

**REQUEST FOR PROPOSAL (“RFP”) FOR SELECTION OF  
OWNER’S ENGINEER FOR SETTING UP COAL BASED  
POWER PLANT AT IB THERMAL POWER STATION,  
ORISSA, INDIA**

**THROUGH INTERNATIONAL COMPETITIVE BIDDING**

**BACKGROUND**

Orissa Power Generation Corporation Ltd. (“OPGC”) is a Public Private Partnership of Government of Orissa, and AES Corporation, USA. OPGC owns and operates Ib Thermal Power Station (current capacity 2x210 MW Coal based units) located at Banharpalli, Jharsuguda District, Orissa, India. OPGC is a profit making company and ranks among the top 15 generating companies in the country. Recently OPGC has been allotted with two coal blocks (Manoharpur and Dip side of Manoharpur) by Ministry of Coal, Government of India, in Ib-Valley area for captive use of the expansion project with a reserve of 531 MMT. As a part of the business expansion plan, OPGC intends to install coal based thermal power plant at Ib Thermal Power Station as an expansion project to the existing 2x210 MW units. Being an expansion project with coal blocks for its captive use, it enjoys inherent advantages such as availability of sufficient quantity of water and access to existing infrastructure and facilities built in for Phase-1 of the project that can be shared and augmented.

**STATUS OF THE PROJECT**

Required land for the expansion project is already in physical possession and Water Resources Dept. Govt. of Orissa, has already given consent for drawl of water from Hirakud reservoir which is adjacent to the plant site. Most of the required permits and licenses for the expansion have been either obtained or are in the advanced stages of procurement. The project will be funded through non recourse project financing from domestic/overseas lending institutions. The project is proposed to be implemented within 40 - 44 months from the Notice to Proceed (NTP) to the Engineering, Procurement and Construction (EPC) contractor and both NTP and financial close is expected to be completed by fourth quarter of 2008.

**CAPACITY CONFIGURATION**

Presently OPGC is pursuing to set up two units of coal based power plant adjacent to its existing plant at Ib Thermal Power station. The capacity shall be decided by OPGC after detail study on the various technology and configuration options by Owner’s Engineer and likely to be in the range of 600 MW  $\pm$  20%. While the Owner’s Engineer may cover the wider range capacity options starting from 210 MW for its scope of studying technology and capacity options, its bid for the remaining scope may be based on capacity range of 600 MW  $\pm$  20%.

## **QUALIFYING REQUIREMENT**

The bidder should have done basic engineering, detailed engineering and construction management as Owner's Engineer in at least two coal fired power plants having unit sizes of at least 210 MW, which have been successfully executed and commissioned in last five years, both in India and abroad. The scope of services for each reference plants should necessarily include basic and detailed engineering and, construction management of steam generator and auxiliaries, steam turbine and generator, thermal cycle, critical piping and balance of plant equipments along with associated civil, electrical and control and instrumentation and construction management for setting up of the plant.

The scope of "**basic engineering**" in above reference plants should have included technology evaluation, technical and economical feasibility and detailed project report (DPR) which covers selection and sizing of equipment / systems design parameters and operating features, development of conceptual layouts and P&IDs and detailed system optimization studies.

The scope of "**detailed engineering**" in above reference plants should have included preparation of EPC specification, layouts and drawings of complete plant and systems, bid evaluation and all post contract engineering including approval of vendor drawings / documents design engineering review services.

The scope of "**construction management**" in the above reference plant should have included project management, site management, shop inspection & testing services and plant takeover service.

## **SCOPE OF WORK**

The detailed scope of work is given in **Annexure - 1**

## **BID DOCUMENTS**

Bidders are required to submit their proposal in two parts i.e. 1) Techno Commercial and 2) Price Bid.

The Techno Commercial Bid shall cover the following documents:

- a) List of power plants where the bidder has been involved as Owner's Engineer and which have been successfully executed and commissioned, in last five years, both in India and abroad, along with details of scope of work handled. Details of similar projects under execution may also be provided.
- b) At least one performance certificate from the owners of plants commissioned in the last five years, as per (a) above.
- c) List of key professionals to be involved in the project, giving
  - i) Names and brief experience background who would be dedicated to this assignment.
  - ii) Specifying nature of engagement, i.e., full time or activity specific.
  - iii) Whether such personnel involved will be full time employees of the organization or externally hired resources.
  - iv) Organization chart for this project.

