OPG POWER GENERATION PVT LIMITED

UNIT – V & VI - 2 x 360 MW COAL BASED THERMAL POWER PROJECT

AT GUMMIDIPOONDI, TAMILNADU STATE

PRE FEASIBILITY REPORT

APRIL 2015

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1. EXECUTIVE SUMMARY

OPG Power Generation Pvt Ltd (OPGPGPL) a Subsidiary of OPG Power Ventures PLC presently has 2 x 77 MW units, 1 x 80 MW unit in operation and under Phase - III, 1 x 180 MW unit is in the advanced stages of installation and expected to be commissioned by April 2015. The Company has proposed to install 2 x 360 MW Units Coal based thermal Power plant in Periya Obulapuram Village, Nagaraja Kandigai, Madharpakkam Road, Gummidipoondi, Tamil Nadu State after decommissioning the existing Sponge and Iron plant located in that site.

Aquatherm Engineering consultants India Pvt Ltd, Chennai, has been appointed as Technical Consultant by OPG for undertaking the Pre-feasibility Study preparation for 2 x 360 MW Coal fired Thermal Power project. The project would be based on Sub-critical technology.

This Pre-Feasibility report has been prepared taking into consideration of availability of land, water, fuel, power evacuation facilities, and other basic infrastructures and evaluated the technology available and suitable for establishment of such large thermal power station of capacity in the order of 2 x 360MW.

The project site is located about 3 kms away from Gummudipoondi town and 55 kilometers from Chennai. The site is aptly located to serve industrial customers and is close to the ports of Ennore and Chennai. The project site is located 3 km away from Chennai - Nellore High way. The nearest airport is located at Chennai.

The newly proposed 2 x 360 MW Units will be brought up in a location just adjacent to the operating units of 414 MW Power Plant owned by OPG Power group. An old abandoned sponge iron plant (owned by sister concern of OPG Group) adjacent to operating units of the power plant existed already and it was decided to bring the new units in that plant area of about 45.4 acres. The land is already retrieved by demolishing and clearing all plant equipment after decommissioning the sponge iron plant. The retrieved land along with newly acquired land from private parties, to an extent of 32.1 acres in adjacent area will be utilized to accommodate the construction of the proposed 2 x 360 MW unit.

Primary fuel of the project would be imported coal which shall be obtained from Indonesia. At present, only Sea cum Road transportation is envisaged for Coal transportation. Rail transportation may also be made feasible by creating a Railway siding, for which necessary facilities can be developed. It can be taken up only under a long term planning in future. But not envisage at present.
Secondary fuel for the startup and stabilization of the power plant shall be High Speed Diesel (HSD) / HFO and shall be brought from nearest depot.

Raw water for the plant will be sourced from Borewells inside the plant area. The Co., has already obtained from Tamil Nadu WRD/ PWD approval for drawl of ground water to the extent of 1000 m³/day. Requirement of fresh water inlet for all the proposed 2 x 360 MW units put together will be about 425 m³/day. It is proposed to recirculate and reutilize 567 m³/day from the reject generated and collected in collection tank after treatment of plant effluent water. The total requirement of water for the new units will be 992 m³/day.

Since the plant is proposed to use air-cooled condenser for turbine steam cooling, water required will be far less than conventional water cooled condensers.

Electrical Energy from the station is proposed to be wheeled through a dedicated 400 kV double circuit transmission line to the nearest TANTRANSCO S.S at Thervoikandigai for further transmission to the prospective buyers of power.

The project shall have one unit of coal fired thermal power plant units of 2 x 360 MW capacity based on Sub-critical parameters. The First unit shall achieve commercial operation in 33 months respectively calculated from the award of contract for Boiler, Turbine and Generator (BTG) package and Second unit 4 months thereafter.

The project cost is estimated as INR 43200 Million, which shall be funded by 70:30 debt equity ratio. The debt portion shall be arranged from various lenders funding the power projects. Loan repayment period of 10 years has been considered in the financial analysis.

The capacity of the project, fuel comfort, availability of water and power evacuation arrangement can make this project a success, which shall bring benefit to the nation as a whole and Tamilnadu state in particular.

2. INTRODUCTION OF THE PROJECT/BACKGROUND INFORMATION

2.1. IDENTIFICATION OF THE PROJECT AND PROJECT PROPONENT

The proposed coal fired thermal power project shall have two units each with 360 MW capacity based on sub critical parameters.

The proposed project site lies in an existing Sponge and Iron plant in an area of about 45.4 acres and in the additional land already procured adjacent to it of around 32.1
acres. The site is about 55 km from Chennai. The plant will be adjacent to the existing 2 x 77 MW + 1 x 80 MW + 1 x 180 MW Thermal Power Plants

The Geodetic co-ordinates for the site will be latitude 13°25’55.74” N and longitude 80°06’00.49” E.

PROJECT PROPOONENT

OPG GROUP

OPG Power Generation Pvt Ltd is a Subsidiary of OPG Power Ventures PLC with the main objective of setting up Group Captive Power Plant for the use of the promoters and others as permitted under the law.

OPG Power Ventures PLC is developing and operating Power plants in India. The Company is committed to building shareholder value and to being the first choice provider of reliable, uninterrupted power at competitive rates to its customers. OPG’s customers include hotels, hospitals, commercial companies and industries. OPG’s model allows power supply directly to such customers through the state grid, generally at attractive prices, benefiting them on cost and being able to receive reliable and uninterrupted power. Transporting coal from the coal mines by truck or train can be expensive due to the distance and sometimes it is not possible due to inadequate transport infrastructure. OPG’s principal plant sites have been chosen to be in close proximity to port e.g. Gujarat site is 30 kilometers from the port and Gummidipoondi is 55 kilometers away from Chennai Port. This allows OPG to bring Indian coal and imported coal by sea to the nearest port - thereby reducing significant land logistics cost.

Following are the Power plants successfully run or under implementation by OPG group

**OPG Energy** - Mayavaram - (25.4MW) a natural gas based power plant and the same is operating successfully under the Group Captive Power Policy. This natural gas based plant is near Mayavaram in Tamil Nadu

**OPG Power Generation** – is already operating 2 x 77 MW + 1 x 80 MW Coal based Power projects successfully at Gummidipoondi in adjacent premises and to the newly commissioned unit of 1 x 180 MW Coal based unit under the expansion scheme.

**OPG POWER Gujarat** in Bhadreshwar, Kutch, Gujarat is constructing a 2 x 150 MW Coal based Power project. The first unit is already commissioned and COD was declared by end of Mar 2015. The second 150 MW Unit is in advanced stage of commissioning and is going to be synchronized by end of Apr 2015.
OPG Power Generation has also proposed to construct 1 x 350 MW Coal based Power project near Bellary in Karnataka. Preliminary works like obtaining approval / permits from various agencies are underway.

OPG Renewable Energy - A 10 MW waste heat recovery plant is located at Gummudipoondi. The plant uses waste heat from the contiguous sponge iron facility of an associate, Kanishk Steel, and a blend of coal and dolomitic charcoal which is a process residue in sponge iron production with residual calorific value. The present proposal of constructing a 2 x 360 MW unit will be taken up at the same premises after decommissioning the existing sponge iron & power plant

2.2. BRIEF DESCRIPTION OF NATURE OF THE POWER PROJECT

The Project is a Coal based Thermal Plant with 2 units of 360 MW capacities each based on Sub-critical Technology.

Main fuel of the project would be imported coal. High Speed Diesel / HFO will be used for startup and stabilization of the unit.

Water requirement for the project shall be met from Bore wells existing inside the plant.

Power shall be evacuated through a dedicated 400 kV double circuit transmission line to the nearest TANTRANSCO S.S. at Thervoikandigai.

The project shall comply with all the environment regulations and guidelines as prescribed by MOEF and State Pollution Control Board. The plant will operate as zero-discharge plant.

2.3. NEED FOR THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY AND OR REGION

The economic growth of any country depends upon the availability and consumption of energy. The level of development of a country is measured in terms of per capita energy consumption. Presently, India's per capita energy consumption at 704.2 kWh/year (for year 2007 - 2008) is less than that of other developing countries like China (1,891) and Malaysia (1,000). The per capita energy consumption of the developed countries are very much higher as can be seen from the figures of such countries like United States of America (13,338), Sweden (16,665) and Canada (18,117). World average per capita energy consumption is 2,596 kWh / year.

It is a well-known fact that electricity is the most essential input for growth and development of any State. The rapid growth in industrial and agricultural sectors in India has consequently resulted in rising trend of demand for power. However the
growth in installed power generating capacity has not kept pace with the projected demand.

As per the approach paper of Planning Commission to the Eleventh Five Year Plan, the growth in power sector needs to be 10% annually to support GDP growth rate of 8-9% per annum. This target has since been increased to 10% for the terminal year of the Plan.

2.3.1. Power Situation

The installed generating capacity by the end of 31st of March 2014. In the country has been as follows as per CEA statistics:

<table>
<thead>
<tr>
<th>Type</th>
<th>MW</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>145273.39</td>
<td>59.776</td>
</tr>
<tr>
<td>Gas</td>
<td>21781.85</td>
<td>8.962</td>
</tr>
<tr>
<td>Oil</td>
<td>1199.75</td>
<td>0.493</td>
</tr>
<tr>
<td>Total Thermal</td>
<td>168254.90</td>
<td>69.231</td>
</tr>
<tr>
<td>Hydro</td>
<td>40531.41</td>
<td>16.677</td>
</tr>
<tr>
<td>Renewable</td>
<td>29462.55</td>
<td>12.126</td>
</tr>
<tr>
<td>Nuclear</td>
<td>4780</td>
<td>1.966</td>
</tr>
<tr>
<td>Total</td>
<td>243028.95</td>
<td>100</td>
</tr>
</tbody>
</table>

The sectoral distribution of the above is given below:

<table>
<thead>
<tr>
<th>Sector</th>
<th>MW</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>State sector</td>
<td>68125.95</td>
<td>28.032</td>
</tr>
<tr>
<td>Central Sector</td>
<td>92187.7</td>
<td>37.932</td>
</tr>
<tr>
<td>Private sector</td>
<td>82715.3</td>
<td>34.035</td>
</tr>
<tr>
<td>Total</td>
<td>243028.95</td>
<td>100</td>
</tr>
</tbody>
</table>

(Source: CEA)

2.3.2. Demand & Supply Scenario

The demand – supply position in the country with regard to electricity has been as follows during the month of March 2014

<table>
<thead>
<tr>
<th></th>
<th>Demand</th>
<th>Supply</th>
<th>Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>84958 MU</td>
<td>81860 MU</td>
<td>(-) 3.6</td>
</tr>
<tr>
<td>Peak Demand</td>
<td>131945 MW</td>
<td>126793 MU</td>
<td>(-) 3.9</td>
</tr>
</tbody>
</table>
It can be seen that the demand for power has been outstripping the supply. Substantial peak and energy shortages prevail in the country. The shortfall in Energy during the twelve months of the previous financial year is 42431 MU and the shortfall in Peak Demand during the same period has been 6103 MW.

### 2.3.3. Indian Electricity Act 2003

Government policies are now in favour of private entities investing and building & operating power plants. Indian Electricity Act 2003 has put in place the rules and regulations that encourage private investment power generation. The Act also put in place Regulators in Center and in States which are vested with authority to regulate the power tariff and provide equitable and level playing ground to private investors.

### 2.3.4. Power Scenario in Tamilnadu

The demand for electrical energy has been steadily growing in the State of Tamilnadu owing to the IT sector, industrial growth, Tourism and increased demand for rural electrification & for irrigation as well as growing population. The state has been adding new power generation projects to cope with the demand, but the demand for power always outstrips the availability.

Tamilnadu State depends on a mix of hydro, thermal and non-conventional energy generation for power development with thermal portion catering to about 29%, Hydro 21 %, Gas 5%, Non-conventional energy 5 % and Private sector Power plants about 12 % and Central assistance 28 %. Unreliable Wind energy forms 98% of Non-conventional energy produced. However unpredictable monsoon resulting in reduced hydel storage and growing demand for power accompanied with coal shortages in thermal plants force the State to look for other fast track opportunities for further augmentation of power to match with the industrial development. Combined Generation plants with gas engine based power plants is an easy and economic solution, for quick relief and augmentation under the present power situation.

### 2.3.4.1. Power Position in Tamilnadu State

Installed capacity as on 31-03-2014

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>Capacity in MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THERMAL</td>
<td>10411.06</td>
</tr>
<tr>
<td>2</td>
<td>HYDEL</td>
<td>2182.2</td>
</tr>
<tr>
<td>3</td>
<td>NUCLEAR</td>
<td>1024 (Including-Koodankulam)</td>
</tr>
<tr>
<td>4</td>
<td>RES</td>
<td>7946.13</td>
</tr>
</tbody>
</table>
The proposed project of 2 x 360 MW would help in bridging the gap of growing power demand. Setting up of project in the area would definitely result in improvement of social structure of in and around the project area besides direct and indirect employment.

Data sourced from CEA reports.

**2.4. IMPORTS VS INDIGENOUS PRODUCTION**

This equipment for the proposed power plant project may or may not involve any imports component from any competitive foreign suppliers or may be completely by Indigenous Production, in spite of several issues related to cost of importing Electrical energy equipment and quality of products in comparison.

**2.5. EXPORT POSSIBILITY**

This power plant project does not involve any Export Possibility issues to other countries.

The energy produced will be delivered to prospective buyers through TANTRANSCO substation at Therviokandigai.

**2.6. DOMESTIC / EXPORT MARKET**

**2.6.1. Export Market**

This Project does not have any Export Market as of now for the reasons stated.

**2.6.2. Domestic Market and Concept of Independent Power Producers**

The Union Power Ministry is encouraging Independent power producers (IPP’s) across the country as a means to create additional generating capacity at a faster rate through private sector participation.
Power plants usually sign long-term power purchase agreements (PPAs) with state governments under which they agree to sell power to state-owned distribution utilities at a fixed rate for a specified period.

Independent power producers will cater to different uses in the market – to supply electricity regularly to the grid or to meet peak loads. IPP’s shall sign long-term power purchase agreements with a single buyer, also alternately they can commit a certain percentage of their capacity to such agreements and sell the balance generation in the open market to licensed power traders who needs the power at that particular time.

Past few years have seen many players entering the Power Trading market both on the buy- side as well as the seller-side. A few players have also received license to act as intermediaries

Gridco, West Bengal State Electricity Board (WBSEB), Damodar Valley Corporation (DVC), Tripura Electricity Department, HP Government, Malana Hydro Power Station, Jindal Tract etc. are among the notable suppliers, while Maharashtra State Electricity Board (MSEB), Madhya Pradesh State Electricity Board (MPSEB), Uttar Pradesh Power Corporation Limited (UPPCL) etc are among the major buyers of power

Power Trading Corporation (PTC), Adani Exports, NTPC Vidyut Vyapar Nigam Ltd. (NVVN), Reliance Power, Tata Power are some of the established intermediaries in the Power Trading Business.

The Electricity Act, 2003 recognized the concept of trading as a distinct licensed activity and CERC is identified as the regulator. CERC have issued guidelines for trade licensing, power trading and for setting up power exchanges. CERC have issued power trading licenses to many trading companies and setting up of power exchanges is in the process.

