BIHAR MEGA POWER LIMITED

A wholly owned subsidiary of Power Finance Corporation Limited
(A Govt. of India Undertaking)

4000 MW

ULTRA MEGA POWER PROJECT

NEAR KAKWARA VILLAGE, BANKA DISTRICT, BIHAR

PRE-FEASIBILITY REPORT

APRIL - 2016

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1.0 EXECUTIVE SUMMARY

With increasing population and expanding development activities the demand for electricity is continuously outstripping the supply in India. Capacity addition in power generation has therefore taken the center stage in all our development programs.

Ministry of Power, Govt. of India has, in this context, taken the initiative to develop coal based Ultra Mega Power Projects (UMPPs) of 4000 MW capacity (using Supercritical Technology) in different parts of the country. Power Finance Corporation Limited (PFC) is the nodal agency and Central Electricity Authority (CEA) is providing technical support for development of these UMPPs.

The present 4000 MW UMPP is proposed to be set up near Kakwara village in Banka district of Bihar. In this regard, Bihar Mega Power Limited (BMPL), a wholly owned subsidiary of PFC Ltd. has been formed to carry out detailed studies and establish the Project through private developers to be selected through competitive bidding as per the guidelines of the Ministry of Power, Govt of India.

Bihar is one of the power- starved states in the country with high potential for development. The 4000 MW UMPP will play a key role in providing the much needed power to overcome the short fall as well as in spurring all round economic development in the State. It will also supply power to other states as per the tentative break up given below:

I).	Bihar	:	2000 MW
II).	Jharkhand	:	1000 MW
III).	Uttar Pradesh	:	600 MW
IV).	Karnataka	:	400 MW

Bihar Mega Power Limited, A wholly owned subsidiary of Power Finance Corporation Limited (A Govt. of India Undertaking) has planned to setup a

coal based 4000 MW UMPP near village Kakwara in District Banka in Bihar.

In this direction, PFCCL have engaged Desein Private Limited, Consulting Engineers for Consultancy Services for site Feasibility Study, Acquisition of land conducting various Technical Studies and abtaining MoEF/SPCB clearances etc. of 5x800 MW coal based power plant at Kakwara Village, Banka District, Bihar. DESEIN is looking into all pros and cons for the preparation of Pre-Feasibility Report. This Report is based on Central Electricity Authority (CEA) guidelines, Bihar Electricity Regulatory Commission (BERC) norms and MoEF for obtaining Terms of Reference (ToR).

The scope covers the following:

a) Justification of the project
b) Basic requirements such as land, fuel, water, infrastructure, etc
c) Description of the major aspects of the proposed plant and auxiliary systems covering technological aspects and salient description of civil and structural works.
d) Preliminary Plot Plan of the Power Plant
e) Consideration of Environmental Aspects
f) Project execution and management.

PROJECT HIGHLIGHTS

1.	Project	:	Banka Ultra Mega Power Project
2.	Promoters	:	Bihar Mega Power Limited A wholly owned subsidiary of Power Finance Corporation Limited (A Govt. of India Undertaking)
3.	Plant Capacity	:	4000 MW

4.	Plant Configuration	:	5x800 MW		
5.	Location	:	Kakwara Village, Banka District, Bihar		
		:	Latitude : 24°46'32" N		
		:	Longitude : 86°51'41"E		
		:	Nearest Town : Banka : 15 km		
		:	Nearest National Highways : NH – 333A : 500 M		
		:	Nearest Railway Station : Banka : 12 km		
		:	Nearest Airports : Patna : 250 km		
		:	Nearest Sea Port : Kolkata		
6.	Site Elevation	:	Height above MSL : 120 m – 150 m		
7.	Seismic Zone	:	Zone - IV as per IS:1893 (part-1) - 2005		
8.	Land Requirement	:	Break up of area required for the Power Plant.		
				Description	**Acres**
			a)	Main Power Block & Auxiliaries	100
			b)	Switchyard	95
			c)	Raw Water Reservoir	130
			d)	Water facilities	150
			e)	MGR, Coal Storage Area and facilities	325
			f)	Ash Dyke	800
			g)	Green Belt	267
			h)	Misc. Non Plant Buildings	153
			i)	Colony	150
			k)	Unutilized Space	230
				Total	**2400**
10.	Source of Water (Distance from site)	:	Ganga River near Sultanganj (70 Km)		