- d) Audited financial statements for last three years.
- e) List of tools / software proposed to be used for project monitoring and management.
- f) Methodology to be adopted along with activity chart.
- g) The Owner's Engineer will submit the list of inputs required from OPGC for making configuration study, preparation of DPR & finalisation of EPC bid Specifications.

The Price Bid shall be as per the format provided in **Annexure - 2**.

OPGC reserves the right to accept/reject, at its sole discretion any or all bids or cancel the bidding process without assigning any reason whatsoever and no further correspondence shall be entertained in this regard.

**Evaluation Criteria**

The evaluation will be carried out internally for each technical proposal, taking into account various criteria like: (a) the consultant's relevant experience for the assignment, (b) the quality of the methodology proposed, (c) the qualifications of the key staff proposed, (d) Financial standing, etc. The evaluation will be done on the basis of technical capability and cost. Award of work will initially be for STAGE - 1 (Unit-size & Technology selection). STAGE-2 (Pre - EPC services) will be awarded based on the report of STAGE - 1 and award of STAGE - 3 (Post - EPC services) shall be made subject to successful performance of the selected firm in execution of STAGE - 1 and STAGE - 2.

**BID SCHEDULE**

Deadline for Bid Submission	15.00 hrs on 5 <sup>th</sup> Jan 2008
Opening of Techno Commercial Bids	17.00 hrs on 5 <sup>th</sup> Jan 2008
Opening of Price Bids	17.00 hrs on 7 <sup>th</sup> Jan 2008

For any clarification, the bidders may contact Manager (Mechanical) in the following address.

**CONTACT ADDRESS:**

Orissa Power Generation Corporation Ltd.  
 7<sup>th</sup> Floor, Zone-A, Fortune Towers,  
 Chandrasekharpur,  
 Bhubaneswar - 751023.  
 Tel-91-674-2303764,  
 Fax-91-674-2303755/56,  
 E-Mail: sarojkarbbsr@rediffmail.com

## ANNEXURE - 1

### SCOPE OF WORK FOR OWNER'S ENGINEER

#### STAGE-1

##### 1. Unit-Size & Technology Selection

Based on standard industry parameter and specification, most suitable for the existing site condition considering availability of shared facility which will be cost effective and attract maximum numbers of EPC contractor, the Owner's Engineer will suggest the most suitable technology (sub-critical v/s super critical) based on PC v/s CFBC types of boiler, unit capacity and configuration. Based on this study for suggested unit size and technology, the Owner's Engineer shall prepare a report and the report should be comprehensive and should also consider following items.

- a) Sourcing of main equipments and recommendations.
- b) Capital costs estimation inclusive of price break-up for plant component and systems based on current international and domestic market.
- c) Reliability and availability.
- d) Environmental compliance.
- e) Performance and efficiency aspect.
- f) Water requirement.
- g) Turn down and secondary oil utilization for different technology.

Owner's Engineer shall make necessary study of the existing units and its facility which can be shared for the proposed unit. Wherever possible OPGC shall make necessary arrangement to provide information on existing plant as per the request of Owner's Engineer.

The above study shall ultimately form a part of the DPR.

## **STAGE - 2**

### **2 Pre EPC Services**

The Pre EPC Services shall include the followings:

- a) Preparation of detailed project report (DPR).
- b) Preparation of request for qualification (RFQ).
- c) Preparation of request for proposal (RFP).
- d) Bid evaluation.
- e) Review of project documents.
- f) Assistance for financial closure.

#### **2.1 Preparation of Detailed Project Report (DPR)**

Owner's Engineer shall prepare the DPR for the project after finalization of configuration study and confirmation by OPGC about the capacity range taking into consideration the available shared facilities existing along with the already commissioned two Units of 210 MW each in Phase- I of the project .The details requirement of DPR are outlined in **Annexure - 3**.

#### **2.2 Preparation of Request for Qualification (RFQ)**

Owner's Engineer shall prepare the qualifying requirements and RFQ for EPC Bidders.