To facilitate sale of power to power traders and third parties, the government has established an open access policy in power transmission. Introduced in the Electricity Act, 2003, open access basically refers to the right to transmit power over a system belonging to a third party. CERC have laid down procedures open access in distribution. SERC of many states have followed up by laying down of provisions for open access. Limited power flow on open access basis has already started.

With such concerted efforts in all areas, IPP’s are considered a favorable option to meet the power demand.
Under such a favourable condition, putting up a power plant of 2 X 360 MW capacity by OPG Power Generation Pvt Ltd in Gummidipoondi is justified in all aspects, since this will only meet a fraction of the projected power demand of the country.

### 2.7. EMPLOYMENT GENERATION (DIRECT AND INDIRECT DUE TO THE PROJECT)

This power plant project generates direct as well as indirect employment and will have at least 450 employees in the operation phase. During construction, around 200 persons will be working with a peak strength of 1000 persons. Contractors will have their own employees. During annual overhaul time the employment opportunities will be still more.

Due to the employees, contractors and Professionals, Manufactures and dealers visiting the project, the indirect employment potential thro’ Schools, markets, Shops hospitals, lodges, clubs, post office, Banks and Cinema theaters will increase in the adjacent area.

### 3. PROJECT DESCRIPTION

#### 3.1. TYPE OF THE PROJECT INCLUDING INTERLINKED AND INTERDEPENDENT PROJECTS (IF ANY)

This 2 x 360 MW Unit Coal fired Thermal Power Project shall be a pulverized fuel fired unit and adopt sub critical technology.

There are many Power projects operating in the nearby area like ARS, TCPL, SURYADEV etc., and the area is fast emerging as a Power hub. Likewise, there are many Power consuming Industries around.

#### 3.2. PROJECT LOCATION

OPG has proposed to decommission the existing sponge iron and waste heat recovery power plant in Gummidipoondi in Thiruvallore District of Tamilnadu to establish this Project.

The location of the project site has facilities of National Highway, Railway and Airport. National Highway is running within 3 KM from the site. Gummidipoondi railway station is within 4 KM from this site. And the nearest airport is at Chennai around 55 km from project site. Nearest port will be Ennore and Chennai.

A 400 kV Sub-station of TANTRANSCO is proposed to be constructed at about 10 km from site at Thervolkandigai.

The nearest town is Gummidipoondi and the nearest city is Chennai.
The nearest meteorological station of Indian meteorological department is at Chennai. Available infrastructure at Chennai is adequate for handling the offshore equipment including major power plant equipment.

Plot Plan indicating project details is enclosed as Annexure-4

Map Showing Site location, is also enclosed as Annexure-8

3.3. DETAILS OF ALTERNATE SITES, CONSIDERED

OPG has inspected various sites in and around the area for the project and selected the site, as the site falls within an industrial area and has sufficient infrastructural facility to develop a Power plant.

3.3.1. Selection of Site

**Basis of Selection of above site**

- Adequate land
- Adequate water supply
- Adequate infrastructure for fuel & water supply and its transportation system
- Facilities like road, rail, Airport etc., available in the neighborhood.
- Construction water and construction power facilities.
- Power evacuation facilities

3.3.2. Siting Guidelines

**A. Following siting guidelines will be followed in land acquisition**

- As far as possible prime agricultural land/forest land will not be converted into an industrial site.
- Land acquired should be minimum but sufficient to provide for a green belt wherein the treated wastewater, if possible/suitable, could be utilised from wastewater treatment systems.
- Enough space may be provided for storing solid wastes. The space and the waste can be made available for possible reuse in future.
- Layout and form of the project must conform to the landscape of the area without unduly affecting the scenic features of that place.
• Associated township of the project if any to be created must provide for space for phyto graphic barrier between the project and the township and should take into account predominant wind direction.

**B. In addition the following distances will be maintained:**

• Coastal Areas: at least 0.5 km from the high tide line (within 0.5 km of High Tide Line (HTL), specified activities as per CRZ notification, 1991 are permitted) (The HTL is to be delineated by the authorized agency only.)
• Estuaries: At least 200 metres from the estuary boundaries
• Flood Plains of the Riverine systems: at least 500 metres from flood plain or modified flood plain or by flood control systems
• Transport/Communication System: at least 500 metres from highway and railway
• Major Settlements (3, 00,000 population) at least 25 km from the projected growth boundary of the settlement.

**C. In addition to the siting criteria listed above, the proposed project location will be reviewed in relation to the following salient issues:**

• Ambient air, water and noise quality standards
• Critically polluted areas
• Natural disaster prone areas
• Ecologically sensitive areas
• Availability of water and other critical infrastructures like electricity, roads with adequate width and capacity
• Facilities for Power evacuation—proximity to EHV sub-stations

Based on the above guide lines, additional land required is proposed to be purchased from Land owners.

**3.4. SIZE OR MAGNITUDE OF OPERATION**

Presently Two units of 360 MW capacities each with sub critical Parameters have been selected.

The annual generation will be 5676.4 M.U. at a plant load factor of 90%. This Project will use about 2.645 Million Tons per annum of imported coal & 5676 KL per annum of Light Diesel oil / HFO for the above generation.
Water requirement will be 425 m³ per day for cooling and consumptive use for the proposed units.

3.4.1. Unit Size Selection

Following major criteria are given utmost considerations while selecting unit size and plant configuration:

- Cost of generation
- Load demand
- Power cycle efficiency
- Proven 'unit' generating set
- Reduction in size of the equipment due to adoption of Sub-critical Technology.
- Lesser Environmental effects

- The contribution of bigger unit sizes has been increasing over the years and today 200/210 MW and 500 MW, 660 MW & 800 MW units constitute about maximum percentage of total thermal capacity. With the progressive increase in installed capacity, higher share of thermal generation and large peak to off peak ratios, backing down (part load operation) and cyclic operation of thermal units would become imminent.

- From consideration of stability, the system should be able to withstand contingencies involving outage of one such unit without loss of grid stability. The stability studies show that the system planned for 10th and 11th Plan periods, can generally withstand outage of units up to 1000 MW and 1300 MW respectively. At present, Eastern Region, North Eastern Region and Western Region are already in synchronous operation and as such, the “K” factor (Power Number) of this network is quite large- in the range of 2000 to 3000 MW/Hz. In such system dip in frequency following outage of 1000 MW unit would be less than 0.5 Hz. Accordingly the present grid system can support larger units.

- Considering the above and availability of land and other resources, 2 X 360 MW units on Sub-Critical parameters with Pulverized Coal fired power plant has been selected based on the above.

- Sub-Critical Technology has been a proven and time tested one for units above 200 MW. A large population of thermal units in India is adopting this technology and the metallurgy has also been successful so far. Further present day manufacturing units can easily supply spares and other services.

- Initial cost of Sub Critical units is also lower compared to Super Critical unit cost.
CEA has emphasized the urgent need for introduction of large scale thermal plants in environmentally friendly manner. Thus, in order to achieve the twin objective of quick capacity addition and better efficiency, unit size of 2 x 360 MW Sub-critical Power Plant is ideally suitable.

Thus, for this project, 2 x 360 MW generating set operating in Sub-critical pressure / temperature range with single reheat has emerged as a favorable configuration.

**Selected 2 x 360 MW Unit Parameters**

The parameters for the aforesaid proven selected thermodynamic cycle are as follows:

- Superheater Outlet : 170 Bar / 565 °C
- Reheater Outlet : 45 Bar / 565 °C
- Turbine ESV inlet : 165 Bar / 560 °C
- Condenser Vacuum : 0.18 Bar a
- Output @ generator terminal : 360 MW excluding excitation loss

### 3.5. PROJECT DESCRIPTION WITH PROCESS DETAILS

#### 3.5.1. Power Equipment and Systems

The 2 x 360 MW Power Plant Process Flow Diagram is enclosed as Annexure – 6.

The 2 x 360 MW unit shall consist of the Sub-critical Steam Generator with natural circulation; single reheat, condensing, extraction type steam turbine and generator, air cooled condenser, condensate extraction and feed water systems, heaters and all equipment for reheat regenerative feed heating.

The unit shall be provided with adequately sized HP and LP turbine bypass stations for quick hot start-up and to provide stability during large load throw-off conditions.

Process Flow Diagram indicating project components details is enclosed as Annexure-6.

Plot Plan indicating project Layout details is enclosed as Annexure - 4.

#### 3.5.2. Mechanical Equipment and Systems

##### 3.5.2.1. Steam Generator and Accessories

The Steam Generator shall be of natural circulation with Subcritical steam parameters, drum type, single reheat arrangement for firing pulverized coal.
The Steam Generator shall be designed to fire 100% imported coal having the characteristics as shown in fuel analysis.

The steam generator will have the following accessories:

- Soot Blowing System
- Air Pre-heaters
- Draft System
- Milling system with Coal Pulverizing Mills
- Support Fuel Oil System

3.5.2.2. Electrostatic Precipitators

Each steam generating unit shall be provided with the required electrostatic precipitators (ESP). Each ESP shall have four parallel gas paths. Each gas path can be isolated for maintenance while the other path being in operation. Each path shall comprise of the required number of fields in series for collection of fly ash. The ESP will have efficiency of around 99.9%. The ESP will have adequate number of ash hoppers provided with electric heaters. ESP will be provided with Microprocessor based controller. The design of ESP shall be such that the outlet dust burden or solid particulate matter (SPM) content at its outlet does not exceed 50 mg/Nm$^3$ at 100% MCR with worst coal, with one field out of service.

3.5.3. Steam Turbine and Accessories

3.5.3.1. Steam Turbine

The steam turbine would be tandem compounded, single reheat, condensing, horizontally split machine with uncontrolled extractions for Four (4) LP heaters, Three (3) HP heaters and One(1) Deaerator. The steam turbine will consist of proven HP turbine, IP turbine, and LP turbine modules. However the final number of heaters will depend upon the steam turbine supplier selected for this project.

The turbine will have a lubricating oil system for supplying oil to turbine and generator bearings and also to hydrogen seal oil system of the generator. The lubricating oil will be cooled by closed circuit cooling water system water as cooling medium.

Necessary protective & supervisory system will be provided to ensure trouble-free, safe and efficient operation of the turbine generator. Each unit will be guaranteed to generate 360 MW at generator terminals continuously.
3.5.3.2. **Air cooled Condenser**

The condenser will be air cooled condenser designed as per the requirements of Heat Exchange Institute Standards for Steam Condensers and ASME. The materials used will be conforming to acceptable and reputed material specifications and standards. The condenser will be sized to condense the maximum quantity of exhaust steam. The exact condenser parameters will be optimized on the basis of site data and most economical combination of cooling surface and cooling air requirement. The condenser will be designed as per HEI. The ACC will be suitable for outdoor installation. The ACC will be direct air cooled type with forced draft. The noise levels will meet with the OSHA requirements. The ACC will be of ‘A’ frame type supported on RCC columns or steel frame. The arrangement of the ACC will be in single row preferably, with number of modules. (Number of modules may be finalized during detailed design). The air flow control through the ACC will be through fan's speed control with two speed motors or single speed motor with VFD.

For each unit, 3 x 50% vacuum pumps will be provided to maintain the vacuum in the condenser by expelling the non-condensable gases.

3.5.3.3. **HP / LP Turbine Bypass System**

HP and LP turbine bypass system will be provided along with the steam turbine and auxiliaries. The bypass station will be sized for a flow corresponding to 60% of steam generator MCR.

3.5.3.4. **High Pressure Steam turbine driven Feed Pumps & Deaerator**

Each unit shall be equipped with 3 x 50% (2 no. turbine driven working + 1 no. motor driven as standby) feed pumps with the booster pumps mounted on the common shaft. For deaerating and heating of the feed water the unit will be provided with a spray-cum-tray type deaerating heater with a horizontal feed water storage tank of 6 minutes capacity of steam generator MCR condition. The deaerator will be designed to keep the oxygen content of the condensate below 0.005 cc/litre with zero free carbon dioxide.

3.5.3.5. **Condensate Extraction pumps & Regenerative system**

3 x 50 % capacity Condensate Extraction Pumps & Regenerative Feed Water Heating System will also be provided as a part of turbine auxiliaries

3.5.3.6. **Coal Unloading, Transportation and Feeding System**

Coal handling plant (CHP) will be consisting of 2 nos. hydraulic truck tipplers), 2 nos self-tippling platforms, crushers / stacker cum reclaimers and conveyors from the
stockyard and conveying the same to steam generator bunkers. The scheme of coal handling system comprises of:

- Hydraulic truck tipplers
- Hoppers
- Vibratory feeder
- Belt Conveyor
- Belt Scales
- Magnetic separators
- Metal detector
- Coal Sampling Units
- Crusher & screens
- Stacker cum reclaimers
- Reclaimer
- Travelling Tripper
- Dust suppression system
- Dust extraction system in enclosed areas like transfer point, bunkers
- Hoists/ Equipment handling facilities
- Control and instrumentation
- Electrical System
- Ventilation System
- In-motion weigh bridge
- Safety and protective instrumentation

The coal handling system shall be designed for:

- Imported coal requirement for 2 x 360 MW unit at Turbine MCR condition (@ 90 % PLF & GCV of 5100 Kcal/Kg – 8054 T / day
- 12 hours operation
- The maximum lump size of the coal received from coal block or linkage at power plant site will be 250mm.
• Coal stockyard for stacking of crushed coal will be for 15 days at full load considering this as a pithead station.

• For conveying coal from unloading area to the stockpile and from stockpile to SG bunkers, two streams of conveyors and equipment will be provided.

3.5.3.7. Fuel Oil Handling System

HSD shall be used as supporting fuel for boiler cold start-ups and HFO for hot start up and flame stabilization during low loads. HSD / HFO shall be brought to plant by road tankers and shall be unloaded and stored in storage tanks of adequate capacity by means of 3 x 50% unloading pumps. 2 nos of 1000 T capacity each for HFO and 2 nos of 500 T capacity each for HSD will be provided. The HSD / HFO forwarding system having 3 x 50% forwarding pumps will feed the boiler burner at the required pressure and temperature.

3.5.4. Ash Handling System

Bottom ash & fly ash will be collected in dry form to facilitate utilization and the unutilized fly ash will be disposed in ash dyke. The system adopted for bottom ash removal would be Dry Bottom ash handling system and for fly ash removal, pneumatic system will be used. Ash disposal would be carried out in dry form using trucks from the ash silo for external agencies.

3.5.5. Mill Rejects Handling System

Mill rejects will be handled by 1 no. belt / pneumatic conveyor system for each unit. Mill rejects / pyrites discharged from the mills will be fed to the steel storage silo of 24 hour capacity through conveyor and auto operated gates provided at the outlet of mill reject hoppers. The silo will be located adjacent to the mill bunker building. The rejects from the silo will be disposed off-site by trucks.

3.5.6. Plant Water System

The plant water system will be designed to supply cooling water makeup and other consumptive water requirement for the proposed plant. A closed cooling water system partially employing fin fan coolers and adiabatic coolers has been envisaged for the proposed unit to minimize the plant water intake requirement. The proposed scheme of water system comprises of the following.