11.	Water Requirement	:	12,000 m^3/hr
13.	Primary Fuel & Source (Distance from site)	:	Domestic Coal from Rajmahal group of coal fields in Pirpainti - Barahat (70 Km)
14.	Support Fuel & Source	:	HSD/LDO from nearest refinery/oil depots.
15.	Coal Requirement	:	20 million tonnes per annum with GCV of coal as 3425 kcal/kg & Station Heat Rate 2300 kcal/kwh at 85% PLF.
17.	Transportation		
	i. Coal	:	By Rail
	ii. Support fuel	:	By Rail/Road Tankers
18.	Steam Generator	:	Semi outdoor type two pass single re-heat balanced draft, drumless unit designed for firing pulverized coal as main fuel.
19.	Steam Turbine Generator	:	The steam turbine generator will be single shaft, two / three cylinders, tandem compound, reheat, regenerative, condensing unit directly coupled to AC Generator giving a continuous output at generator terminal of 800, 000 KW at 21~27 KV.
20.	Control System	:	Distributed Digital Control and Management Information System (DDCMIS) with integrated, CRT/Key Board operation for Steam Generator, Turbine, Generator and auxiliaries from Central Control room.
21.	Chimney	:	Two (2) twin flue and One (1) single flue chimney of 275 M high.
22.	Power Evacuation	:	765 / 400 kV Transmission System
23.	Project Completion Schedule	:	First unit 52 months from 'zero date' Subsequent units at an interval of 6 months.
24.	Total Project Cost (Estimated)	:	₹ 30,000 Crores
25.	Cost Per MW (Estimated)	:	₹ 7.50 Crores

2.0 JUSTIFICATION OF THE PROJECT

2.1 Power Demand and Supply Analysis

"Power sector Report" as per CEA website gives the details of power supply position. The details at IXth plan end, Xth plan end, XIth plan end and April 2012 – November 2012 for All India is given in **Table - 2.0.**

Table-2.0

Period	Peak Demand (MW)	Peak Met (MW)	Peak Deficit/ Surplus (MW)	Peak Deficit/ Surplus (%)	Energy Require-ment (MU)	Energy Availa-bility (MU)	Energy Deficit/ Surplus (MU)	Energy Deficit/ Surplus (%)
IXth Plan End	78441	69189	-9252	-11.8	522537	483350	-39187	-7.5
Xth Plan End	100715	86818	-13897	-13.8	690587	624495	-66092	-9.6
XIth Plan End	130006	116191	-13815	-10.6	937199	857886	-79313	-8.5
April 15 – March 16	153366	148463	-4903	-3.2	1114235	1090713	-23522	-2.1

Table-2.1 shows the details of peak load and energy requirement for Eastern Region and Bihar state as on November - 2012.

Table-2.1

Description	Unit	Eastern Region		Bihar	
		March, 2016	April 2015 – March 2016	March, 2016	April 2015 – March 2016
Peak Demand	MW	17968	18076	3547	3735
Peak Availability	MW	17733	17972	3347	3484
Peak surplus/ deficit	MW	-235	-104	-200	-251
Peak surplus/ deficit	%	-1.3	-0.6	-5.6	-6.7

Energy Requirement	MU	11092	124608	2163	24050
Energy Availability	MU	11068	123635	2147	23748
Energy surplus/ deficit	MU	-24	-973	-16	-302
Energy surplus/ deficit	%	-0.2	-0.8	-0.8	-1.3

Installed capacity of All India level, Eastern Region and Bihar State as on 30.11.2012 is given in **Table-2.2.**

Table-2.2

All India

Figures are in MW

Sector	Thermal				Nuclear	Hydro	RES** (MNRE)	Total
	Coal	Gas	Diesel	Total				
State	64320.50	6975.30	438.57	71734.37	0.00	28092.00	934.22	101760.59
Private	69462.38	9978.00	554.96	79995.34	0.00	3120.00	36887.29	120002.63
Central Sector Share	51390.00	7555.33	0.00	58945.33	5780.00	11571.42	0.00	76296.75
Total	**185172.88**	**24508.63**	**993.53**	**210675.04**	**5780.00**	**42783.42**	**38821.51**	**298059.97**