#### **2.3 Preparation of Request for Proposal (RFP)**

Owner's Engineer shall prepare the RFP documents which shall comprise of instruction to Bidders, technical specifications, commercial terms & conditions including draft EPC agreement and other information for EPC Bidders to enable OPGC to go for International Competitive Bidding (ICB) for selection of EPC Contractor.

##### **2.3.1 Instruction to Bidders**

Owner's Engineer shall prepare instruction to EPC Bidders which will contain bidding procedure and relevant information required for the EPC Bidders to bid for the project.

##### **2.3.2 Technical specifications**

Preparation of technical specifications, bringing out functional requirements, design and sizing criteria, functional guarantees, scope of work, requirement of spares, erection, commissioning and quality requirements etc. for plant and systems including all mechanical, electrical, control & instrumentation system, civil works etc as required to make the plant complete.

The Owner's Engineer's responsibility will involve, but shall not be limited to the following:

- a) Finalise the Technical Specification such as basic design data, design criteria, detailed scope of supply, services and responsibilities for all equipment / system / structures etc. to be covered under EPC contractor's scope.
- b) Provide complete project information including fuel quality, water quality, meteorological data, wind and seismic data, general technical requirements, quality control and quality assurance requirements, performance parameters requirements in respect of shop testing, packing, transport storage etc.
- c) Finalise the detail list of procedures and standards required for construction, erection, testing, trial runs, commissioning tests and commercial operation, including formats for executing guarantees.
- d) Prepare all drawings, P&IDs, schemes, electrical single line diagram, Power system diagram, DCS configuration diagram, plot plan, suggestive layouts, suggestive building plans and elevations along with architectural features, roads, paving and drainage schemes, and other documents as required for clarity of the scope of work involved under the EPC Contract.
- e) Prepare list of guarantees which are subject to liquidated damages(e.g. turbine capacity, turbine heat rate, boiler capacity, boiler efficiency, auxiliary power consumption, mill wear part warrantee etc), those guarantees which are mandatory (e.g. ESP efficiency) and those which are required to demonstrate capabilities of equipment/auxiliaries(e.g. mill capacity, ID/FD/PA fan capacities, motor capacities, steam parameters at SH/RH outlet, SH/RH spray, BFP, CEP margins, capacities and capabilities of other turbine auxiliaries, and for balance of plant equipment). Owner's Engineer to recommend rates of liquidated damages for shortfall in performance for identified guarantees and provide calculations for arriving at those values. Owner's Engineer to specifically recommend correction which will be applicable to the guaranteed performance parameters and list the same for EPC contractor to submit along with the bid.
- f) Prepare detailed bid data sheet to be filled by the EPC contractor including (i) data sheets for performance of plant and equipment at Boiler Maximum Continuous rating (BMCR), Turbine Maximum Continuous Rating (TMCR)/100% rated Load, 80% TMCR, 40% TMCR, HP Heaters out of service, (ii) equipment data requirement including performance data sheets for individual equipment, (iii) data sheets for performance guarantees, (iv) data sheets for civil commodities.
- g) Finalise and recommend the Bid evaluation criteria including the Bid Evaluation Factors/loading factors for guaranteed parameters (turbine capacity, boiler capacity, turbine heat rate, boiler efficiency, auxiliary power consumption etc.). Owner's Engineer to provide calculations for working out bid evaluation factors.
- h) Recommend OPGC's scope of work, terminal points.
- i) Recommend spare parts required.

- j) Recommend list of Engineering Documents to be furnished by EPC contractor along with the bid; detailed list of engineering drawings, documents, calculations, procedures required to be furnished by EPC contractor during detailed engineering stage along with sequence of submission so as to match with overall schedule of project implementation.

### **2.3.3 Commercial Section**

Owner's Engineer shall prepare commercial section of the RFP in consultation with OPGC. OPGC will provide draft EPC contract for review, validation and updation by Owner's Engineer.

### **2.4 Bid Evaluation**

The Owner's Engineer would review and evaluate the technical and commercial bids received from the EPC Bidders, issue of clarification letters to the EPC Bidders, participate in detailed bid discussions with the EPC Bidders for obtaining required clarifications and prepare the bid evaluation report.