The plant water requirement will be around 425 m$^3$/day met by a number of bore wells inside the site. Separate pumps from each bore well will be pumping water into a raw water reservoir which will have storage capacity adequate to meet the plant water requirement for around 7 days.
3.5.6.1. Pre-Treatment Plant and Raw Water Distribution System

Two (2) raw water supply pumps will supply raw water from reservoir to pre-treatment plant to cater to the needs of the following primary water circuits:

a. Demineralization Plant
b. Cooling Tower Make up and Closed Circuit Cooling Water Make Up
c. Plant Service Water and Fire Water Requirement

The raw water is expected to have high turbidity / suspended solids during monsoon and with the quality of water required for various systems in the plant being clarified water, it is proposed to include a pre-treatment system to treat the raw water.

Now the raw water is pumped with the help of raw water pumps to the pressure sand filter. Then the filtered water from PSF is fed into the Activated carbon Filter which in turn feeds the filtered water into the Softener. The backwash water of PSF & ACF shall be routed back to the Sedimentation Tank (Client’s scope) with 90 minutes retention time. The clear water from the sedimentation tank shall be circulated back to the raw water storage tank with the help of dedicated pumps. Finally, the feed water passes through micron cartridge filters, where the fine suspended impurities are kept below limits to ensure that RO membranes are not clogged. The Micron cartridge filter discharge header shall be provided with an on-line Oxidation Reduction Potential meter (ORP) for detection of any free chlorine in the water.

3.5.6.2. RO - MB Plant

The pre-treated soft water is pumped by High pressure RO module – 1 feed pumps of a rated capacity to the RO module – 1 system.

The two modules of the RO system shall consist of set of cleaning system consisting of RO cleaning tank, RO cleaning pump & cartridge filter. The cleaning system shall be used for membrane cleaning, whenever required.

The product water obtained from the RO module – 1 system is pumped by High pressure RO module – 2 feed pumps of a rated capacity to the RO module – 2 system.

The dissolved solids in the water are reduced in the RO system.

The Post treatment system consists of single stream of Degasser Tower, Degasser Blower, Degassed Water Storage Tank, Degassed Water pumps & two streams of Mixed Bed Exchangers provided for final polishing of water to render desired quality of DM water, Mixed Bed Blowers with both acid measuring tank and caustic dilution tank. The degassed water collected in the degassed water storage tank, shall be pumped by
degassed water transfer pumps to the MB and to the DM water storage tank. The head of the degassed water pumps to be selected in such a way that the DM water to be pumped upto the DM water storage tank of 750 m³ capacity (24 hrs’ requirement of the plant). The three nos. of (3 x 50%) DM water Transfer pumps of suitable capacity will be provided to transfer the DM Water from the DM plant storage tank to Condensate storage tanks which will feed power cycle make up, CCW system make up, chemical dosing requirements, Hydrogen gas plant, Stator water cooling system etc.

Two (2) nos (@ x 100%) SG fill pump shall also be provided in the DM tank. The SG fill pump shall draw water from the tank and fill the SG unit before start-up.

3.5.7. Auxiliaries Cooling Water System

The cooling water requirement of the main / auxiliary equipment is taken care by the closed cooling water system for each unit separately. The cooling medium for CCW system is DM water. The major equipment requiring cooling water is as follows:

a. Steam Turbine Lube Oil Coolers  
b. Auxiliary turbine for BFP lube oil coolers  
c. Generator gas Coolers, Stator water coolers  
d. PA,FD & ID Fans  
e. Boiler Feed Water Pump Bearings, Hydraulic Coupling Oil Coolers  
f. SWAS Sample Coolers  
g. Coal Mills  
h. Air Heater Bearings  
i. Eco / APH Hoppers if required

With a view to reduce water consumption, CCW system will be proposed with a partial dry cooling system using fin fan coolers and another wet cooling system with adiabatic coolers which will consume minimum raw water for spray. The return cooling water from each cooler is collected & pumped through a header to the radiator cooler (Fin Fan Cooler) where fans circulate air and remove the heat / adiabatic cooler, where water sprayed air will be forced thru’ the heat exchanger to remove the heat. The cooled water is then distributed to all coolers, where it removes the heat from the lube oil / equipment etc. Both systems will be provided with 3 nos circulating pumps separately. A CCW expansion tank is provided in each system, where the makeup water is added and ensures a flooded suction to the closed cooling water pumps located below. No of fin fan coolers / adiabatic coolers will be decided during detailed engineering.
3.5.8. Service Water and Potable Water System

The service water system covers supply of water ash dust conditioner, air heater washing, air washer and miscellaneous water requirements such as fire protection system, dust suppression system in coal handling plant, plant washing & gardening etc.

Two (2) horizontal, centrifugal pumps, (1 no. working and 1 no. standby) will pump water from the clarified water storage tank to the service water overhead tank located at an elevation of about 30 m. Water from the overhead tank to the different consumer points would be distributed by gravity.

Requirements of the plant potable water system will be met from the filtered water storage tank located on the roof of the DM plant building. Two (1 no. working and 1 no. standby) horizontal, centrifugal type potable water pumps dedicatedly for plant and Two (1 no. working and 1 no. standby) horizontal, centrifugal type potable water pumps for colony shall be envisaged. The above potable water pumps will draw suction from the filtered water tank for further distribution of potable water to various consumption points in the plant and colony.

3.5.9. Effluent Treatment Plant

a. The plant is designed for zero liquid effluent discharge. The liquid effluents will be collected in ETP and treated / recycled generally as per the following:

b. Effluents from steam generator, turbine, transformer yard and other areas, which may contain oil traces, will be sent to oil / water separator. The oil will be pumped out periodically and trucked offsite for disposal. The treated water of significantly low quantity will be directed to central monitoring basin.

c. Rainfall runoff from the coal pile will contain mainly suspended solids. This runoff will be routed to the settling basin for retention and settling of suspended solids, and the clear water from there will be used for dust suppression in the coal pile area.

d. Filter backwash waste, which is generated in raw water pre-treatment system and contains high-suspended solids, will be directed to waste water tank for further re-use and to minimize wastewater effluent.

e. All chemical feed and storage areas will be contained by curbing, which will have sufficient volume to contain the chemicals stored within the area. All chemical area drains and demineralization regeneration wastes are directed to the neutralization basin. The neutralized effluent will be sent to Waste water treatment plant and the treated effluent will be reused.
f. The neutralized effluent from DM plant and CPU and WTP RO stage-1 rejects will be passed thru’ a chain of clarifier, filters and RO modules where the product water will be sent to Raw water reservoir and the rejects will be reused or sent to evaporation ponds for final disposal.

g. Boiler blow down will be very minimum. However blow down water will be mixed with raw water and sent to ETP for further treatment and disposal. Blow down from adiabatic coolers, if any, will also be added to this.

h. CMB will have a guard pond of 24 hrs’ capacity where effluents from item i to item above will be mixed, treated and reused.

3.5.10. Fire Detection and Protection System

a. A comprehensive fire detection and protection system is envisaged for the complete power station. This system will generally conform to the recommendations of TAC guidelines and NFPA - 850.

b. The following fire detection and protection systems are envisaged,

c. Hydrant system for complete power plant covering the entire power station area

d. Automatic high velocity water spray system for all transformers located in transformer yard and those of rating 10 MVA and above located within the boundary limits of plant, main and unit turbine oil tanks and purifier, lube oil piping (zoned) in turbine area, generator seal oil system, lube oil system for boiler feed pumps

e. Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room, CHP control room and ESP control room, conveyors, galleries, transfer points and crusher house, uninsulated fuel oil tanks storing fuel oil having flash point 65°C and below

f. Foam injection system for fuel oil storage tanks

g. Clean Agent Extinguishing system for protection of control room, equipment room, computer room and other electrical and electronic equipment rooms

h. Fire detection and Alarm system to cover the complete power plant

i. Portable and mobile extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.

j. Required fire tenders/engines of water type, DCP / foam type, trailer pump with fire jeep etc will be provided in the fire station.

Fire hydrant & spray pumps will be installed in the raw water pump house.
Horizontal type fire hydrant pumps (1 no electric driven +1 no diesel driven) will be installed in the pump house for hydrant and Horizontal type spray pumps (1 no electric driven +1 no diesel driven) for spray system as per TAC guidelines. The water for foam system will be tapped off from the hydrant system pumps. Separate booster pumps (1 no electric driven +1 no diesel driven) near Boiler area will be provided as the boiler height will be about 60-70m. For the above system, automatic pressurization system consisting of jockey pumps and air compressors will be provided.

3.5.11. Plant Air and Instrument Air System

Plant / service air and instrument air system shall include suitable capacity and duty rotary screw / centrifugal compressors having a discharge pressure of 8.5 kg/cm². Air drying plants of adequate capacity will be provided near main plant.

The air-drying plants will be capable of achieving a dew point of (-) 40°C at atmospheric pressure. Suitable number of air receivers will be provided near each air compressor and further unit air receivers will be provided near main plant of each unit.

Total 3 (2W+1S) Screw type air compressors shall be installed for both the units. 2 Nos compressors shall be sized to meet Instrument and service air requirements under normal condition. Interconnection will be made from service air to the instrument air system to provide back-up for instrument air system.

3.5.12. Air Conditioning System

Inside design conditions of 24.5 ± 1.5 °C dry bulb temperature and relative humidity not exceeding 60% is proposed to be maintained in all air-conditioned areas.

Air conditioning system will be provided for all those areas, which require close control of environment conditions and will cover the following areas:

- Central Control Room consisting of Control Rooms,
- Control Equipment rooms,
- Telecommunication Rooms,
- Microprocessor,
- Computer and Programmers Rooms,
- Data Storage Rooms,
- UPS Rooms,
- Instrumentation Laboratory and Steam and Water Analysis Rooms,
- Conference Room,
- Shift Charge Engineer's Room (if applicable),
- Relay Rooms.
- Other areas like control rooms of Switchyard / ESP /AHP / CHP / Administrative building / WTP / ETP etc will be provided with package type / split type air conditioning units.

3.5.13. Ventilation System

Ventilation system will be designed to supply fresh outdoor air and will be selected for maintaining inside conditions for those areas where close control of temperature is not required, but nevertheless have a stipulated maximum temperature.

The following areas will be provided with forced ventilation system with filtered supply air and exhaust fans / roof exhausters:

- All floors of turbine building other than the area which is air-conditioned.
- Switchgear rooms and cable galleries of main plant
- Non air conditioned area of ESP control room
- Any other areas where equipment heat load is high.
- Battery rooms, chemical stores and toilets will be provided with exhaust ventilation with minimum 15 air changes.

All other buildings / areas will be ventilated by mechanical ventilation process using combination of supply air fans and roof exhausters or wall mounted exhaust fans.

3.5.14. Piping System

Piping, valves, fittings, supports, for steam, condensate, water, oil, air and others etc. will be provided as per the requirement of the systems. Pipelines running outside the powerhouse will be routed on pipe trestles to the extent possible. However large diameter raw water and cooling water pipes will be buried. Proper protection by wrapping coating and/ or other necessary corrosion protection devices will be taken.

3.5.15. Chemical Feed System

Although high purity water will be used as heat cycle make-up, careful chemical conditioning of the feed steam condensate cycle is essential as a safeguard against corrosion and possible scale formation due to ingress of contaminants in the make-up system. High Pressure dosing using phosphate to the drum and Low pressure dosing with hydrazine and ammonia in deaerator / suction of feed pump / condensate pipe have been envisaged.
HP dosing system will inject sodium phosphate in the boiler water for water conditioning to suppress corrosion of the plant components/ material and to maintain the required water quality.

The purpose of LP dosing system is to maintain the pH of condensate and feed water and to effectively deal with residual dissolved oxygen in condensate and feed water. Both systems complete with dosing pumps, tanks, associated piping, supports, fittings, valves along with all necessary instrumentation and controls etc. shall be provided accordingly.

3.5.16. Hydrogen Generation Plant

A hydrogen generation plant has been envisaged in order to fill up high-pressure hydrogen cylinders, which are required for generator initial fill up and regular make up required for generator rotor cooling. Hydrogen generation is accomplished by water electrolysis process. The plant will be designed as per the regulations of the Explosives Authority with all the required safety aspects, instrumentation control, including on-line hydrogen purity analyzer system and control panel.

3.5.17. Thermal Insulation

All equipment / pipes / ducts whose surface temperature is higher than 60°C, will be provided with thermal insulation for personnel protection and heat conservation. The insulation material will be chemically inert, non-combustible and will be harmless.

3.5.18. Elevators

Following elevators shall be envisaged for this plant

- 1 no Passenger-cum-freight lift in power house building of 1000 kg Cap
- 1 no Passenger-cum-freight lift in Boiler of 2000 kg Cap
- Chimney (Stack) elevator
- Any other areas where necessary

3.5.19. Cranes and Hoisting Equipment

Two (2) EOT cranes of suitable capacity will be provided in the Turbine Hall, which will be used for lifting/ unloading of heavy equipment at the unloading bay and also for erection and maintenance of heavy equipment.

Conventional and special type of cranes required for maintenance of certain SG and TG equipment will be supplied by the respective equipment supplier.
Miscellaneous hoist shall be provided in all areas under the scope of BOP packages (except the area covered by EOT cranes for turbine hall). The exact requirement of EOT cranes shall be decided during detailed engineering. Suitable rails will be provided on floor for bringing the horizontal feed water heaters under the approach of EOT cranes.

3.5.20. Painting and Corrosion Protection

All mechanical and electrical equipment including piping system and structures will be painted with international standards / IS standard colour code for ease of identification. All steel structures will be painted with epoxy resin based paints. All buried piping will be provided with bitumen paint based coating and wrapping.

3.5.21. Workshop and Laboratory

The power plant will be equipped with a work shop capable of catering to the routine maintenance requirements of the plant.

A central chemical laboratory adjacent to the DM plant building is envisaged for the station. This will have necessary equipment and facilities to test and analyze steam, water, oil, coal etc. required to ensure satisfactory operation and maintenance of the station.

3.5.22. Electrical Equipment and Systems

General Design Philosophy and Design Features

Considering the capacity of project as 2 x 360 MW and availability of State Transmission systems, it is proposed to adopt the evacuation voltage level as 400 kV. Power generated from unit would be stepped up to the evacuation voltage level through suitably rated Generator Transformer and will be evacuated through 400 kV transmission lines.

Presently one no. 400 kV Double Circuit outgoing line has been considered for evacuation of generated power. Accordingly provision for 2 Nos. of 400 kV line bays has been kept in switchyard. 400 kV Gas Insulated Switchyard will be designed with one and 1/2 breaker scheme.

3.5.23. Auxiliary System

The voltage adopted for the AC auxiliary systems are:

- 415 V for motors rated up to 200 kW.
- 6.6 kV for motors above 200 kW and above.

All electrical equipment shall be rated for an ambient temperature of 50 °C.
3.5.23.1. **DG Sets (Emergency Back-up)**

For the safe shut down of plant under emergency conditions two diesel generating sets, each of 750 kVA shall be provided, one each for one unit. The diesel generating sets shall supply power to all essential AC auxiliaries of the plant including emergency lube oil pump, seal oil pump, jacking oil pump and turning gear, battery chargers, firefighting system, UPS and ac emergency lighting system etc.