RES** = Renewable Energy Sources

Eastern Region

Figures are in MW

Sector	Thermal				Nuclear	Hydro	RES** (MNRE)	Total
	Coal	Gas	Diesel	Total				
State	7540.00	100.00	0.00	7640.00	0.00	3168.92	225.11	11034.03
Private	8731.38	0.00	0.00	8731.38	0.00	195.00	244.43	9170.81
Central Sector Share	14351.49	90.00	0.00	14441.49	0.00	925.20	0.00	15366.69
Total	**30622.87**	**190.00**	**0.00**	**30812.87**	**0.00**	**4289.12**	**469.54**	**35571.53**

Bihar State

Figures are in MW

Sector	Thermal				Nuclear	Hydro	RES** (MNRE)	Total
	Coal	Gas	Diesel	Total				
State	210.00	0.00	0.00	210.00	0.00	0.00	70.70	280.70
Private	0.00	0.00	0.00	0.00	0.00	0.00	43.42	43.42
Central Sector Share	2531.24	0.00	0.00	2531.24	0.00	129.43	0.00	2660.67
Total	**2741.24**	**0.00**	**0.00**	**2741.24**	**0.00**	**129.43**	**114.12**	**2984.79**

Source: CEA Website

2.2 Need for the power generation facility

As per 17th Electric Power Survey (EPS), the Peak load (MW) and Energy requirement (MU) at the end of 11th, 12th, 13th plan period are shown in **Table - 2.3**. The peak load in Bihar state at the end of 11th plan will be 3601 MW it will be 5598.22 MW by end of 12th plan, and 9567.426 MW by the end of 13th plan. During the above periods, peak load in Eastern Region will be 19088.442 MW, 28400.908 and 42711.602 MW respectively.

Table-2.3

Peak load and Energy Requirement at Station Bus Bar

YEAR	Bihar State		Eastern Region	
	Peak Load (MW)	Energy Requirement (MKWH)	Peak Load (MW)	Energy Requirement (MKWH)
2011-12	3607	19904.77	19088.442	11802.293
2016-17	5598.22	32857.08	28400.908	168941.670
2021-22	9567.426	58248.405	42711.602	258215.949

Considering the power scenario of the Bihar State, the need for setting up of proposed 5x800 MW Banka Ultra Mega Power Project by BMPL at Banka, Bihar is fully justified.

3.0 INFRASTRUCTURAL REQUIREMENTS

3.1 Site Selection and Features of the Selected Site

For the establishment of a power project a number of basic inputs such as land, fuel, water etc. are required. Location of power station is primarily governed by the following basic considerations:-

1. Availability of land
2. Rail / Road accessibility
3. Availability of fuel and its transportation
4. Availability of water and proximity to source
5. Proximity to the grid for evacuation of power
6. Environmental considerations

The most important criteria for selection of sites for Power Project is the availability of land with least Resettlement and Rehabilitation (R&R) issues, Fuel availability and its transportation, water availability and the acceptability from the environmental considerations.

Sites comparison sheet is as per **Annexure - 3.1.**

The site is located near village Kakwara 500 m to the NH-333A which is running from north to north-west of the site. It is at about 50 km from Bhagalpur city and is covered under the jurisdiction of Banka and Katoria police stations. The Banka town is at a distance of about 15 km from site.

The Latitude and Longitude of the proposed site are 24^0 46' 32" N and 86^0 51' 41" E respectively.

Site Location map is shown as per **Annexure – 3.2.**

a) **Land**

The total land for the proposed power plant is 2400 acres, including 150 acres land required for township as per CEA guidelines.

b) **Rail/Road Accessibility**

The site is well connected by National Highway at a distance of 500m. This National highway connected to banka – katoria.

The nearest railway station is at Banka which is about 15 km from the site.

Nearest Town from the proposed site is Banka, which are at distance of 15 km.

c) **Coal Availability & Transportation**

Coal requirement for the project is estimated at 20 million tonnes per annum (MTPA). Gross Station Heat Rate has been taken as 2300 kCal/kWh. Domestic coal will be sourced from the Rajmahal group of coalfields in Pirpainti – Barahat at a distance of 80 km. Coal Block is located in the State of Bihar and Jharkhand.

d) **Availability of Water**

The estimated consumptive water requirement for the project is about 120 cusec which will be met from the Ganga River near Sultanganj flowing flows at a distance of about 70 kms from the proposed project site.

e) **Power Evacuation**

Power from the proposed plant will be evacuated through 765 KV / 400 KV transmission lines.

f) **Ecologically Sensitive Area**

Notified ecologically sensitive areas or wildlife sanctuary are not located within 15 km distance from the site.