### **2.5 Review of Project Documents**

#### **2.5.1 Technical Review of the PPA & Fuel Supply Arrangement / Agreement**

Owner's Engineer will review the technical aspects of the plant and associated technical schedules/appendices. This review will include:

- a) Risk allocation of the PPA & Fuel Supply Arrangement / Agreement
- b) Areas where technical compliance would carry high cost or risk for little benefit
- c) Opportunities for innovation in performance or saving of cost
- d) Any underlying technical issues affecting bankability
- e) Suggested deviations/clarifications, if applicable

#### **2.5.2 Review of Power Evacuation Study**

Owner's Engineer shall review and verify load flow study for power evacuation point and transmission interconnecting capacity.

#### **2.5.3 Environmental Review**

With respect to the Environmental Review, Owner's Engineer will ensure that the EPC specifications and subsequent technical specifications submitted by the EPC Bidders are in conformation with the environmental limits specified by the various authorities / Lenders' Requirements.

#### **2.5.4 Review of Permits**

The Owner' Engineer shall review all the permits/consents required for setting up the plant and ensure that all permits are in place by OPGC.

### **2.5.5 Review of Technical Assumption**

Owner's Engineer will review and assist OPGC on all technical assumption to be taken in the financial model as and when required.

### **2.5.6 Review of Other Documents**

Owner's Engineer shall review other documents like EIA report, soil investigation, topographic, hydrological reports and recommend foundation type,etc. Owner's Engineer shall recommend mandatory spares from the EPC offer.

### **2.6 Assistance for Financial Closure**

The Owner's Engineer will provide technical assistance as and when required by OPGC for submission and presentation for the project till financial closure and up to NTP with lenders, insurers, investors, statutory and Government Authorities. Owner's Engineer will also prepare lenders' report as per the format requested by the lenders.



## STAGE – 3

### 3 Post EPC Services

The Post EPC Service shall include the followings

- a) Design engineering review services.
- b) Project management.
- c) Site management services.
- d) Shop inspection and testing services.
- e) Plant takeover services.

#### 3.1 Design Engineering Review Services

##### 3.1.1 Review of EPC contractor's Basic Engineering Documents

The Owner's Engineer's responsibility shall include review of EPC contractor's basic engineering work for the project. The scope will cover the review of EPC contractor's basic concepts, design criteria, design procedures etc to ensure that the resulting detailed engineering and subsequent procurement and construction would meet the contractual requirements in respect of the following aspects:

- a) Scope of work.
- b) Technical requirements.
- c) Adherence to codes and standards.
- d) Compliance to environmental and other statutory norms.
- e) Safety, reliability, operability and maintainability aspect.
- f) Materials safety and disposal standards as applicable.
- g) Overall compliance to sound and contemporary engineering practices.

##### 3.1.2 EPC Drawings, Documents and other submissions review

This review would be for providing assurance to OPGC that the technical execution is progressing along agreed contractual lines and shall be advisory in nature with alternate proposals such that the extent & efforts are not duplicating EPC contractor's detailed engineering activity. The review will cover the following:

- a) All basic studies and concept notes.
- b) Design manuals indicating design criteria, design procedures & assumptions, software details etc.
- c) Plot plan and Area plans.
- d) General arrangement drawings of buildings and facilities.
- e) Flow diagrams and schematics including piping drawings and isometrics.
- f) Electrical single-line diagrams.
- g) Instrumentation and control schematics, panel configuration drawings and control room layout drawings.
- h) Logic diagrams.
- i) Protection schemes.
- j) Technical data sheets and performance curves/data of major plant and equipment.

- k) Design calculations of critical systems / structures.
- l) Any and all of the EPC contractor's drawings and documentation such that plant aesthetics, layout, maintenance ease are addressed and shall include detailed layout drawings for ducting, cabling, tubing etc., fabrication drawings, construction drawings, erection drawings, component and/or sub-assembly drawings of equipment etc.

### **3.1.3 Review of Documents under "Procurement"**

Owners Engineer's review of EPC contractor's documents shall be to ensure that all plant, equipment and services that are procured by the EPC contractor are in line with the requirements of the contract. The documents to be reviewed shall include.