3.5.23.2. **Generator and Excitation System**

**Generator**

The main parameters of Generator would be as follows:

Nominal rating : 360 MW

Rated output : 424 MVA

Power factor : 0.85 (lag) - 0.95 (leading)

Rated voltage : As per manufacturer's Standard (in the range of 18 - 24 kV)

Speed : 3000 rpm

Short circuit ratio : Not less than 0.48

The Generator shall be capable of continuous safe operation at rated output and power factor under any of the following conditions:

- Terminal voltage variation of ± 5% of the rated value.
- Frequency variation within 47.5 to 51.5 Hz.
- Absolute sum of combined voltage & frequency variation of 5%.

The Generator winding will be star connected with the phase & neutral terminals brought out for connection to isolated phase bus duct. The star point will be connected to earth through a transformer having the secondary shunted by a resistor. The generator shall be provided with Class 155 (F) insulation. The Generator shall generally comply with the requirements specified in IEC – 60034-1, 60034-3, etc.

The stator winding of the Generator shall be cooled by means of de-mineralized water, passing through hollow stator conductor. The core and the stator shall be cooled by hydrogen gas which in turn shall be cooled in hydrogen gas coolers with DM water as coolant.
Generator auxiliary system like stator water system, hydrogen cooling system, seal oil system and CO2 system for purging of hydrogen and fire protection system with suitable capacity shall be provided.

The excitation system shall be static / brushless type with DVR.

**Power Transformers**

**Generator Transformer**

Each 2 X 360 MW unit shall have three (3) single phase transformers with combined rating of 424 MVA, for the Generator Transformer. One no. single phase unit shall be provided as spare.

The transformer will be mineral oil filled, ‘OFAF’ cooled. Generator transformer will be provided with on line circuit tap changer. The transformer winding will have vector group Ynd11. Transformers will be provided with requisite protection devices and accessories.

**Unit Transformer (UT)**

Two number Unit Transformers will be provided for each unit. Each unit transformer will be three phase, two winding, outdoor, Dyn1, oil filled with ‘ONAF’ cooling. The transformer will be provided with Off Circuit tap changer. The capacity of the unit transformer shall be selected on the basis of the unit auxiliary load with due consideration to the starting of the largest motor, available circuit breaker capacity and voltage regulation requirement.

**Station Transformer (ST)**

The Station Transformers shall be of three phase, three winding 400/6.6/6.6 kV, outdoor oil filled, ‘ONAF’ cooled. The Station Transformers supply the 6.6 kV station switchgear. The transformers will be provided with On-load tap changer with ±10% tapping on the HV side. One number Station transformer is envisaged in the Power station.

**Low Voltage Auxiliary Transformers**

Required quantity of 6.6kV / 433 V adequately rated transformers for supplying the unit loads and station low voltage loads shall be provided. The transformers shall be sized on 2 x 100% or 3x50% rating basis. These transformers will be provided with off circuit tap changer ± 5%. The auxiliary transformers will be DYn11 connected and the neutral will be effectively grounded.
These transformers shall be mineral oil filled (ONAN cooled) for outdoor installation or epoxy cast resin/resin encapsulated type in case of indoor installation.

3.5.23.3. 400 kV Gas Insulated Switchyard

400 kV GIS shall be designed with one and a half breaker scheme. 400 kV switchyard shall be provided with the following fully equipped bays.

- 2 – Generator transformer bays
- 2 – 400 kV line feeder bays
- 2 – Station transformers bay
- 1 – Reactor bay

The switchyard will be provided with necessary circuit breakers, disconnectors, earthing switches, current transformers, capacitor voltage transformers, surge arrestors, lightening arrestors, protective relays etc. The control and supervision signaling of the 400 kV switchyard will be through SCADA in the switchyard control room. All operationally important control commands and signals for reporting system status, fault and abnormal condition for electrical auxiliary system will be available in the SCADA.

There will be a separate room in the switchyard control room building for the DC system consisting of battery, battery charger and DC distribution boards for the 400 kV switchyard.

One set of dedicated instrument transformers and Electronic (KWH / KVARh) meters compatible to CEA’s Metering code for each metering point shall be provided on the 400 kV feeders to measure Active and reactive power and energy delivered to the Grid and also active and reactive power and energy received from grid. The meters shall be suitable for working in ABT regime. The meters, current transformer and voltage transformers will have an accuracy class of 0.2S.

3.5.23.4. Other Electrical Equipment

**BUS DUCTS**

*Generator Bus Duct (Isolated Phase)*
The generator shall be directly connected to the generator transformer through isolated phase bus duct. Current transformer and Voltage transformer for AVR, protection, metering etc., shall be provided in the generator bus duct.

**6.6kV & Low Voltage Bus Ducts**

Unit transformers and Station transformers will be connected to the 6.6 kV switchgears by phase segregated bus duct or by cables depending on the layout.

For connection of low voltage side of the Low voltage auxiliary transformer to the 415 V Switchgear, non-segregated phase bus duct of adequate rating will be used as permitted by the layout.

**SWITCHGEAR**

**6.6kV Switchgear**

The unit transformer or the Station transformers will supply to the respective 6.6 kV switchgears through suitably rated circuit breakers for further distribution to the 6.6kV voltage motors and to the Low voltage auxiliary transformers.

**415 Volt Switchgear**

415 Volt system consist of Power Control Centre (PCC), Motor control centers (MCC) and AC Distribution boards (ACDB) for distribution of low voltage power supply to motors and other plant consumers.

**Plant DC System**

The DC power system will supply power to DC emergency pumps, emergency lighting, protection, annunciation, control, indication etc. Each battery will have its own float / boost charger. Each of the unit batteries shall be sized for supplying the total DC load of the unit for a period of 30 minutes under a complete black out condition. The 220 V system will be unearthed. Each unit will have a 220V DC system comprising of one no. of Nickel-Cadmium / Lead acid plant batteries, and two nos. of float cum boost chargers. The battery charger will be of solid-state control rectifier type. One battery set for Station auxiliaries in BOP areas has been considered. Separate batteries for 400kV switchyard have been envisaged.

**Uninterruptible Power Supply (UPS) System**
The uninterruptible power supply (UPS) system provides a reliable and interruption free source of required voltage, three/single phase power to the vital part of the plant control system for plant control and emergency shutdown. 2x100%, 240 V UPS sized to supply the Power Plant DDCS critical equipment is envisaged.

**Illumination and Small Power Supply System**

The plant lighting system will comprise of normal AC lighting and emergency lighting. The lighting from the luminaires supplied from the normal AC and emergency AC power supply will provide 100% illumination. The AC emergency lighting will provide 20% of the total illumination required in the area. DC emergency lighting will be provided in selected areas of the plant. HP mercury vapour, sodium vapour (LP and HP), compact fluorescent lamps (CFL), incandescent lighting fixtures etc. Energy efficient lamps will be used for energy conservation.

The illumination level in the different parts of the power stations shall be as recommended in IS 3646. The choice of the type of luminaire (lighting source) will depend upon the area to be illuminated.

**3.5.23.5. Neutral Grounding System**

400kV system is considered as solidly grounded as per the prevailing practice.

Generator Neutral will be grounded through distribution transformer resistor loaded secondary limiting the earth fault current to 10 Amps.

For having selective tripping on earth fault and limiting the over-voltages and also damage to equipment due to incidence of the earth fault, medium resistance grounding of 6.6 kV systems neutral is envisaged. The 6.6kV system neutral will be grounded through resistance with fault current limiting to 300 amperes.

415 V system is envisaged as solidly grounded as per Indian Electricity Rules.

**Safety Grounding**

The equipment body grounding is adopted to provide protection to personnel from potential hazards caused by ground faults and lightning discharges through low resistance conducting path to the ground. A stable ground grid will be provided for grounding equipment and structures maintaining the step and touch potentials within safe limits.
The plant grounding system will be designed as per the requirements of IEEE-80 / IEEE 665/IS-3043. The plant grounding will utilize Mild Steel Rods. Equipment grounding conductor will be of galvanized steel flats/GI wire.

**Lightning Protection**

The chimney and powerhouse building including switch yard will be equipped with lightning protection. Lightning protection conductors located on the top of the structures will be connected to the ground loop surrounding the structures with downcomers as per the provisions contained in the latest issues of Indian Electricity Rules and IS 2309.

**Plant Electrical Control System**

The complete electrical system of Power Plant shall be controlled and monitored from the Plant DDCS system. A Backup Electrical Control panel will be provided, if required.

- Generator System
- 6.6 kV System
- 415 V System

All operationally important control commands and signals for reporting system status, fault and abnormal condition for electrical auxiliary system will be available in the DDCS. Synchronizing facility shall be provided for each 400 kV generator circuit breaker. Check synchronizing relay shall be provided for synchronized closing of each 6.6 kV unit transformer incomer circuit breaker and unit to station bus tie 6.6 kV circuit breakers.

The emergency DG Set will be started automatically in case of failure of the normal AC auxiliary supply. Manual starting facility from the DDCS will also be provided in addition to automatic starting.

**Electrical Protection System**

For protection of equipment against abnormal system conditions, state-of-the-art protective devices will be installed in the respective switchgear and/or relay panels. Each equipment shall be provided with a unit as well as backup protection. Also, protection against lightning surges will be provided with lightning arresters at suitable locations for outdoor equipment over and above the shielding wires and lightning masts. The protective relays shall be of numerical type.

All protective relay panels will be of free standing, floor mounting, and sheet steel enclosed. The panels will be located in air-conditioned rooms.
Clock System

A master clock panel will be installed in the switchyard control room for correct time keeping and frequency monitoring. The master clock will drive a number of slave clocks located at key points throughout the power plant. The clock system will have its own DC battery and charger.

Plant Communication System

The following communication facilities would be provided for fast communication between the plant personnel for efficient operation, maintenance and handling of emergency conditions.

An EPABX telephone system covering entire main and auxiliary plants and colony.

Dedicated distributed public address systems party and paging channel for unit and one common public address system for main plant, one public address system for coal handling plant.

3.5.24. CONTROL & INSTRUMENTATION

EQUIPMENT AND SYSTEMS

Design Philosophy

The control and instrumentation system for the generating unit of the plant will be designed to ensure safe, efficient and reliable operation of the plant under all regimes of operation viz. start up, shutdown, normal operation, part load operation and under emergency conditions resulting in cost effective power generation with optimum fuel consumption and reduced emission levels.

The operation, control and monitoring system would be based on a state of the art microprocessor based Distributed Digital Control Monitoring and Information System (DDCMIS). The DDCS will provide a comprehensive integrated control and monitoring system to operate, control and monitor the Steam Generator and auxiliaries, Steam Turbine-Generator and auxiliaries and Balance Of Plant (BOP) systems including all main plant equipment and auxiliaries with a hierarchically and functionally distributed structure.

Monitoring and control, Data acquisition, alarm annunciation, fast response time, fail safe design, sequence of events recording, online diagnostic and online maintenance
are some of the inherent features of the DDCS to be designed for the proposed Power Plant.

Plant operation and control will be through the Operator Interface Units (OIU) located on the Unit Control Desk (UCD) in the Central Control Room which will consist of colour graphic LCD (TFT) monitor, keyboard/Mouse and also through Large Video Screen (LVS) connected to dedicated LVS work stations.

The main plant unit controls will be located in one central control room. DDCS will include the sequential control and protection of the steam generator, steam generator auxiliaries, turbine, turbine auxiliaries and the modulating controls of the main plant process of the air and flue gas cycle and steam and water cycle including Co-ordinated Master control. DDCS would also include the Turbine governing and other Turbine modulating controls.

All sequential control functions for the main plant including Steam Generator and the Steam Turbine Generator and their auxiliaries along with Balance of Plant (BOP) equipment and systems controls will be interfaced into the DDCS so that centralized drive operation for the main plant, the auxiliaries and the Balance of Plant is possible.

The control functions will be backed up by protection, interlocks and safety functions. This would cause pre-planned actions in cases where unsafe conditions develop faster than the control capability of modulating controls or before the operator can be expected to respond to the plant upset conditions in any regime of plant operation.

Operation and Monitoring of Plant Electrical and downstream System will be performed through DDCS. Additionally, DDCS will have a redundant Software link with SCADA System for monitoring of Switchyard electrical system.

Sequence of Event Recording function will be provided for recording and printing occurrence of events in a chronological order for quick diagnostic of fault and remedial action.

DDCS will perform online performance calculations to determine plant/equipment efficiency and to detect and alarm unit/equipment malfunctions.

The plant offsite systems like Water treatment, Coal handling, Ash handling, Instrument and Service air system etc. will be controlled and monitored through the respective Local Control panels and control systems. Independent and Stand-alone PLCs in hot redundant configuration will be used for control and monitoring of these offsite systems. PC based Operator Interface Units (OIU) with LCD (TFT)/KBD/ Mouse will be provided for these offsite systems, which will be kept in the respective Local Control Areas.
Additionally, control and monitoring of these offsite packages shall be possible from DDCS Operator Interface unit and Large Video Screen (LVS) from Central Control Room.

Plant abnormal conditions will be alarmed through the Operator Interface Units. Alarm printer will be provided to print out all alarms with time tagging and in the chronological order. Additionally the signals, critical in nature, will also be connected to Plant main DDCS by hardwired connection.

**Steam and Water Analysis System (SWAS)**

Recognizing the importance of water chemistry in the power plant operations, a centralized comprehensive Steam and Water Analysis System (SWAS) for each unit will be provided for continuous on line monitoring of water and steam purity in the plant cycle. Measurements of Conductivity, pH, Hydrazine, Dissolved Oxygen, Silica, Sodium and Phosphate will be provided.

**Stack Emission Monitoring System**

Continuous Emissions Monitoring System (CEMS) for monitoring of Flue gas Emissions from the Stack of the Plant will be provided, which will consist of the following analyzer Instruments:

- Oxides of Nitrogen NOx
- Sulphur Dioxide SO2,
- Carbon Monoxide CO
- Stack Opacity Monitor.

CEMS will be complete with in situ flue gas analyzers. PC based Emissions Monitoring System with 21” Colour Graphic LCD / TFT Monitor with Keyboard, Mouse along with Laser jet Printer. A software link will be provided to hook up the Emission Monitoring System to the plant DDCS.

**Closed Circuit Television System (CCTV)**

Closed Circuit Television System (CCTV) with all equipment and accessories will be provided for the purpose of surveillance of major Electrical Drive areas e.g. Steam generator feed Pumps, ID Fans, FD and PA fans, Mills, Condensate Extraction Pumps and critical areas like Turbine hall, firing floor, ACW, CHP, Switch Yard, Main Gate, Pump House, Ash Plant areas etc. so that, by and large, all important areas and
equipment can be brought under surveillance. Also, cameras shall be installed at the Main Gate and other common auxiliary plants.

3.6. RAW MATERIAL AND FINISHED PRODUCT

Raw material required for the power project is the fuel and Process medium. i.e. coal, High Speed Diesel / HFO and water

Finished product is electrical energy.