4.0 TECHNOLOGY & UNIT RATING

4.1 Adoption of Supercritical Technology

The proposed 800 MW units will have super critical steam parameters to achieve higher efficiency and hence, lower cost of generation. Steam parameters of supercritical technology are as follow:

Pressure	:	270 kg/cm² (a)
Main Steam Temperature	:	600°C
Reheat Steam Temperature	:	600°C

The main advantages of adopting higher unit size of 800 MW with supercritical parameters are brought out below:

i. From Plant Performance Point of View:

- Reduction in coal consumption.
- Reduction in ash generation.
- Reduction in effluent gasses to atmosphere.
- Reduction in suspended particulate matters to environment.
- Better performance during off-design operation due to variable "Evaporate End Point".

ii. From Operation Point of View

- Better heat rate at full load as well as partial load.
- Lesser percentage of auxiliary consumption, hence increase in net power export.
- Lesser startup time and hence less consumption of startup fuel and power.

- Quicker load following capabilities i.e. better response to load rise / fall.
- Lesser consumption of cooling water.
- Boiler drum is eliminated hence no need of level control.
- More favourable for frequent start / stop even for two-shift operation.
- Lesser requirement of service like compressed air; water etc. because of reduction in number of units.

iii. From Plant Upkeep Point of View

- Lesser requirement of manpower for the operation & maintenance.
- Lesser number of equipments to maintain, hence lesser *inventory.*
- Increase in cost due to expensive materials to withstand higher pressure and temperature is off-set for reduction in size of balance of plant as well as number of units.

Super Critical Pressure power plant is envisaged in view of above indicated benefits.

5.0 TECHNICAL FEATURE OF THE BOILER & TG PLANT

5.1 General

Steam Generator, Design Considerations

1. **Furnace Type**

(i) Two Path / Tower Type
(ii) Spiral (plain/bare tube) Wall and Vertical (rifled/ribbed tube) Wall Type
(iii) UP Type / Benson Type

5.2 Description of Steam Generator

The steam generator will be supercritical, technology designed for firing coal as primary fuel, balanced draft furnace suitable for semi-outdoor installation. Boiler including auxiliaries will be designed for operation with 100% coal.

The steam generator will be capable of operating on sliding parameter. The load charge for sliding parameter will be from 40% SGMCR to 100% TGMCR. However, it will be possible to operate the steam generator with modified pressure sliding mode with constant pressure mode operating between 90% TGMCR to 100% SGMCR. Steam generator will be designed to meet the Indian Boiler Regulation (IBR) requirement. Wherever IBR is not specific, ASME or equivalent reputed international code will be used.

Steam and water system will essentially comprise of steam separator, separator storage tanks evaporator down comers, water walls,

superheater, reheater, desuperheater, economizer, valves, fittings, piping, insulation, supporting hanger's instrumentation etc.

The furnace will be designed to withstand pressure regimes without permanent deformations and will be made of gas tight welded membrane walls design required for openings of wall blowers, observation ports, access doors and instruments.

The furnace walls will either be spiral wound and vertical tubes or vertical rifle tubes as per the manufacturer's design. The furnace will have hopper bottom with stainless steel seal plates suitable for connection to an ash hopper. A suitable sealing arrangement shall be provided for connecting to water impounded wet type bottom ash hopper.

The water / steam separators will be arranged at the evaporator outlet and will be so sized to ensure adequate steam separation. The water / steam mixture will be fed into the separators by connecting pipe work which will enter around the circumference at an inclined angle to ensure mixture moving spirally downwards and the water / steam separation is done by means of applied centrifugal force. The water will be led downwards to the collecting vessel and the steam escapes centrally upwards to the connections towards the first superheater stage.

The water received in the separators will be re-circulated to the economizer inlet via 1x100% startup water re-circulation pump. At higher loads the re-circulation pump will not be in operation and the entire flow from the evaporator is directed to the superheater. It will also be possible to start the steam generator without the re-circulation pump.