- a) Purchase specifications of major plant and equipment sub-contracted by the EPC contractor.
- b) Purchase specifications of all civil works sub-contracted by the EPC contractor.

### **3.1.4 Review of Quality Assurance Plan**

The scope of work would cover the following tasks related to quality assurance aspects of the project.

- a) Approval of sub-contractors, proposed by the EPC contractor.
- b) Review & approval of the EPC Contractor's / sub-contractor's and its vendors Quality Plans such as QA & QC including customer hold points for inspection.
- c) Review & approval of shop and site performance test procedures for all major equipment and systems.

## **3.2 Project Management**

Owners Engineer's responsibilities in respect of Project management functions would include the following:

- a) Conducting project coordination meetings.
- b) Review of detailed network schedules, preparing the revisions and up dates.
- c) Review of project coordination and communication procedures.
- d) Progress review and monitoring, participation and conducting the review meetings.
- e) Certification of EPC contractor's invoices.
- f) Review and certification of change orders.
- g) Technical Support to OPGC in settlement of claims and disputes.
- h) Assisting OPGC in providing solutions to resolving design related problems and contractual problems and site related issues.
- i) Preparation of weekly and monthly MIS reports on progress of work.
- j) Monitoring progress with actual and budgeted and indicating the slippages, deviations and suggesting the remedial measures.

### **3.3 Site Management Services**

Owner's Engineer will depute a team of Engineers to be at the project site for:

- a) Supervision of construction, erection, testing and commissioning of plant, equipment and facilities by the EPC contractor to ensure full compliance of the EPC contract with regard to quality, safety and performance.
- b) Review of construction schedules and monitoring site activities with respect to the latest approved schedule.
- c) Advising OPGC regarding adequacy of special tools/equipment, manpower and resources of EPC contractor.
- d) Review of EPC contractor's work plans for ensuing week/month.
- e) Preparation of weekly/monthly site progress reports covering current construction status, deviations from approved schedules, critical areas and proposed remedial measures.
- f) Providing advice to OPGC regarding technical problems encountered at site.
- g) Proposing corrective actions to be taken in case of works that are not in line with approved designs / specifications.
- h) Review and advise regarding field changes desired by EPC contractor.
- i) Review and advise regarding site quality assurance plans and compliance.
- j) Advise on safety aspects during construction and commissioning of the project and monitor the EPC contractor's and subcontractors safety efforts.
- k) Interface and co-ordinate with the fuel supplier including coordination for coal supply arrangement and ensure build-up of fuel stock for commissioning and performance testing and verify fuel analysis.
- l) Reviewing of documents for testing, commissioning, performance testing for establishing guaranteed performance parameters and for operation and maintenance and training of personnel.
- m) Review of pre commissioning checklists for various equipment and systems.
- n) Interface and co-ordinate activities to monitor the plant testing from initial synchronization of the unit through all performance testing.
- o) Witness performance guarantee at site on all the important equipments / system; review and evaluation of test results, with comments / recommendations. Conduct independent calculations to verify test results.

### **3.4 Shop Inspection and Testing Services**

Owner's Engineer shall inspect and test the material as and when required by OPGC both in India and abroad.

### **3.5 Plant Takeover Services**

Owner's Engineer's scope of work under this includes:

- a) Witnessing performance testing of the plant to be conducted by the EPC contractor at site prior to take-over.
- b) Assistance to OPGC in interpretation and acceptance of the test results.
- c) Preparation of Defect and Liability list.

- d) Preparation of Warranty and Guarantee points for the EPC contractor.
- e) Review of the Equipment running hour criteria, demonstration and acceptance of the same.
- f) Resolution of open points from erection / commissioning.

#### **4 Exclusions & Assumptions**

##### **4.1 Exclusions**

Following items are not included in the Owner's engineer scope.

- a) Soil Investigation, Survey and EIA Study.
- b) Power Evacuation Study.
- c) Support services for work to be performed by OPGC or any other agency outside of the EPC contract.
- d) Final decision on EPC contract award.
- e) All work related to shop inspection unless specifically asked for by OPGC.
- f) Quantity surveying.
- g) Liaison with lending institutions.
- h) Liaison with Government agencies.
- i) Assistance in securing NOCs, approvals from various statutory organizations.