3.6.1. Primary Fuel and Secondary Fuel

The primary fuel shall be coal and secondary fuel shall be fuel oil i.e. HSD / HFO.

**Primary Fuel Requirement, Estimated Quantity and Source**

The primary fuel of the proposed power plant (2 X 360 MW) shall be imported coal. The power plant shall require coal of around 2.645 Million Tonnes per annum (MTPA) based on the following:

- Plant Load Factor - 90%
- Station Heat Rate - 2377 kCal / kWh (as per CERC norms – design Heat rate x 1.065 )
- Gross Calorific Value of Imported Design Coal - 5100 kCal / kg
- Imported coal shall be purchased from Indonesia

**Mode of Transport of Coal**

Domestic coal would be transported from the mines to the site by road. Coal will be received at Chennai / Ennore Port wherefrom trucks will transport coal to the Station Coal yard.

Indonesian coal analysis is tabulated in **Annexure – 2**.

**Secondary Fuel Requirement, Estimated Quantity and Source**

Secondary fuel for the startup and stabilization of the power plant upto 30% BMCR conditions shall be High Speed Diesel (HSD) / HFO and shall be brought from nearest Oil depot. The annual requirement of HSD / HFO will be 5676 kL.

Fuel oil analysis is tabulated in **Annexure -2**.
3.6.2. Raw Material Water Requirement, Estimated Quantity and Source

Consumptive and cooling water requirement for the station comprising adiabatic cooler make-up, heat cycle make-up, other process water requirement along with evaporation and drift loss with recommended design margin works out about 17.7 m^3/hr for the 2 X 360 MW TPS. The system design would consider maximum recirculation of wastewater for use in less priority areas.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Estimated Quantity</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m^3/hr</td>
<td>m^3/day</td>
</tr>
<tr>
<td>1</td>
<td>CW make up for adiabatic coolers</td>
<td>2.66</td>
<td>64</td>
</tr>
<tr>
<td>2</td>
<td>DM water for SG makeup, ACW makeup</td>
<td>24</td>
<td>576</td>
</tr>
<tr>
<td></td>
<td>DM plant effluent</td>
<td>14.67</td>
<td>352</td>
</tr>
<tr>
<td>3</td>
<td>Total</td>
<td>41.33</td>
<td>992</td>
</tr>
<tr>
<td>4</td>
<td>Treated water from ETP available for reuse</td>
<td>23.63</td>
<td>567</td>
</tr>
<tr>
<td>6</td>
<td>Net water required from Bore wells</td>
<td>17.7</td>
<td>425</td>
</tr>
</tbody>
</table>

Water shall be sourced from BORE WELLS inside the plant.

3.6.3. MODE OF TRANSPORT OF WATER

The Raw water from various Bore wells shall be pumped to a raw water reservoir within the plant area thru’ a dedicated water pipeline to be laid. The raw water reservoir shall cater to the requirement of the station for any disruption in water drawl /supply system. The reservoir shall have two chambers for a total reserve capacity of 7 days’ consumptive water requirement.

3.6.4. Finished Product

3.6.4.1. Marketing of Finished Product – Power

The finished product power shall be shall be evacuated thru’ state Grid and sold to prospective buyers.

3.6.5. Mode of Transport of Finished Product - Power Evacuation

In view of large number of Power projects in the area as well as Power augmentation programmes by some of the Projects, TANGEDCO, the Transmission arm of TNEB has
planned to construct a 400 kV substation at Thervoikandigai near Gummidipoondi which shall be used for evacuating power from the proposed 2 x 360 MW Power project. The power plant shall be connected with the substation through a 400kV double circuit transmission line.

As per the details available from the report on development of transmission system for the upcoming generation projects in Tamil Nadu. The above Substation will be interconnected with TANGEDCO network for transfer of power to other areas including interstate transmission.

### 3.7. RESOURCE OPTIMIZATION / RECYCLING AND REUSE ENVISAGED

Coal consumption will be optimized by the use of Sub-critical parameters for steam generator.

Process Water consumption will also be reduced with the adopted cooling process i.e. air cooling arrangement for condenser and auxiliaries. Air cooled condenser will reduce the water consumption by about 75%.

The process medium water will be converted to steam in boiler and will deliver mechanical power thru’ turbine and be cooled in an Air cooled condenser. The condensed water will be recycled back to the boiler through regenerative system and reused in the process. Only startup quantity and makeup water shall be drawn from water system thus ensuring minimum use of water in the process.

Similarly Closed Cooling Water System for the auxiliaries will be adopted. In this system hot water from a part of the auxiliaries will be cooled in a Fin fan cooler and for the balance auxiliaries, adiabatic coolers will be used minimizing the CW consumption, since only startup losses will be made up.

Waste water emanating from DM plant, Oil water separator, Coal pile run off, blow down etc, will be suitably treated in ETP and reused.

### 3.8. AVAILABILITY OF WATER, ITS SOURCE, ENERGY/ POWER REQUIREMENT

The power project requires water for various purposes such as process medium, cooling medium, various services for equipment and staff including Firefighting and for drinking purposes in the power plant as well as in colony.

Water shall be sourced from Bore wells to be dug inside the plant. The plant water requirement will be around 17.7 m3/hr Water shall be pumped to a raw water reservoir within the plant area and dedicated water pipeline shall be laid up to the reservoir. The raw water reservoir shall cater to the requirement of the station for any disruption in
water drawl / supply system. The reservoir shall have two chambers for a total reserve capacity of 7 days consumptive water requirement

Approval for tapping the required consumptive water is being obtained from the concerned authorities

3.9. QUANTITY OF WASTES TO BE GENERATED (LIQUID AND SOLID) AND SCHEME FOR MANAGEMENT AND DISPOSAL

3.9.1. Liquid Waste Generated & Management and Disposal Scheme

The plant is designed for zero liquid effluent discharge.

Break up for the effluents:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Estimated Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>m3/hr</td>
</tr>
<tr>
<td>1</td>
<td>Flash steam to Atmosphere from IBD tank</td>
<td>7.2</td>
</tr>
<tr>
<td>2</td>
<td>Blow down from IBD tank</td>
<td>16.8</td>
</tr>
<tr>
<td>3</td>
<td>DM plant effluent including RO rejects</td>
<td>14.67</td>
</tr>
<tr>
<td>4</td>
<td>Adiabatic cooler make up</td>
<td>2.66</td>
</tr>
<tr>
<td>5</td>
<td>Total water required</td>
<td>41.33</td>
</tr>
<tr>
<td>6</td>
<td>Effluent available for treatment</td>
<td>31.66</td>
</tr>
<tr>
<td></td>
<td>(item 2 + item 3)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Treated water from ETP available for reuse</td>
<td>23.63</td>
</tr>
<tr>
<td>8</td>
<td>Rejects to Solar pond</td>
<td>7.84</td>
</tr>
</tbody>
</table>

Water for gardening and other uses like dust suppression, washing etc, will be met from the treated effluent available from the existing units

The liquid effluents will be collected and treated / recycled generally as per the following

A. Effluents from steam generator, turbine and other areas

Effluents from steam generator, turbine and other areas, which may contain oil traces, will be sent to oil / water separator. The oil will be pumped out periodically and trucked
offsite for disposal. The treated water of significantly low quantity will be directed to central monitoring basin.

B. **Rainfall runoff from the coal pile**

Rainfall runoff from the coal pile will contain mainly suspended solids. This runoff will be routed to the settling basin for retention and settling of suspended solids, and the clear water from there will be used for dust suppression in the coal pile area. Provision will also be kept for disposal of coal pile runoff to ash pond via central monitoring basin.

C. **Chemical area drains and demineralization regeneration wastes**

All chemical feed and storage areas will be contained by curbing, which will have sufficient volume to contain the chemicals stored within the area. All chemical area drains and demineralization regeneration wastes in DM plant area are directed to the neutralization basin. The neutralized effluent along with WTP RO rejects will be sent to Waste water treatment plant where a 2 stage RO plant will be used to treat the effluent and the treated effluent will be reused. Final reject from 2\textsuperscript{nd} stage RO module in ETP will be sent to evaporating pond.

D. **Boiler blow down**

Boiler blow down water which will be generated during start up and all load conditions will be quenched with cold water and reused in the plant.

3.9.2. **Sewerage System**

Sewerage from the Project shall be led into a sewerage treatment plant through a sewerage network using concrete pipe. Manholes shall be provided at every 30m and at all junctions. A permanent sewerage treatment plant shall be provided to cater to the sewerage discharge of the plant. The treated effluent shall be utilized for the irrigation of the landscaped areas.

Sewerage waste - 1000 l/hr (considering 300 persons to be employed)
fly ash escaping from furnace along with flue gas and will be collected under Electrostatic precipitator, duct and stack. The design of ESP shall be such that the outlet dust burden or solid particulate matter (SPM) content at its outlet does not exceed 50 mg / Nm3 at 100% MCR with worst coal, with one field out of service.

A maximum of 20% of the total ash produced by the Steam Generator would be collected in the refractory lined furnace hopper as bottom ash (BA) in dry form. Dry bottom ash handling system such as, one detailed below shall be provided. The bottom headers of the water wall in the pulverized fuel fired boiler will be at 4m above ground level to facilitate incorporation of the dry bottom ash handling system with a mechanically flexible sealing arrangement. The Dry bottom ash handling system shall include dry bottom hopper, surge hopper, S.S. conveyor, Crushers, surge hopper II and suitable conveying system upto bottom ash silo. Ash in silo will be unloaded to trucks for further disposal.

One (1) silo shall be used for storing bottom ash of 2 units (24 hrs’ storage capacity) considering difficulties in off-site disposal to external agencies). The capacity of bottom ash silo will be 80 T. Space provision will be made for future extension.

Fly ash will be collected in dry form to facilitate utilization and the un-utilized fly ash will be disposed in dry form. A dense phase ash handling system shall take care of fly ash from various boiler ash generation points and up to the outlet of fly ash silo including ash conditioning arrangement.

The fly ash collected in ESP hoppers shall be gravity fed into individual ash vessels provided below each hoppers. The fly ash shall be further conveyed to the fly ash silo with the help of compressed air through transport piping. The conveying air required for the system shall be drawn from conveying air compressors.

1 no fly ash silo of 320T Capacity will be provided to store about 24 hrs’ collection of ash. Vent filters will be provided on top of the silos and unloading arrangement will be provided at the bottom of the silo

3.10.2. Mill Rejects

Tramps, stones and other extraneous materials escaped from the coal yard will be separated in the Mill and collected in the tramp iron chute. Mill rejects will be handled by 1 no. belt/pneumatic conveyor system. Mill rejects / pyrites discharged from the mills will be fed to a steel storage silo of 24 hour capacity through conveyor and auto operated gates provided at the outlet of mill reject hoppers. The silo will be located adjacent to the mill bunker building. The rejects from the silo will be disposed off-site by trucks
3.10.3. Clarifier Sludge

The clarifier sludge generated in ETP treatment system will be further thickened and dried in thickener and drying bed. The dry sludge from the sludge drying bed will be manually sent through truck for offsite disposal.

Dry sludge - 1.5 TPH

3.10.4. Sewerage System

Sewerage from the Project shall be led into a sewerage treatment plant through a sewerage network using concrete pipe. A permanent sewerage treatment plant shall be provided to cater to the sewerage discharge of the plant. The treated effluent shall be utilized for the irrigation of the landscaped areas and the dry sludge collected over a long period will be disposed thru' trucks for offsite disposal.

3.10.5. Liquid and Solid Waste Disposal Provisions in the Plant

The Plant is designed for zero liquid effluent discharge. For this purpose following shall be provided:

- Oil / water separator pit in boiler, turbine, transformer yard, fuel oil handling areas
- Coal settling basins in coal handling plant area
- Filter back wash waste water tanks in the pre-treatment plant area.
- Neutralization basin in the DM plant and CPU Regeneration areas.
- Sewerage treatment plant.
- Central Monitoring Basin with effluent treatment plant.
- Cooling water pond for evaporative cooling

The treated water from the neutralization basin and other settling tanks shall be used for plant use and other purposes like green belt development, dust suppression etc.

3.10.5.1. Waste Management – Environmental Management plan

A project of the proposed scale is bound to exert certain adverse as well as beneficial impacts on the immediate surroundings. Primary impact on environment due to installation of a power plant comes from the combustion of fuel and discharge of chemicals and effluents from the plant through wastewater.

Environmental management plan (EMP) is proposed to be established for the plant to detail out the environmental quality measures to be undertaken during the construction.
and operational phases. EMP will also address the post project monitoring measures to be adopted by the plant authorities in order to maintain the effluent qualities within the acceptable limits specified by the MP State Pollution Control Board and the Ministry of Environment and Forests (MOEF).

The environmental monitoring programme will be provided with trained and qualified staff who will monitor the ambient air as well as stack flue gas quality to ensure that the quality of effluents are maintained within the permissible limit. The main stack will be provided with potable monitors to periodically monitor the SPM, CO, NOx and SOx constituents in the flue gas on daily basis.

The plant effluents will be periodically analyzed on a weekly basis so that the effluents are maintained within the permissible levels of the pollution control board regulations.

3.11. SCHEMATIC OF REPRESENTATION OF FEASIBILITY DRAWING

Schematic drawings for information to EIA purposes are attached as Annexure – 7

4. SITE ANALYSIS

4.1. PROJECT SITE CONNECTIVITY

The project site is falling in the village of Periya Obulapuram Village, Nagaraja Kandigai, Madharpakkam Road, Gummidipoondi, Tamilnadu State.

The nearest town to project site is Gummidipoondi.

The nearest city to project site is Chennai which is at a distance of around 55 km from project site.

The location of the project site has facilities of National Highway, Railway and Air port.

National Highway is running within 3 KM from the site. Gummidipoondi railway station is within 4 KM from this site and the nearest airport is at Chennai around 70 KM.

Power shall be evacuated through a dedicated 400 kV double circuit transmission line to the 400 kV Sub-station of TANTRANSCO at Thervoikandigai at a distance of 15 KM.

4.2. LAND FORM, LAND USE AND LAND OWNERSHIP

4.2.1. Land Form

The total identified area of 77.5 acres for plant site falls in the village of Periya Obulapuram & Pappankuppam and the type of land is Flat and leveled. The above land...
area is sufficient for locating the power plant associated facilities, coal storage yard, and coal handling system, in plant Raw water Reservoir, Green Belt Development, Ash Dyke

Further, the preliminary geo-technical investigations are being conducted to ascertain the nature of soil parameter and bearing capacity. Foundation system shall be designed on the basis of findings and recommendations of geo-technical investigation

4.2.2. Land Use

The type of use of land is industrial. As the area is not inhabited, no major displacement and rehabilitation of local population is foreseen.

4.2.3. Land Ownership

45 acres of land is already owned by the Proponent. Additional land required has also been acquired for the project by the Proponent. However, land for corridor pertaining to transmission line etc. is to be acquired separately based on the alignment and routing of the corridor to be determined at later stage on detailing the engineering for the same.

4.3. TOPOGRAPHY

The Topography of the land is flat. Grade level of the land is approximately level.