The superheater and reheater will be designed to maintain superheat and reheat steam temperatures at superheater and reheater outlet over the entire steam temperature control range.

The attemperators are to be of spray type fitted with an inner removable lining. RH temperature control is by means of damper control of the flue gases or gas recirculation.

The economizer will be of non-steaming and bare tube type. The tube banks will be of inline arrangement.

5.2.1 Air and Flue Gas Draft System

(1) Draft System

The Draft system will comprise of two (2) sets of FD fans each set rated for 60% of BMCR capacity. The FD fans will be axial reaction variable pitch control. Two (2) Nos. axial type induced draft (ID) fans each rated at 60% of BMCR flow will be axial radial reaction single stage, with variable blade pitch control.

Boiler unit will be equipped with two (2) Nos. 60% capacity primary air fans. Primary air fans will be axial reaction two stages and variable pitch blade control. Cold primary air system will be provided.

The fans will be complete with lube oil, hydraulic regulations and all other accessories required for continuous operation and will be suitable for outdoor installation. 2x100% seal air fans will be radial type.

(2) **Air Heater**

Secondary air and primary air will be preheated in two trisector or four bisector air preheater, two (2) each for secondary air and primary air separately.

Additionally, two steam heated air preheaters (SHAP) will be provided on upstream of the secondary section of regenerative air preheater.

(3) **Coal Feeding and Burning System**

Coal feeding and burning system will essentially comprise of gravimetric coal feeders, coal mills, coal pipes and coal burners.

For firing high ash content abrasive coal, medium speed vertical spindle of large capacity bowl mills will be provided having low power consumption; relatively high availability, low maintenance cost and fineness control. The mill size and numbers will be selected such that on an average two mills remain standby.

Considering the grinding fineness required, the mills will be equipped with rotating classifiers having speed adjustment to control grinding fineness. The firing system will employ latest “State of the Art” burners and will permit load variation from 40 to 100% BMCR without use of support fuel. The ratio of fuel and air flow will be controlled. Due to sufficient burner wall distance and the burner swirl direction, operation with low excess air will be possible without the risk of wall damage.

Tilting Tangential Firing system in which injection of fuel and air from wind box in the furnace corner is envisaged.

(4) **Coal Mill Rejects Handling System**

The Mill Rejects Handling System will be provided for collection of the rejects from each mill of the boiler unit and to convey to storage bunker. Each mill will be provided with collection and transportation equipment comprising of one no. Pyrite Hopper with water spray arrangement plate valves at inlet and outlet and a transport vessel connected to storage bunker.

(5) **Secondary Fuel Oil System**

The fuel oil system will be provided for boiler start up; and for flame stabilization during low load operation with or without coal firing. Light Diesel Oil (LDO) for boiler start up (up to 7.5% of BMCR) and Heavy Fuel Oil (HFO) for low load operation and flame stabilization for minimum capacity of 30% of BMCR will be provided.

High Energy Arc (HEA) igniters will be provided to ignite the fuel oil.

(6) **Soot Blowing System**

Soot blowing system will comprise of steam soot blowers in various heat transfer sections suitable for automatic and sequential control.

(7) **Electrostatic Precipitators**

The high efficiency electrostatic precipitators having collection efficiency of 99.89% will limit the outlet dust emission to 30 mg/Nm^3

at ESP outlet with all fields in service while the boiler is operating at its BMCR, firing worst coal having maximum ash content in coal.

For each unit, four electrostatic precipitators comprising of eight (8) bus sections in the direction of gas flow and two bus sections perpendicular to the gas flow will be provided. Electrostatic precipitators will be provided with microprocessor based programmable type rapper control system and ESP management system to ensure the safe and optimum operation of ESP. The dust collection hoppers at all strategic locations will have a minimum storage capacity of eight (8) hours.

(8) Boiler Structures

Boiler and auxiliaries will be complete with necessary piping, valves and fittings. Supporting structural steel, stairways, platforms and walkways, hand rails complete, weather covering interconnecting platforms, buck stay and tie bars for boiler, refractory & insulation etc. will be provided.

Space provision for the FGD system to be installed in future (if required), will be kept behind the chimney as per environmental stipulation. The design and layout of steam generator and its auxiliaries will be such that a wet/dry flue gas desulphurisation system can be installed, taking suction from duct after ID fan and feeding the desulphurised flue gases back to the chimney with provision for bypassing the FGD system.