##### **4.2 Assumption**

On award of job, the Owner's Engineer will submit the list of inputs required from OPGC for making configuration study, preparation of DPR & finalisation of RFP.

#### **5 Site Facilities to be Provided by OPGC**

The following facilities will be paid for / provided by OPGC free of charge to the Owner's Engineer for their personnel to be deployed at site.

- a) Independent accommodation for each engineer.
- b) OPGC shall provide suitable office at site for site personnel of Owner's Engineer. This shall include proper office furniture, fax, telephone, computers and e-mail connections with related equipment. The Owner's Engineer shall however bear the operational cost of the office including telephone, fax, e-mail, water, electricity charges and secretarial services.

#### **6 Liabilities of the Owner's Engineer**

- a) The Owner's Engineer shall exercise reasonable skill, care and diligence in the provision of the Services as per the Agreement. In the event the Owner's Engineer is in default of its performance, it will without delay rectify the defects incurred and if the rectification is not possible will re-perform the work free of charge.
- b) The Owner's Engineer shall be liable to pay compensation to OPGC arising out of the Agreement, only if a breach of point (a) herein above is established against Owner's Engineer..

- c) The compensation payable shall be limited to amount of loss and damages actually suffered as a result of such breach, subject to following:
- i) The Owner's Engineer shall not be liable for any damage or injury caused by or arising out of the act, neglect, default or omission of any person other than the Owner's Engineer or its personnel.
  - ii) The Owner's Engineer has no liability whatsoever for any part of the work not designed by it or under its responsibility or which has not been constructed under his supervision.
  - iii) Notwithstanding anything else in the Agreement, the total liability of the Owner's Engineer under or in connection with this Agreement howsoever arising, shall in no circumstances exceed in aggregate 25% of the total remuneration received under this Agreement by the Owner's Engineer from OPGC.
  - iv) The Owner's Engineer liability under the Agreement shall cease on the completion of the Owner's Engineer's services or termination of this Agreement.

## 7 Time Schedule for Deliverables

Activities		Time schedule
A	<b>STAGE – 1</b> <b>Unit-size &amp; Technology Selection</b>	
	Unit-size and Technology Selection	15 days from date of award of contract.
B	<b>STAGE – 2</b> <b>Pre - EPC Service</b>	
	Preparation of DPR	45 days from date of award of contract.
	Preparation of Request for Qualification(RFQ)	20 days from date of award of contract.
	Preparation of RFP	60 days from date of award of contract
	Bid Evaluation	60 days from the date of receipt of bids
C	<b>STAGE - 3</b> <b>Post - EPC Service</b>	Job will start after issuance of NTP

## ANNEXURE-2

### BIDDING FORMAT FOR PRICE

Sl. No.	Services	Lump sum Price (Rs.)
<b>A</b>	<b>STAGE - 1</b>	
	<b>Unit-size &amp; Technology Selection</b>	
1	Unit-size and technology selection	
<b>B</b>	<b>STAGE – 2</b>	
	<b>Pre-EPC Service</b>	
1	Preparation of DPR	
2	Preparation of Request for Qualification (RFQ)	
3	Preparation of RFP	
4	Bid Evaluation	
5	Review of project documents	
6	Assistance for Financial Closure	
<b>C</b>	<b>( STAGE – 3)</b>	
	<b>Post EPC Services</b>	
1	Design Engineering Review services	
2	Project Management services	
3	Site Management Services	
4	Shop inspection and testing services. *	
5	Plant take over services	

\* To be quoted as per man-day rate.

## ANNEXURE - 3

### Detail Project Report (DPR) - Scope

The DPR shall be detailed and comprehensive in content based on the technologies being pursued for various systems/equipment/other facilities of the entire plant. The Owner' Engineer shall identify alternatives for each equipment and elaborate techno-economic justification to recommend the most suitable option for each of the equipment/systems. Owner's Engineer shall also examine use of super critical technology in the report.