Depending upon the topographical survey and area drainage study, the formation levels of various blocks shall be finalized. Formation level shall be optimized by balancing the cutting and filling as far as possible. The roads / storm water / sewage system will be planned by taking care of all relevant data.

Topography map will be enclosed after topographical survey

4.4. EXISTING LAND USE PATTERN

National park, wild life sanctuary, eco sensitive areas, water bodies and forests are not located in the nearby areas.

4.4.1. Features of the Site

The features of the selected site for the project are briefly as follows:

- No structure of archaeological importance
- Availability of Airport nearby
- Availability of railway line and National Highway nearby
- No populated city in vicinity
- No reserve forest nearby
4.5. EXISTING INFRASTRUCTURE

**Availability of Land**

The land area is sufficient for locating the power plant including associated facilities.

**Availability of Coal and Water**

Coal is to be sourced from Indian mines and Indonesia.

Ground Water is available and will be tapped from Bore wells

Infrastructure facilities like workshops, fabricating shops, etc available at Chennai are adequate for handling the major power plant equipment. Minor works can be carried out at Gummipipoondi.

The nearest meteorological station of Indian meteorological department is at Chennai.

4.5.1. Transport

The location of the project site has facilities of National Highway, Railway and Airport at a distance of 70 kms. The site can be easily reached by a well laid 4 lane road / double track rail.

4.5.2. Construction Power

The construction power shall be supplied at 11kV level from the nearest 110/11 kV substation of the state power distribution company. Owner will provide a distribution substation of 11/0.415 kV for further internal distribution of construction power at the site.

4.6. CONSTRUCTION WATER

The maximum requirement of construction water is estimated to be 30 m$^3$/hr for potable and service purposes, which would be catered to by digging bore wells to be located in plant site and having an overhead steel tank with distribution network.

4.7. SOIL CLASSIFICATION

The preliminary geo-technical investigations are being conducted to ascertain the nature of soil parameter and bearing capacity. Foundation system shall be designed on the basis of findings and recommendations of geo-technical investigation.
4.8. **CLIMATIC DATA FROM SECONDARY SOURCE**

The nearest meteorological station of Indian meteorological department is at Chennai. The available data will be furnished separately.

4.9. **SOCIAL INFRASTRUCTURE AVAILABLE**

The project site have social infrastructure facilities of transport only i.e; National Highway, Railway and Airport. The other social infrastructure facilities such as hospitals, schools etc are available in Gummidipoondi near the project area since project site falls in rural areas with less population (No R&R issues in the project area) Major Social infrastructure are available at Chennai city. But the proposed power project will help further develop necessary social infrastructures in the project area.

5. **PLANNING BRIEF**

5.1. **PLANNING CONCEPT**

**Type of industry – Power Plant**

**Site Facilities**

The location of the project site have facilities of National Highway, Railway and Airport, fuel availability and transport, Plant water availability, Power Evacuation, construction power and construction water,

Existing power plant projects in the proposed plant area are OPG owned 3 units of 2 x 77 MW & 1 x 80 MW.

**Transportation**

Transportation of Raw Material - COAL

Coal would be sourced from the Indonesian mines & would be transported from the mines thru’ Sea cum Road.

**Transportation of Raw Material- Fuel Oil (HSD/HFO):**

Oil shall be brought from nearest depot to main plant site by road tankers for unloading and storage at site.

**Transportation of Men, Materials and Equipment for Construction:**
The project site is well connected by National Highway, Railway and Airport and got provision of drawl of electrical power facilities. This enables easy transport of Raw materials. Equipment and spares, Lube-oil, chemicals to plant site for erection, commissioning and operation activities. Man power including professionals, can reach the plant site by using above the facilities beneficially.

5.1.1. **Town and Country Planning / Development Authority Classification**

The project site is located in the villages of Periya Obulapuram. The project area is purely a village area.

Hence the concerned Village, Taluk and District Authorities and Town and Country Planning Authorities are the basic authorities for Building, Road, Water and other amenities and facilities.

Further the Directorate of Town Planning and Water Board, Pollution Control Board Authorities of Government of Tamil Nadu and Govt. of India are to be approached for approvals for civil, building and road facilities water drawl to plant site.

Statutory Clearances to be obtained for this power project are tabulated in **Annexure – 5**

5.2. **POPULATION PROJECTION**

The proposed site is occupied by Sponge & Iron plant (to be decommissioned) and adjacent land proposed to be procured is barren and flat and have no population.

5.3. **LAND USE PLANNING (BREAKUP ALONG WITH GREEN BELT ETC)**

**Land use planning**

The area identified of 80 acres has sufficient area for locating the power plant including associated facilities, coal storage yard and coal handling system, in-plant raw water reservoir, green belt development and ash dyke breakup along with green belt.

The land required for putting up 2 x 360 MW Power Plant is furnished below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Area in Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Block Area</td>
<td>24.1</td>
</tr>
<tr>
<td>Plant Water System</td>
<td>3</td>
</tr>
<tr>
<td>Ash Dyke / Bund</td>
<td>3</td>
</tr>
<tr>
<td>Coal Handling Plant</td>
<td>18</td>
</tr>
<tr>
<td>Switchyard &amp; Transformers</td>
<td>0.4</td>
</tr>
<tr>
<td>Other Facilities</td>
<td>3</td>
</tr>
</tbody>
</table>
**5.4. ASSESSMENT OF INFRASTRUCTURE DEMAND (PHYSICAL & SOCIAL)**

**5.4.1. Assessment of Infrastructure Demand – Physical**

The power plant requires following physical Infrastructure facilities:

- Availability of suitable and sufficient land for power station
- Making the land ready for power plant construction (Topographical survey after decommissioning the existing steel & power plant) and cutting and filling the land accordingly.
- Development of Buildings Facilities for various plants (Geo–Technical survey and soil investigation and drawing building foundation accordingly)
- Development of Transport Facilities for transport of Men, Materials and Equipment (laying approach roads and railway lines to site from the existing facilities)
- Development of Drinking water, power availability, construction power and water i.e laying transmission lines to site from existing Sub-station if required
- Development of Sub-Station at site, laying water lines to site from water source
- Development of Road, Drainage, and Sewerage Facilities
- Development of Storage Facilities for Materials and Equipment
- Development of Communication Facilities
- Development of Effluent Treatment and final disposal Facilities
- Power Evacuation facilities

**5.4.2. Assessment of Infrastructure Demand – Social**

The power plant requires following Social Infrastructure facilities:

The OPGPGL already has developed a small township for their employees 3-4 kms away from the site. Further activities planned are as follows:

- Development of Township
- Development of Hospital
- Development of Schools
- Power and Water for Township
- Development of Shopping and Hotels
- Development of Club, Community Centre and Guest Houses
- Development of Bank, Post Office Parks, Estate Office, Telephone Exchange, Transport Centre

5.5. AMENITIES / FACILITIES

Approach roads to plant site, Development of buildings at site and Township, drinking water to plant site and colony, sanitary facilities in site and colony. Storage facilities for materials in site, internal roads and drainage systems of the plant and colony, Communication, transport, power availability in plant site and colony, hospitals, schools are some of the basic amenities / facilities to be developed from the existing Infrastructure.

6. PROPOSED INFRASTRUCTURE

6.1. PROPOSED INFRASTRUCTURE IN INDUSRIAL AREA (PROCESSISING AREA)

6.1.1. Civil Structural and Architectural Works

This Civil work for plant shall cover design and construction works, including site formation, foundation, super-structure, all required buildings, building services, all necessary infrastructural works required and associated works that are necessary for the construction, operation and maintenance of the Power Plant.

The civil work shall also include all excavation, back filling, piling work (if required), concrete work (plain and reinforced), structural steel work, water proofing, architectural work, sanitary, plumbing, roads, paving, drainage and finishes including and other building services as required for the Project.

The building and equipment foundations shall be suitably designed considering the loads and bearing capacity of the soil.

6.1.2. Land Development

The topographical survey is being conducted and the general information on land terrain will be ascertained to plan necessary infrastructure facilities and the necessary formation level. Depending upon the topographical survey and area drainage study, the formation levels of various blocks shall be finalized. Formation level shall be optimized.
by balancing the cutting and filling as far as possible. The roads / storm water / sewerage system will be planned by taking care of all relevant data.

Green Belt development shall be done in line with MOEF guidelines. However, the total green belt area to be provided around the plant periphery and in plant shall be around one-third of the total area within the plant boundary.

6.1.3. Geo-Technical Investigations

The preliminary geo-technical investigations are being conducted to ascertain the nature of soil parameter and bearing capacity. Foundation system shall be designed on the basis of findings and recommendations of geo-technical investigation.

6.1.4. Topographical Survey

The topographical survey will be conducted and the general information on land terrain will be ascertained to plan necessary infrastructure facilities and the necessary formation level.

6.1.5. Boundary Wall, Gate House & Watch Towers

A permanent boundary wall with barbed wire security fencing at top shall be provided around the periphery of total plant area towards security of the power plant. Gate house shall be provided at the main entry point to the plant.

Separate PVC coated chain link fencing shall be provided for switchyard, transformer yard, storage areas etc.

Watch towers along the boundary of the plant shall be provided at the vulnerable locations for security purpose.

6.1.6. Plant Roads and Drainage

Plant shall be connected to National Highway through approach road. All internal plant roads (Double lane roads) shall be 7.0 m wide black topping with 2.5 m wide shoulders on both sides of the road. Single lane roads shall be of 3.75 m wide black topping over WBM sub-base and base with 1.0 m wide shoulders on both sides of the road. Access roads to building/facilities shall generally be single lane roads without shoulders.

Rain water for the power plant areas shall be collected through a network of drains, all storm water shall be discharged through gravity flow. Surface drains shall be open drains of either RCC rectangular drains or brick lined drains trapezoidal in section. All drains in the power plant area and around Buildings shall be covered drains. However, the entire plant drainage system shall be finalized once the area drainage study has been carried out.
6.1.7. **Plant Buildings / Power Block Area**

Plant buildings / power block area shall comprise of:

6.1.7.1. **Main Plant Building**

Main Plant Building in the Power Block area will comprise of Main Power House Building (turbo generator bay, and the other one as Electrical, SG Feed Pump, Heater and Deaerator bay). The building would be a non-basement structure.

The building shall be of steel-framed structures with RCC floor slabs and in-filled brick masonry wall up to initial height of 3m. Above the initial height, colour coated metal cladding shall be provided. EOT cranes shall be provided in the TG Bay. Roof of TG bay shall be provided with metal decking sheet. In all other areas roof and floor shall be provided with cast-in-situ RCC slab. The central control room shall be provided adjacent to the TG hall at operating floor level.

6.1.7.2. **Boiler and ESP Structure**

Boiler and ESP shall be supported on steel structure, which shall generally rest on raft foundation. Boiler and ESP shall be on the back side of control room as shown in general layout plan. The boiler's structure shall have intermediate connecting corridors with the main plant building.

6.1.7.3. **Mill and Bunker Building**

Mill and bunker building would be preferably placed on both sides of the Boiler. But alternatively front mill arrangement may also be envisaged based on type of Boiler. It shall be made of steel structure with RCC floor. Tripper floor area of the building shall be provided with colour coated metal cladding.

Bunker shall be circular shape with a conical hopper portion. Conical Portion of the bunker shall be provided with stainless steel lining.

6.1.7.4. **Auxiliary Buildings**

Auxiliary buildings in the main plant area shall include compressor house, Diesel Generator Set building, ESP & VFD building, Air washer room, CPU regeneration building, Service building etc.

6.1.7.5. **Non Plant and Offside Buildings**

Non Plant Buildings such as administrative building, canteen building, gate complex, workshop, permanent stores, fire station etc shall be constructed of RCC frame structure having in-filled brickworks.
Hydrogen generation plant shall be located away from common facilities as per the explosive requirement.

6.1.8. Paving / Plinth Protection

Plinth protection around building and paving in entire main plant area from Transformer yard up to Chimney shall be provided. Paving/hard surface shall be provided for vehicle parking. Covered vehicle parking for cycles, scooters and cars/jeeps near service and administrative buildings shall be provided.

6.1.9. Foundation System

All foundations shall be designed in accordance with provisions of the relevant Indian Standards. Type and arrangement of foundation system shall be based on the soil investigation report being carried out at project site.

For the foundations of Steam Turbo-generator, Boiler feed pumps, Fans, Mills, Crushers etc detailed static and dynamic analysis shall be carried out.

Steam Turbo-generator, Boiler feed pumps, Fans (ID, FD and PA), Mills, Crushers shall generally be supported on vibration isolation system or solid foundation which will be ascertained during detailed engineering stage.

As per present information and as per preliminary site reconnaissance, foundation can be provided with open type foundation. Foundation system shall be designed on the basis of finding and recommendation of geotechnical investigation.

6.1.10. Transformer Areas

RCC Foundation for all the Transformers supported on suitable foundation together with fire wall, drainage, containment arrangements for spillage of oil shall be provided. Transformer foundations shall be provided with necessary rail tracks from the generator stator-handling rail track to its place for handling and removal from their foundation without disturbing the other transformer(s). Fencing shall also be provided around transformer area as per Indian Electricity Norms.

6.1.11. Switchyard

Galvanised steel structures with bolted connection shall be used for supporting gantry and the towers structures. Concrete raft foundation shall be provided for this structure. Outgoing line shall be routed towards proposed 400 kV pooling TANTRANSCO Sub-station near Gummidipoondi.

While the main switchyard will be indoor type gas insulated, tariff metering arrangement will be constructed on outdoor structure.
The switchyard control building shall be a RCC framed structure housing all equipment including MCC and switchgears.

The switchyard shall be provided with a separate PVC coated fencing with entry gate, 150 mm thick gravel filling with anti-weed treatment and road, cable trench & drain inside of the switchyard.

6.1.12. Chimney

The Chimney shall be a twin flue reinforced concrete chimney. The flue gas emission point shall be 275 meters above the plant grade level. Internal and external platforms shall be of structural steel construction. The other components of the chimney include a large roll up door and a personnel access door at grade level, doors at all platform levels, rain water drainage system, flue liner drainage system, louvers with bird screens for ventilation openings, stair and platform lighting, and aviation obstruction lighting. Rack and pinion elevator shall be provided in the Chimney.

Wind and seismic conditions will be taken care of in structural design as per relevant sections of the Bureau of Indian Standards.

6.1.13. Raw Water Pre-Treatment Plant

Raw water reservoir, Clariflocculators, chemical house, filtered water storage tank etc. shall be provided to meet the treated water requirement of the power plant.

6.1.14. DM Plant

Demineralization Plant building shall be a framed RCC structure with unfilled brick work. Underground RCC neutralization pit shall be constructed in two compartments with concrete of suitable grade. The inside face of pit shall be provided with acid/ alkali resistant lining.

Degasser and acid storage tanks being out door type installations, R.C.C. foundation along with dyke wall is envisaged. This shall be of RCC pedestals in suitable grade of concrete.

Suitable foundation for the DM tanks shall be provided. Neutralization pit, drain and floors likely to be subjected by corrosive effluent shall be provided with acid/ alkali resistant brick / tile lining with applicable mortar.