5.2.2 AUXILIARY BOILER

One number outdoor installation type, natural circulation, single / bi-drum, pressurized furnace, water tube Boiler suitable for firing LDO and having required steaming capacity but not less than 60 T/hr. (Excluding steam requirement of Auxiliary Boiler) with operating steam parameters of 19 kg/sq.cm(g) pressure & 250 deg. C temperature at super-heater outlet. Output steam of the auxiliary boiler shall be connected to the low temperature station header.

Boiler and its supporting auxiliaries are capable to generate 110% MCR steaming capacity for half hour every shift of eight hours.

The steam temperature control range of Auxiliary boiler shall be from 60% to 100% load.

The design of Auxiliary Boiler shall meet (or exceed) all requirements of IBR. The Bidder shall be responsible to obtain necessary approval of Inspection Authority / Chief Inspector of Boiler on behalf of Customer as may be required for design & design calculation, manufacturing & erection procedures, testing etc. as called for under IBR.

The auxiliary Boiler, including its interlock & protection system shall conform to NFPA – 85.

5.3 Steam Turbine and Auxiliaries

5.3.1 Steam Turbine Plant

The turbine component and its auxiliaries will be designed and selected to meet the stringent requirements in respect of superior thermal performance, excellent product reliability & operational flexibility.

The turbine will be designed based on modular design approach that divides the turbine into three main parts:

- High-pressure (HP) section
- Intermediate-pressure (IP) section and
- Low-pressure (LP) section

The turbine will have one single flow HP, one double flow IP and two double flow low-pressure cylinders exhausting downwards into condensers. All components will be selected based on long-proven records and standardized modules. The turbines will be of the tandem compound design. The individual shafts of the cylinders and the generator rotor shaft will be coupled rigidly together.

5.3.2 Gland Steam Sealing System

A fully automatic gland sealing steam supply system will be provided for the TG Set and the turbine drives of BFPs. HP & IP turbine shaft glands will be sealed to prevent escape of steam into the atmosphere and the LP turbine glands will be sealed for preventing leakage of atmospheric air into the turbine. Steam will be used for sealing these spring backed labyrinth glands.

During start-up and low loads (say 40% load), seal steam will be supplied to the turbine glands from the auxiliary steam header or cold reheat line through a seal steam regulating valve. During normal operation (above 40% load), the HP and IP turbines will be of self-sealing type and under that condition the auxiliary / CRH steam source will be cut off and the leak-off steam from HP and IP glands will be used for sealing the LP glands. The excess leak-off steam will be led to the condenser.

A gland steam condenser will be provided to condense and return to the cycle, all gland leaks off steam including that from BFP turbines. 2x100% capacity vapour exhausters will be provided to remove non-condensable gases from the gland steam condenser.

5.3.3 Oil System

The oil system will supply oil for lubrication and cooling of turbine and generator bearings, driving the hydraulic shaft turning gear during start-up and shutdown, jacking the rotor shaft system at low speed. This system will be provided with AC & DC powered oil pumps.

A separate, self contained high-pressure fluid system with dedicated pumps will be provided for valve actuation. The system will specifically include the following:

(a) Turbine shaft driven main oil pump will have the sufficient capacity to handle lube oil requirement of the bearings and emergency seal oil requirements during normal operation.

(b) During start-up and shutdown, one of the electrically driven main oil pump will supply the lube oil to the bearings. Second main oil

pump will be automatically put into operation by pressure switch when the oil pressure drops below the pre-set value.

(c) 1x100% DC emergency oil pump for meeting lube oil requirements of bearings during emergency with automatic starting on low lube oil pressure pre-set value.

(d) One (1) AC motor & one (1) DC motor jacking oil pumps will be provided to lift the rotor at the bearings during turning gear operation.

(e) Each unit will be provided with an oil tank of sufficient capacity with 2x100% duty vapour extraction fans. 2x100% capacity oil coolers will be provided for oil cooling.

(f) A lube oil purification unit will be installed for each unit for the total oil charge on a continuous basis.

5.3.4 Control Fluid System

Control fluid supply for hydraulic actuators will be provided by means of a common hydraulic supply unit. The system will comprise of:

a) A control fluid reservoir of adequate capacity to ensure fluid supply.
b) Oil purification unit for control fluid system.
c) 2x100% AC motor driven pumps to pump the fire resistant fluid from the reservoir.
d) 2x100% capacity control fluid cooling via blast air coolers designed for service with DM water.
e) Required fluid conditions will be maintained by separate filtering lube with micro filters.