For all equipment of entire plant and specially the steam generators, electrostatic precipitators, steam turbine, generator, feed heating cycle, critical piping, boiler feed pump, condensate extraction pump, HP-LP bypass system, circulating water system, coal handling plant, ash handling plant, water treatment system, effluent treatment system, control and instrumentation, plant electrical system etc. The recommended product design features, type, design and sizing criteria etc shall be elaborated in the DPR. Emphasis will be laid to the features required to adapt the technology to the specific conditions of grid, fuel, O&M practice etc. The DPR shall be exhaustive such that it becomes the basis for preparation of technical specifications. Following areas shall be specifically covered in the DPR.

- a) Plant Layout, Optimization & Project Implementation: (Site layout considering present capacity and future expansion, O&M issues, spares management, facility sharing, staffing, operational flexibility, major outages)
  - i) Cycle configuration: Turbine cycle configuration defining number of HP and LP heaters, their extraction points for the finally selected set of main steam and reheat parameters, optimum value of final feed-water temperature (FFT). One set of calculations bringing out techno-economic advantage/justification for selecting above parameters shall be submitted along with the DPR.
  - ii) Circulating Water (CW) system optimization: Detailed study to find out the most optimum CW system parameters like CW flow, condenser vacuum, condenser TTD, condenser tube velocity, cooling tower range and approach, CW duct velocity etc.
  - iii) Boiler Exit Flue gas Temperature: Recommendations on the optimum temperature for the boiler exit flue gas temperature taking into consideration acid dew point corrosion of air-preheater back end elements, unit start-up economy, selected final feed water temperature, overall cycle optimization etc.
  - iv) General Layout Plan: Development of general layout plan with optimum land use of the generating facility considering future expansion of at least two more units of same size. Layout plan shall indicate area for lay-down, item wise break up of land preassembly activities during project execution along with basis of recommendations.

- v) Main Plant Layout: Development of layout of main plant including TG hall and its various floor levels, its bay width and height. The Owner's Engineer shall also cover various features to have compact layout.
  - vi) Project Implementation: Prepare project implementation plan, erection strategy, requirement for construction of major plant equipments, time cycle adjustment in PERT network.
  - vii) Process diagrams: Process flow diagrams showing all main equipment (e.g. air and gas diagram for boiler, water and steam diagram for boiler and steam turbine cycle, auxiliary steam system, coal conveying, pulverizing and firing system, fuel oil unloading, storage, pressurizing and firing system, ash handling system, plant air system, auxiliary cooling water system, water balance diagram, turbine cycle heat balance diagrams etc.)
  - viii) Coal data: The Owner's Engineer will analyze the borehole coal data (to be provided by OPGC) from the link mines and recommend the design, best and worst coal characteristics to be considered for design of boiler, ESP, FGD, coal and ash handling systems. The Owner's Engineer shall also recommend the range of coal characteristics to be considered for plant design.
  - ix) Site Conditions: The Owner's Engineer shall recommend the site conditions such as ambient temperature and humidity, wind velocity, rainfall, seismic conditions for plant design, etc. Owner's Engineer shall provide details of rainwater harvesting and how it will be used in the plant.
- b) Steam Generator and Auxiliaries:
- i) Boiler Sizing: Recommended sizing philosophy for boiler for working out boiler capacity.
  - ii) Coal/Ash specific design features: Design features that are Coal/ash specific shall be elaborated with particular emphasis on design/sizing of furnace and pressure parts.
  - iii) Design features for cyclic loading/variable pressure operation.
  - iv) Selection/sizing/design basis of boiler auxiliaries such as mills, fans, air-heaters, SCAPH, ducts and dampers, ESP, FGD etc.
  - v) Other boiler systems: Recommendations on design and sizing criteria for fuel oil unloading storage, pressurizing and firing system taking into account the facilities of existing units. Recommendations on sizing of auxiliary steam system.
- c) Steam Turbine & Auxiliaries:
- i) Steam turbine configuration, special features of major turbine component / systems like governing system, lube oil system, governing oil system, condenser system, air evacuation system etc. Techno-economics of combined HP-IP or IP-LP cylinders, nozzle govern and throttle govern machines, margin between VWO and TMCR (turbine maximum continuous rating), back pressure value selection, selection of type of condenser, materials of condenser components, sizing criteria for condenser etc.