6.1.15. Effluent Treatment and Final Disposal

The following shall be provided:

- Oil / water separator pit in boiler, turbine, fuel oil handling etc areas.
- Sludge draw out & stilling chamber cum aerator and cooling towers areas.
- Coal settling basins in coal handling plant area
- Filter back wash waste water tanks in the pre-treatment plant area.
- Neutralization basin in the DM plant and CPU Regeneration areas.
- Sewerage treatment plant.
- Central Monitoring Basin with holding tanks and acid & alkali storage tanks etc.
- Cooling water pond for evaporative cooling

6.1.16. Coal Handling System

6.1.16.1. Truck Tipplers and Associated Structures

Two Nos of Hoppers for two truck tipplers (1W+1S) and two nos for truck unloading with associated structures shall be of RCC construction. The pit shall accommodate the hoppers along with feeder and conveyors below. Truck tippler pits shall be designed as a water retaining structure. Steel liners will be provided on the hopper surfaces which will be in contact with coal. Control room for wagon tipplers located nearby shall be of RCC construction.

6.1.16.2. Transfer Points

Transfer points shall be provided at every change of direction of the conveyors. Transfer points shall have structural steel frameworks with RCC roof and floors. Cladding shall be of colour coated metal sheet.

6.1.16.3. Conveyor Galleries

Overhead conveyor galleries shall be of structural steel frame with colour coated metal sheet roofing and cladding. Walkways shall be provided by the sides and between conveyors. The galleries shall be supported on steel trestles which shall have RCC foundations.

6.1.16.4. Crusher House

A separate building shall be provided for housing the crushers. This building shall be of structural steel framework with RCC flooring and colour coated metal cladding. The crushers shall utilize a vibration isolation system with spring assembly and visco dampers.
6.1.16.5. Control and MCC Room Building

The control and MCC Room buildings shall have RCC framed structures with brick cladding. In addition, a separate CHP maintenance building and bulldozer shed shall be provided.

6.1.16.6. Stacker cum Reclaimer Foundation

This shall be of rigid type RCC continuous strip foundation provided under each rail. The ground conveyor shall be supported by concrete pedestals. The edges of the area adjacent to the ground conveyor shall be paved with concrete.

6.1.16.7. Drainage in Coal Stack Area

RCC drains shall be provided by the side of the stacker cum reclaimer. The drain shall have pre-cast RCC covers.

6.1.16.8. Underground Conveyor with Reclaim Hopper

RCC tunnels shall be provided for underground conveyors. Reclaim hoppers shall be made of RCC.

6.1.17. Fuel Oil Handling

Fuel oil for the plant is envisaged for transportation through road route using road tanker and / or through rail using rail tankers. The following civil works are to be provided for the Fuel oil handling system:

- RCC / Steel frame structure building for the pump house with in filled brick walls to house the oil pressurizing pumps etc.
- A raised platform with ramp for unloading the fuel oil from road tankers, if applicable.
- RCC ring wall / flexible foundations as per IS 803 for Storage tanks
- RCC dyke wall with suitable paving around the tank area along with Oil separator pit and peripheral drains.
- Miscellaneous foundations for pumps, pipe racks, pipelines trenches fencing etc.
- Unloading trench for rail tankers, if applicable.

6.1.18. Ash Handling System

RCC silos for storage of fly ash will be constructed at a height of 5m above grade level to facilitate easy movement of trucks for ash disposal.
Pipe racks and compressor house shall be provided for fly ash handling system. Pipe trenches as required shall be provided in compressor house. A separate office building shall be provided in ash silo area for controlling the transportation of ash through trucks.

All equipment foundations, trestles for belt conveyors etc. as shall be required for the entire ash handling system shall be designed suitably and accordingly provided.

**Ash Dyke**

A properly designed Ash Bund shall be constructed along the periphery of ash disposal area. The bund shall be constructed in two stages.

The ash disposal area shall be provided with HDPE liner. All necessary measures shall be provided for protection as well as to ensure proper functioning of liner against ground water table / pressures that are likely to be encountered.

Necessary drains for disposing the storm / rain water shall also be provided. The ash disposal area shall be fenced to protect the area from trespassing.

6.1.19. **Pipe and Cable Rack / Trenches**

LP pipes and cables shall be laid either underground in trench or over ground on the rack. Trench shall be constructed with RCC with suitable water proofing arrangement. Racks shall be constructed of structural steel supported on RCC foundation.

6.1.20. **Miscellaneous Civil, Structural & Architectural Works**

Any other civil, structural and architectural work not specified but necessary to render the Project complete shall be carried out.

6.1.21. **Design Basis**

Dead and live loads will be considered as per relevant IS codes and standard engineering practices.

The basic wind speed and design of buildings / structures shall be considered as per IS: 875: Part III.

The power plant is located in Seismic zone III as per IS: 1893 -2002 and seismic forces will be considered accordingly for the structures / buildings.

6.1.22. **Landscaping**

Landscape of the entire Power plant area shall be provided with a soft and hard treatment including supply of plants, maintenance and sprinkling of water through
distribution pipe network shall be provided. Landscaped areas shall be irrigated by sprinklers with the treated water from the sewerage treatment unit.

6.2. PROPOSED INFRASTRUCTURE-RESIDENTIAL AREA (NON-PROCESSISING AREA)

6.2.1. Township
A small township has been already developed located at about 4 kms from the site. Township shall be developed further to provide modern amenities.

6.3. GREEN BELT
Green Belt development shall be done in line with MOEF guidelines. However, the total green belt area to be provided around the plant periphery and in plant shall be around one-third of the total area within the plant boundary.

6.4. SOCIAL INFRASTRUCTURE
Township, barracks for securities staff and field hostel and associated facilities/ non-residential buildings like Bank, Post office, Club, Community centre, Medical centre, Guest house, Sports complex, Parks, Estate office, telephone exchange, transport centre, shopping centre and primary school and a temporary labour colony shall be developed.

6.5. CONNECTIVITY (TRAFFIC & TRANSPORT)
A four lane highway connects Chennai on one side and Nellore on the other side. A two way electrified rail track connecting Chennai and Delhi is 4 km away. At present the traffic density is normal on the highway without posing any problem to Vehicle movement and is suitable for Cargo movement.

Two nos Sea port one at Chennai and other at Ennore are available for fuel handling.

6.6. DRINKING WATER MANAGEMENT (SOURCE AND SUPPLY)
Requirements of the plant potable water system will be met from filtered water storage tank through Two (2) (1 no. working and 1 no. standby) horizontal, centrifugal type potable water pumps for further distribution of potable water to various consumption points in the plant and colony.

Drinking water shall be supplied from this source after proper treatment.

During construction phase also, drinking water shall be catered by bore -wells located in at plant site and an overhead steel tank with distribution network arrangement.
6.7. SEWERAGE SYSTEM

Sewerage from the Project shall be led into a sewerage treatment plant through a sewerage network using concrete pipe. Manholes shall be provided at every 30m and at all junctions.

6.8. INDUSTRIAL WASTE MANAGEMENT

Industrial waste from power plant:

Air
- Dust particulates from fly ash in flue gas
- Sulphur dioxide in flue gas
- Nitrogen oxides in flue gas
- Coal dust particles during storage / handling of coal
- Ash dust in ash handling area

Water
- Effluent from ash disposal area
- Effluent from water treatment (WT) plant
- Cooling tower blow down
- Plant drains

Equipment and systems to manage Industrial waste

- The proposed plant will be provided with necessary equipment and systems to meet all applicable environmental regulations. The plant has been envisaged to have the following features, which will help in reducing emissions and effluents.
- The design of ESP shall be such that the outlet dust burden of solid particulate matter (SPM) content at its outlet does not exceed 50 mg/Nm$^3$ at 100% MCR with worst coal, with one field out of service.
- Low NOx burners have been envisaged to reduce the NOx generation and consequent emission.
- High efficiency Electrostatic Precipitators has been envisaged to limit the particulate emissions to meet MoEF and / or CPCB regulations.
- 275 metres tall twin flue chimney has been envisaged for the plant, in line with the MoEF guidelines, which will help dispersion of air borne emissions over lager area and thus reducing the impact of the power plant on ground level concentrations.
• Dust extraction and dust suppression systems have been envisaged in the coal handling plant.

• Zero liquid effluent discharge scheme has been envisaged for the Plant. All effluents in the plant will be treated and recycled as explained in Clause 3.9.1 of this Report.

The environmental monitoring programme will be provided with trained and qualified staff who will monitor the ambient air as well as stack flue gas quality to ensure that the quality of effluents are maintained within the permissible limit. The main stack will be provided with potable monitors to periodically monitor the SPM, CO, NOx and SOx constituents in the flue gas on daily basis.

The plant effluents will be periodically analyzed on a weekly basis so that the effluents are maintained within the permissible levels of the pollution control board regulations.

6.9. SOLID WASTE MANAGEMENT

Ash

The ESP outlet dust burden or solid particulate matter (SPM) content at its outlet does not exceed 50 mg/Nm$^3$ at 100% MCR with worst coal, with one field out of service.

Fly ash will be collected in dry form to facilitate utilization and the un-utilized fly ash will be disposed in wet form.

Bottom ash will be collected in wet form the system adopted for bottom ash removal would be an intermittent jet pump system.

Dust extraction and dust suppression systems have been envisaged in the

Crusher house, Coal unloading area, transfer points, Coal stock pile and bunker area in the Coal Handling plant.

In the Ash Handling plant, bag filters will be provided in silos and sprinklers for ash dyke.

Mill Rejects

Mill rejects will be transported to the silo which will be located adjacent to the mill bunker building. The rejects from the silo will be disposed off-site by trucks.

Clarifier Sludge
The clarifier sludge generated in effluent treatment will be further thickened and dried in thickener and drying bed. The dry sludge from the sludge drying bed will be manually sent through truck for offsite disposal.

6.10. POWER REQUIREMENT-& SUPPLY AND SOURCE

The power required for construction of the power plant will be supplied at 11 kV level from the nearest substation of the state power distribution company. OPG will construct a distribution substation of 11 / 0.415 kV for further distribution of construction power at the site.

Regarding Power supply for the production process, Startup power will be availed from the TANTRANSCO Network and operational power will be tapped from the electrical energy produced in the plant.

7. REHABILITATION AND RESETTLEMENT (R & R) PLAN

7.1. POLICY TO BE ADOPTED

No R & R issues are involved in this project.

8. PROJECT SCHEDULE & COST ESTIMATES

8.1. PROJECT SCHEDULE (TIME SCHEDULE)

Project schedule indicates the likely date of start of construction and likely date of completion of the project (time schedule)

In the current 2 x 360MW Power project, the first and second units shall achieve commercial operation in 33 & 37 months respectively calculated from the award of contract for Boiler, Turbine and Generator (BTG) package

8.1.1. Project Execution

The project is proposed to be executed on multiple EPC package contracts basis

8.1.2. Project Execution Heads

The major phases of the project during its implementation are classified under the following heads:

- Planning and contract packaging
- Design, engineering, tendering and contract award
- Manufacturing, inspection and expediting phase
- Transportation / Handling of equipment
- Construction / Erection and commissioning
- Operation & Maintenance and manpower training and placement

8.1.3. Project Management

A project management system for close monitoring of the project for quality, schedule and environment shall be created to complete the project within the scheduled period.

The project will be managed by the project company under the overall direction and control of a managing director. Full time project management responsibility shall vest in CEO of the project company. The project company's site establishment shall be headed by a construction manager who shall be responsibility for all site works and shall report to the CEO.

CEO shall be responsible for overall project planning and monitoring, obtaining necessary clearances, all preliminary project works, coordination with concerned agencies, contract administration, certification of bills, liaison and coordination with statutory agencies, monitoring of project cost, recruitment of personnel etc.

The project company's site establishment, headed by construction manager shall comprise three basic groups viz., civil, mechanical and electrical / instrumentation. In addition, a separate group shall be established for project monitoring and control. The site establishment shall also have necessary administration and accounts departments.

Some of the project company site engineers shall be initially posted at the corporate office and moved to site progressively as construction / erection activities pick up at the site. After commissioning of the power Plant, most of these engineers would be seconded to the O and M contractor and would occupy suitable positions in the operations and maintenance (O and M) organisation for the power station.

Man Power required for this project is estimated to be 660 persons including contract employees.

A brief methodology adopted for executing the project is as detailed below.
8.1.4. Planning Phase

8.1.4.1. Contract Packaging

The company intends to implement the project through well-defined multiple contracts or packages, which shall be mutually exclusive as well as collectively exhaustive.

The initial site development, enabling works and other miscellaneous works will be carried out by the company through local contractors. Indicative scope of the packages envisaged is as below.

8.1.5. Master Project Implementation Programme – Master Network

A master network (MNW), which is the overall programme of project implementation shall be finalized. It identifies the key milestone dates for each package in the areas of engineering, procurement, manufacturing, dispatch, construction, erection, testing and commissioning. The date of order of the BTG package is the zero date of the master network. The MNW forms the basis of all detailed physical scheduling for all contract packages.

8.1.6. Quality Assurance

All Package Contractors would be asked to follow a comprehensive quality assurance and control programme developed by an independent quality assurance group. The quality plans after discussions and finalization with the Contractor will form a part of the contract.

8.2. PROJECT COST ESTIMATE

The estimated works cost of the project consisting of plant and equipment including civil works, land and site development and establishment charges including consultancy services and margin on working capital amount to INR 38211.8 million. Interest during construction (IDC) is estimated at INR 4989.2 million. The total project cost including IDC thus works out to INR 43201 million, specific cost of the project thus arrives at INR 6 Crores per MW.

The estimated breakdown of project cost is presented in Table 8.1.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Item Description</th>
<th>Total in INR Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Civil Works including Land &amp; Site Development</td>
<td>10008</td>
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### Table of Costs

<table>
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<th>S. No</th>
<th>Item Description</th>
<th>Total in INR Million</th>
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<td>2.</td>
<td>Plant &amp; Equipment</td>
<td>24185</td>
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<tr>
<td>3.</td>
<td>Other expenses</td>
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<tr>
<td>4.</td>
<td>Project Cost excl. IDC (3 to 4)</td>
<td>38211.8</td>
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<tr>
<td>5.</td>
<td>Interest During Construction (IDC)</td>
<td>4989.2</td>
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<tr>
<td>6.</td>
<td>Project Cost incl. IDC</td>
<td>43201</td>
</tr>
</tbody>
</table>

### Economic Viability Of the Project

The financial analysis of the project has been carried out based on the project cost estimated to calculate the levelised tariff as below:

It can thus be concluded that the project cost compares well with the prevailing projects awarded and commensurate with Subcritical technology adopted. The levelised tariff also is comparable with the ongoing tariffs of other projects of similar capacity.

In view of the above, the project can be considered as techno- economically viable.

### ANALYSIS OF PROPOSAL (FINAL RECOMMENDATIONS)

In this Concluding chapter, the financial and social benefits to the local people including to tribal population are discussed as below.