5.3.5 Governing Systems

The turbine will be equipped with multi-channel digital turbine governor control system ensuring stable operation under all operating conditions including grid disturbances and load throw off condition. The turbine governing system will be designed for high accuracy and high speed control tasks of steam turbine. It permits governed run up to rated speed of the turbine.

5.3.6 Turning Gear

Shaft turning gear will be provided to ensure uniform and rapid heating/cooling of casing during start up/trip conditions. The turning gear consists of hydraulic motor, overrunning clutch and intermediate shaft installed in the front bearing pedestal of the LP turbine. Oil supply to the shaft turning gear will be from the shaft jacking system.

Manual turning gear device with ratchet and liver arrangement will also be provided.

5.3.7 Turbine Protection System

Electronic protection system of turbine receives tripping signals from individual tripping criteria such as low condenser vacuum, lube oil pressure, high axial shift, high turbine bearing temperature, high HP exhaust steam temperatures, high absolute turbine vibration, high condenser level, low HPT proportional pressure, electrical generator protection, over speed protection and low vacuum trip etc.

5.3.8 HP-LP Bypass Station

60% HP / LP Turbine bypass station will be provided to act not only as a protection to the turbine during pressure rise resulting from sudden load throw-off but also to enable operation of the unit at loads lower than the control load. Further, HP/LP bypass will permit quick, repeated hot starts of the unit on its tripping.

The LP bypass station will be connected to the hot reheat line and discharges the steam into the condenser. The hot reheat steam will be desuperheated by means of condensate injection. The bypass system shall be in operation when the steam turbine is not able to receive the entire steam quantity, e.g. during start-up or in case of a load rejection.

5.3.9 Condensing System

The function of the condenser is to condense the steam exhausted from the LP cylinders and to produce and maintain as high a vacuum as possible in order to increase the enthalpy drop, which can be utilised in the turbine.

Twin condensers will be provided per unit with cooling water side of condenser in series. Condenser will be of box type construction with divided water box design which facilitate the operation of one half of condenser while the other half is under maintenance. The steam space will be of rectangular construction. The condenser will be provided with integral air cooling system from where air and non-condensable gas are drawn out with the help of air evacuation equipments.

Condenser tube will be of cupronickel or stainless steel. The layout of the tube will be of modular type having properly sized tube bundles.

5.3.10 Air Extraction

The unit will comprise of (2x100%) vacuum pumps for each condenser along with all accessories and instrumentation for condenser air evacuation. The vacuum pumps and accessories will be used to create vacuum by removing air and non-condensate gases from steam condenser during plant operation. Vacuum pumps will be of single/two stage liquid ring type with both stages (if two stage pump is selected) mounted on a common shaft. Vacuum pumps will be sized as per latest HEI requirements.

For quick initial start up, air will be extracted from the condenser using both vacuum pumps.

5.3.11 Condensate Extraction Pumps

Each unit will have 3x50% capacity motor driven condensate extraction pumps (two operating and one standby). The condensate pumps will be vertical barrel type, multistage, double section, diffuser pumps, centrifugal type designed for condensate extraction service having low suction head requirement. The pumps will be capable of handling the condensate from the condenser together with feed heater drains when the machine is operating at maximum unit output with HP heaters out with 3% make-up and discharging this quantity through the condensate polishing unit and the LP heaters to deaerator. The pump will have adequate margins on capacity and head to cater for most adverse conditions of operation such as:

a) HP & LP bypass in operation.
b) HP heaters out of service and unit operating at its maximum load during an under frequency operation.

5.3.12 Regenerative Feed Heating Cycle

Regenerative feed heating cycle will consist of LP heaters, drain cooler, deaerator and a parallel bank of HP heaters. The number of LP & HP heaters will however be based on the optimization of feed heating cycle.

Feed water will be heated by uncontrolled turbine extraction steam from turbine inter-stage tap-offs and cold reheat line in feed water heaters.