- ii) HP-LP bypass capacity selection, number and type of valves, location of tap-off on MS line, hydraulic power pack.
  - iii) Feed Heating Plant and Deaerator: Material of major component of Deaerator sizing criteria, design features, special requirements.
  - iv) Condensate Extraction Pumps: Sizing criteria, configuration, design features, requirements for shop performance tests, margins on pump flow, head, minimum recirculation requirement, NPSH margins taking transient conditions into considerations.
  - v) Boiler Feed Pumps System: Sizing criteria for BFP, design features, specific requirements, recommendations regarding suction specific speed, shut off head, shop performance testing, type of coupling, drive margins, NPSH margins taking into consideration transient conditions etc.
- d) Critical Piping: Selection of material, design parameters, guidelines for stress & dynamic analysis for the critical piping of the plant
- e) Balance of Plant:
- i) Cooling water System: Sizing criteria for CW pumps, design features, recommendations regarding type of pumps, specific product design features to be incorporated. Techno-economic study on IDCT vs NDCT, type of cooling tower, sizing criteria, design features, treatment of cooling water, recommended cycles of concentration considering water quality etc.
  - ii) Water Treatment Plant: Recommendation on water quality for various services such as cooling water for main condenser, plant auxiliaries, plant service water, DM water for cycle make-up etc. Sizing criteria for treatment plant, type of equipments, redundancy etc. Listing of process/treatment for achieving the desired quality considering the source water quality.
  - iii) Condensate Polishing Plant: Sizing criteria for condensate polishing plant for various design and operating conditions (like normal, condenser tube leakage, start-up etc.) Special product design features.
  - iv) Compressed Air system: Identification of continuous and intermittent requirement of instrument and service air (quality, quantity and pressure) duty wise and equipment/area wise like steam generator, turbine & auxiliaries, offsite areas etc. Type, sizing and configuration of compressors and driers.
  - v) Effluent Treatment System: Identification of various liquid and solid effluents (quality/quantity) from various areas of power plant, treatment process, type/parameters of equipment for effluent treatment along with schematic diagram of effluent treatment plant. Study of zero discharge schemes to be included with schematic diagram.
  - vi) Fire Detection and Protection System: Recommendations related to type of fire detection & protection system for complete plant, based on latest design practice.
  - vii) Ash Evacuation and Disposal System : Recommendations on type of bottom and fly ash evacuation system, their sizing criteria, storage capacity required for

- bottom ash and ESP, Economiser and APH ash. Recommendations on various ash disposal and ash management options like HCSD / LCSD, pipe conveyors, dry disposal with ash mound, coal mine filling and its logistics etc.
- viii) Coal Handling System: Selection, design and sizing criteria of coal handling plant and equipment including coal unloading and storage, crushing, coal conveying, bunker storage etc.
  - ix) Other Systems: Type of equipment, design and sizing criteria, expected parameters, redundancy and design margins, materials of construction of critical components of various systems including height and diameter.
    - x) Recommend design basis for chimney shell and flues,
    - xi) Suggestive single line diagram (SLD)
  - xii) Existing facilities: Owner's Engineer to study the additional capacities, layout provisions available at the existing units which can be utilized. A detail study has to be made by the Owner's Engineer on the existing facility available in unit 1&2.
- f) Power Evacuation and Transmission Analysis
- g) Electrical:
- i) Recommendation on sizing and selection of generator transformer, SAT, UAT, motors, electrical protection, high voltage/low voltage switchgears, cathodic protection, grounding & lightning protection etc.
  - ii) Power system stability study, short circuit and voltage drop calculation for the complete system.
  - iii) Overall control and design philosophy for electrical systems, switchyard configuration etc.
- h) Control and Instrumentation:
- i) Design basis and overall control philosophy considering the aspects of safety availability and reliability. Recommendation on type of control to be used for boiler and turbine protection.
  - ii) System configuration diagram for BTG and BOP equipment, control cabling concept, I/O layout design (remote vs. centralized).
  - iii) Recommendation on measuring and control instruments, redundancy requirement, analyzing instruments for CEMS and SWAS.