to the following items:

- (a) Dry gas loss.
- (b) Loss due to hydrogen in fuel.
- (c) Loss due to moisture in fuel.
- (d) Loss due to moisture in air.

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(e) Loss due to unburnt carbon in ash. Ash samples shall be collected from the furnace bottom hopper, air heater hoppers, duct hoppers and ESP hoppers. The ash collection rates for computation of losses shall be assumed as 20%, 5% and 3% in the furnace bottom hopper, duct hopper and air heater hopper respectively. (f) Radiation loss. (g) Loss due to Carbon Monoxide (CO) in flue gas. (h) Any other unaccountable loss through sensible heat in ash and due to radiation to furnace bottom hopper. (i) Manufacturer's margin. 1.5.4 Corrections shall be applied to the tested efficiency, to correct it to the design conditions, for variations in the following parameters only: (i) Feed water temperature at economiser inlet. (ii) Ambient air temperature (iii) Relative humidity of ambient air. (iv) Hydrogen in coal. (v) Moisture in coal. (vi) Gross calorific value of coal. The Bidder shall furnish correction curves, for Owner's approval, covering the expected ranges of variations for all these parameters for the range of coals specified. In all other aspects, not spelt out above, or in specifications, where ANSI code stipulates agreement between the parties concerned before the test, Bidder shall get these approved by the Owner.		

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No negative tolerance on account of instrument in-accuracies or otherwise shall be allowed on the guaranteed values.

Performance tests shall also be conducted to prove the steam generating capacity of the steam generator at rated parameters at stipulated loads.

Necessary write ups, schemes, instrument schedules, detailed procedures clearly indicating periods of tests, frequency of observations, etc. shall be prepared and submitted for all the tests for Owner's review and shall be got specifically approved from the Owner within one year of L.O.A. issue.

1.5.5 Performance / Acceptance Test for Electrostatic precipitator :

The performance test on electrostatic precipitator will commence after a minimum period of three thousand (3000) hours of continuous operation after completion of trial operation. During the interval between the commencement of trial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performing tests.

The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and following the normal operation of the unit including rapping and normal soot blowing and/or warm-up guns. Outlet dust concentration of ESP with one field out in each stream while firing worst coal shall be 50 mg/NM³ (max) subjected to applicable modification adopted by Environmental Department, Government of India, at the time of project execution.

The performance tests shall be carried out in accordance with Method-17 of EPA (Environmental Protection Agency of USA) code. The details of the tests shall, however be mutually agreed upon between the OWNER and the CONTRACTOR.

All calibration procedures and standards shall be subjected to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test and maintenance testing shall conform to the relevant codes. The Bidder shall fully elaborate, in his