### FINANCIAL AND SOCIAL BENEFITS TO THE LOCAL PEOPLE

#### Financial Benefits to local People through the Plant Employment

The Project shall provide employment potential under unskilled, semiskilled and skilled categories. The employment potential shall increase with the start of construction activities, reach a peak during construction phase and then reduce with completion of construction activities. During operation phase also there will be employment opportunities, mainly in service sector, although its magnitude will be much less. The direct employment opportunities are limited and the opportunities exist mainly with the contractors and sub-contractors. These agencies will be persuaded to provide the jobs to local persons on a preferential basis wherever feasible.
9.1.2. Social Benefits to Local People through the Plant Employment

Construction and operation of the project would benefit local people with respect to the following:-

- Increase in employment opportunity in skilled, semi-skilled and un-skilled categories.
- Increase in employment/ self-employment avenues in service sector.
- Availability of large quantities of ash for the cement and construction industries, helping in conservation of land resources.
- Better amenities to the local people by way of providing hospitals, schools, drainage systems, roads, ambulance facilities etc.,

9.1.3. Financial Benefits and Social Benefit to Local People other than Plant Employees

During power plant construction and then regular operation, the employees require Housing, market facilities, schools for their children and medical facilities. Upto the period of construction of the power plant colony, employees depend upon the outside local facilities for school, shopping, and hospital. Even after the completion of construction phase, there will be continuing need for the basic amenities. This will generate more self-employment in the area which will lead to their financial growth. During construction phase, due to the need for a large amount of vehicular traffic bringing in equipments etc, new approach roads / railways will have to be laid by the concerned agencies which will also result in employment generation & financial upliftment and easy accessibility to the nearest town.

Development of green field in and around the site will lead to a better environment.

9.2. FINAL RECOMMENDATIONS

In view of the discussions in various chapters of this Pre-Feasibility report, the capacity of the project, fuel comfort, availability of water & power evacuation arrangement and financial viability makes the project as techno-economically viable. Also the financial benefits and social benefits to local people have also been enumerated in the above chapters.

The Project will enhance the installed capacity of the State and may bring great relief to a power starved state. The high Capacity (2 x 360 MW) proposed may also help Grid managers to tide over Peaking demand Crisis very often faced by them.
The improved power supply will reduce the dependence of general public and commercial establishments on DG Sets thereby reducing the noise pollution as well as air pollution at local levels.

Thus it is concluded that the 2 x 360 MW power plant project at Periya Obulapuram Village, Nagaraja Kandigai, Madharpakkam Road, Gummidipoondi, Tamilnadu Stat proposed to be constructed by OPGGPL will bring benefit to the nation as a whole and Tamilnadu state in particular.
10. **ANNEXURES – AS DETAILED BELOW**

**ANNEXURE – 1**

**PROJECT INFORMATION & SITE DATA**

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<table>
<thead>
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<tbody>
<tr>
<td>1</td>
<td>Owner</td>
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<td>Location</td>
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<td>Nearest Railway Station</td>
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<td>Road Approach</td>
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<td>Soil Bearing Capacity</td>
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<td>a</td>
<td>Maximum</td>
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<tr>
<td>b</td>
<td>Minimum</td>
</tr>
<tr>
<td>13</td>
<td>Climatic Conditions</td>
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<td>14</td>
<td>Latitude / Longitude</td>
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</table>

The site is 8 km from Gummidipoondi town. National Highway is 3 km from the site and all the plant equipment are proposed to be transported by road only. The existing roads need to be extended to connect to the proposed site.

15 | Tropicalisation | All equipment supplied against this specification shall be given tropical and fungicidal treatment considering the climatic conditions prevailing at site as described above. |
Tropical protection shall conform to IS: 3202 titled “Climatic-proofing of electrical equipment” or BS: CP-1014, titled “protection of electrical power equipment against climatic conditions”.

<p>| | | |</p>
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<tr>
<td>16</td>
<td>Design wind pressure</td>
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<td>17</td>
<td>Construction Power</td>
<td>Will be provided at a particular point by purchaser. Vendor has to take power supply from that point, for which the total load requirements to be specified by vendor.</td>
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<tr>
<td>18</td>
<td>General Description</td>
<td>The power plant is of regenerative cycle design and mainly consists of steam generator and auxiliaries with coal as fuel, regenerative feed heat system with condensing steam turbine and auxiliaries and all other equipment associated.</td>
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ANNEXURE – 2
COAL & ASH ANALYSIS

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<th>Proximate Analysis</th>
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<td>Volatile matter</td>
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<tr>
<td>Total Moisture</td>
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<tr>
<td>Inherent moisture</td>
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<tr>
<td>Ash</td>
<td>%</td>
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<tr>
<td>Grindability index</td>
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<tr>
<td>GCV</td>
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<td>SIZING (% WT)</td>
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<th>ASH ANALYSIS</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>SiO2</td>
<td>%</td>
<td>45.6</td>
</tr>
<tr>
<td>Al2O3</td>
<td>%</td>
<td>16.2</td>
</tr>
<tr>
<td>Fe2O3</td>
<td>%</td>
<td>11.00</td>
</tr>
<tr>
<td>CaO</td>
<td>%</td>
<td>9.81</td>
</tr>
<tr>
<td>MgO</td>
<td>%</td>
<td>3.48</td>
</tr>
<tr>
<td>Na2O</td>
<td>%</td>
<td>4.52</td>
</tr>
<tr>
<td>K2O</td>
<td>%</td>
<td>1.118</td>
</tr>
<tr>
<td>P2O5</td>
<td>%</td>
<td>0.961</td>
</tr>
<tr>
<td>SO3</td>
<td>%</td>
<td>6.00</td>
</tr>
<tr>
<td>TiO2</td>
<td>%</td>
<td>0.60</td>
</tr>
<tr>
<td>Mn3O4</td>
<td>%</td>
<td>0.096</td>
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</tbody>
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<table>
<thead>
<tr>
<th>ASH FUSION TEMPERAURE</th>
<th>Reducing</th>
<th>Oxidising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Deformation</td>
<td>°C</td>
<td>1110</td>
</tr>
<tr>
<td>Softening</td>
<td>°C</td>
<td>1140</td>
</tr>
<tr>
<td>Flow</td>
<td>°C</td>
<td>1260</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>FUEL OIL ANALYSIS (HIGH SPEED DIESEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>---------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Sl. No.</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>
## HEAVY FUEL OIL

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Characteristics</th>
<th>IS – 1953, Grade HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Sulphur content</td>
<td>4.5% (Max)</td>
</tr>
<tr>
<td>2</td>
<td>Gross Calorific Value</td>
<td>About 11,000</td>
</tr>
<tr>
<td>3</td>
<td>Flash Point (Min.)</td>
<td>66 Deg C</td>
</tr>
<tr>
<td>4</td>
<td>Water content by Volume (Max.)</td>
<td>1.0%</td>
</tr>
<tr>
<td>5</td>
<td>Sediment by weight (Max.)</td>
<td>0.25%</td>
</tr>
<tr>
<td>6</td>
<td>Asphaltene content by weight (Max.)</td>
<td>2.5%</td>
</tr>
<tr>
<td>7</td>
<td>Kinematic Viscosity in centistokes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at 50 Deg.C</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>at 98 Deg.C</td>
<td>20 – 30</td>
</tr>
<tr>
<td>8</td>
<td>Ash Content by weight (Max.)</td>
<td>0.1%</td>
</tr>
<tr>
<td>9</td>
<td>Acidity (in inorganic)</td>
<td>Nil</td>
</tr>
<tr>
<td>10</td>
<td>Pour Point (Max.)</td>
<td>24 Deg.C (Max.)</td>
</tr>
<tr>
<td>11</td>
<td>Sodium Content</td>
<td>--</td>
</tr>
<tr>
<td>12</td>
<td>Vanadium Content</td>
<td>25 ppm</td>
</tr>
<tr>
<td>13</td>
<td>Specific heat (kCal/kg. Deg.C)</td>
<td>0.5</td>
</tr>
</tbody>
</table>
### RAW WATER ANALYSIS (AS FURNISHED BY OPG)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>Worst Value</th>
<th>Design Value</th>
</tr>
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<tbody>
<tr>
<td>Colloidal Silica</td>
<td>mg/L</td>
<td>0.22</td>
<td>0.33</td>
</tr>
<tr>
<td>pH at 25°C</td>
<td></td>
<td>8.10</td>
<td>8.10</td>
</tr>
<tr>
<td>Conductivity</td>
<td>µs/cm</td>
<td>945</td>
<td>1417.5</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>2.0</td>
<td>3.0</td>
</tr>
<tr>
<td>TDS</td>
<td>mg/L</td>
<td>640</td>
<td>960</td>
</tr>
<tr>
<td>Total Hardness as CaCO3</td>
<td>mg/L</td>
<td>361.0</td>
<td>540</td>
</tr>
<tr>
<td>Nitrate as NO3</td>
<td>Ppm</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Calcium as Ca</td>
<td>mg/L</td>
<td>87.0</td>
<td>130.5</td>
</tr>
<tr>
<td>Magnesium as Mg</td>
<td>mg/L</td>
<td>35</td>
<td>52.5</td>
</tr>
<tr>
<td>Chloride as Cl</td>
<td>mg/L</td>
<td>75.0</td>
<td>112.5</td>
</tr>
<tr>
<td>Sulphate as SO4</td>
<td>mg/L</td>
<td>51.0</td>
<td>76.5</td>
</tr>
<tr>
<td>Total Silica</td>
<td>mg/L</td>
<td>78.0</td>
<td>78</td>
</tr>
<tr>
<td>Sodium as Na</td>
<td>mg/L</td>
<td>34.0</td>
<td>51.0</td>
</tr>
<tr>
<td>Potassium</td>
<td>mg/L</td>
<td>9.00</td>
<td>9.0</td>
</tr>
<tr>
<td>Fluoride as F</td>
<td>mg/L</td>
<td>BDL (D.L=0.1)</td>
<td></td>
</tr>
<tr>
<td>Iron as Fe^3+ Ions</td>
<td>mg/L</td>
<td>BDL (D.L=0.01)</td>
<td></td>
</tr>
</tbody>
</table>
## ANNEXURE – 4
### STATUTORY CLEARANCES

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Clearance</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pollution Control</td>
<td>State Government</td>
</tr>
<tr>
<td>2</td>
<td>Environment and Forests</td>
<td>Central Government</td>
</tr>
<tr>
<td>3</td>
<td>Civil Aviation Clearance for Chimney Height</td>
<td>Airports Authority of India</td>
</tr>
<tr>
<td>4</td>
<td>Registration of Company</td>
<td>Registrar of Companies</td>
</tr>
<tr>
<td>5</td>
<td>Commencement of Business</td>
<td>Registrar of Companies</td>
</tr>
<tr>
<td>6</td>
<td>Publication</td>
<td>Publication of scheme. State Govt. Clearance</td>
</tr>
<tr>
<td>7</td>
<td>Water Availability</td>
<td>State Government</td>
</tr>
<tr>
<td>8</td>
<td>Pollution clearance, including emission, chimney height, and water discharge approvals. Details of public hearing.</td>
<td>State Government / Public hearing</td>
</tr>
<tr>
<td>9</td>
<td>Rehabilitation &amp; resettlement of displaced families by land acquisition</td>
<td>State Government</td>
</tr>
<tr>
<td>10</td>
<td>Import licenses &amp; formalities</td>
<td>Equipment Supplier / Contractor to furnish</td>
</tr>
<tr>
<td>11</td>
<td>Consent of relevant Panchayat for Development of project site and township site</td>
<td>Directorate of Town Planning of Government of Tamilnadu</td>
</tr>
<tr>
<td>12</td>
<td>Consent to Establish</td>
<td>MOEF / state level Environmental Board.</td>
</tr>
</tbody>
</table>

### OTHERS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Clearance</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Land availability</td>
<td>About 45.4 acres of land is utilized by demolishing existing spong iron plant. Additional land to the extent of 32.1 acres purchased from Private parties. Total land required land of 77.5 acre is available in possession.</td>
</tr>
<tr>
<td>2</td>
<td>Fuel linkage approval</td>
<td>Fuel purchase agreement with imported coal supplier</td>
</tr>
<tr>
<td>Sl. No</td>
<td>Clearance</td>
<td>Agency</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Permission/clearance and construction of rail/road crossings</td>
<td>Ministry of Railways / State Government</td>
</tr>
<tr>
<td>4</td>
<td>Frequency allocation for Power Line Carrier Communication (PLCC) equipment</td>
<td>Will be obtained during construction phase.</td>
</tr>
<tr>
<td>5</td>
<td>Power Purchase Agreement</td>
<td>MOU with TANGEDCO authorities, / Others to be signed</td>
</tr>
</tbody>
</table>
ANNEXURE – 5

PLOT PLAN
ANNEXURE – 6
PROCESS FLOW & WATER BALANCE DIAGRAM
**All values are in m³/day**
ANNEXURE – 7

SCHEMATIC REPRESENTATION OF FEASIBILITY DRAWINGS FOR INFORMATION FOR EIA PURPOSES
Figure: Co-ordinate Map

Project:
Expansion of OPG TPP by installation of 2x360 MW
Periya Obulapuram, Tehsil: Gummidipoondi, District: Thiruvallur, Tamil Nadu

Project Developer:
M/s. OPG Power Generation Pvt. Ltd.

Environment Consultant:
GREENCINDIA Consulting Private Limited
(An ISO 9001 QMS, ISO 14001 EMS & OHSAS 18001 H&S MS Certified by BSI)
QC1-NABET Accredited Environment Consultant Certificate No. NABET/ENV/012/04/042

Legend
- Project Site

Source:
2. Project Layout Plan, OPGPL
3. Data Provided by FAE (LU)

Software Used:

Drafted By: Mr. Ankur Agarwal
Approved By: Ms. Nandini Choudhury

Date: 07/08/2014
Revision: 00
Figure: Distance of Project Site from Eco Sensitive Zone of Pulicat Lake

Legend:
- State Boundary/ Eco Sensitive Zone of Pulicat Bird Sanctuary
- Project Site
- Study Area
- Settlements
- Streams
- Roads
- Railway
- Forest
- Ponds
- Vegetation
- Contours
- Locations

Source:
2. Project Layout Plan, OPGPL
3. Data Provided by FAE (LU)

Software Used:

Points:

<table>
<thead>
<tr>
<th>Points</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>13° 26' 32.99&quot; N</td>
<td>80° 05' 40.90&quot; E</td>
</tr>
<tr>
<td>B</td>
<td>13° 26' 26.92&quot; N</td>
<td>80° 06' 03.36&quot; E</td>
</tr>
<tr>
<td>C</td>
<td>13° 26' 05.06&quot; N</td>
<td>80° 06' 05.79&quot; E</td>
</tr>
<tr>
<td>D</td>
<td>13° 25' 55.74&quot; N</td>
<td>80° 06' 00.49&quot; E</td>
</tr>
<tr>
<td>E</td>
<td>13° 25' 56.09&quot; N</td>
<td>80° 05' 51.72&quot; E</td>
</tr>
<tr>
<td>F</td>
<td>13° 26' 00.59&quot; N</td>
<td>80° 05' 32.92&quot; E</td>
</tr>
<tr>
<td>G</td>
<td>13° 26' 13.23&quot; N</td>
<td>80° 05' 32.07&quot; E</td>
</tr>
</tbody>
</table>
ANNEXURE – 8
LOCATION MAP