Spray-cum-tray type deaerator will consist of integral vent condenser, deaerating header and feed storage tank. The deaerator will be capable of deaerating the dissolved oxygen and carbon dioxide in condensate & HP Heater drains. The minimum capacity of the deaerator will be 6 minutes between normal operating level and low level with a filling factor of 0.66. The deaerator will be normally operating by taking extraction steam from IP turbine except during low load operation and start up when the steam is drawn from the auxiliary steam header.

5.3.13 Boiler Feed Pumps (BFP)

The unit will comprise of 2x50% turbine driven boiler feed pumps and 1x35 % electric motor driven boiler feed pump per unit with boiler feed booster pumps mounted on the common shaft. The boiler feed booster pump will be double volute casing, vertical split, casing type. The discharge line of the booster pump will be connected to suction boiler feed pump. Each boiler feed pump will be designed to give parameters to suit the steam generator requirements; such that motor driven feed pump will be used for start-up of unit and will also act as standby BFP. Turbine driven boiler feed pumps will be located at operating floor and the motor driven pump will be located on operating floor and both types will be accessible to turbine house EOT crane for erection and maintenance.

The feed pump will be able to handle feed water of pH. 8.5 to 9.5 and of temperature up to 185^0C (tentative).

The boiler feed pumps will be of horizontal, centrifugal type. The boiler feed pumps outer casing will be of barrel type with end removal. The inner pump assembly comprising of shaft, impellers, stage casings will be capable of being removed and replaced as a unit without disturbing the feed piping. Each feed pump will be provided with ON-OFF / modulating type recirculation control valve to protect the pump under low flow condition. The boiler feed water system will be designed to operate primarily in an automatic mode over the range of system design loads. The arrangement will provide automatic start-up one of the standby motor driven feed pump under conditions like tripping of the running TDBFP's and/or discharge header pressure low etc.

The turbine of boiler feed pump will be of total controlled governing and consist of reaction stages. During stable / normal operation, steam sources for TDBFP will be from IP / LP crossover piping.

Hydraulic coupling will be utilized to achieve speed control of motor driven feed pumps. Provisions will be made for warm up to standby pump, if required.

5.3.14 Lube Oil Purification System

A suitably sized centrifuge type turbine oil purifier will be provided as an auxiliary of the proposed turbine-generator set to condition the turbine oil continuously to remove the water and other impurities.

In addition, a common central facility will be provided common for both units. This will receive the refill of turbine oil from outside. In addition,

central lube oil facilities will be provided common for both the units. The purification plant will be complete with oil purifiers, one clean and one dirty oil storage tank, filter, necessary pumping sets and vent fans.

6.0 DESCRIPTION OF MAJOR SYSTEMS

6.1 MECHANICAL SYSTEMS

6.1.1 Coal Transportation, Unloading Facilities and Handling Plant

The coal will be transported to power plant from coal mines through Rail system.

The Coal Handling Plant (CHP) will be designed to operate throughout the year with coal with calorific value of 3425 kcal/kg.

Gross Station Heat Rate of 2300 kcal/kwh, the coal requirement for all units works out at full load with GCV of coal as 3425 kcal/kg as:

i)	Tonnes per hour (tph)	$\frac{5 \times 800 \times 2300}{3425}$ = 2686.13
ii)	Tonnes per day (tpd)	64467.15
iii)	Million tonnes per year at 85% PLF (mtpa)	20

Wagon Tippler Complex are proposed so that stock building and rake unloading operations can be carried out expeditiously. Track Hopper Complex are proposed so that during emergency situation, rakes with bottom discharge wagons can be unloaded in sufficient numbers.

Suitable Marshaling Yard shall be provided as per requirement of Track Hopper Complex & Wagon Tippler Complex.

MGR system envisaged for coal transportation & Unloading.

6.1.2 Fuel Oil System

A fuel oil system for boiler start-up as well as for flame stabilization during low load operation will be provided. Essentially HSD will be used for the boilers. However, for ignition of furnace Light Diesel Oil (LDO) will be utilized.

6.1.3 Ash Handling Plant

6.1.3.1 Bottom Ash System

Bottom ash (BA) will be collected continuously in a W-shaped, water impounded, storage type, water cooled refractory lined bottom ash hopper. BA hopper will be located directly below the bottom water wall header of boiler; and will have an effective storage capacity of 8 hours ash generated while firing worst coal. Dry bottom ash will be stored in bottom ash silo.

6.1.3.2 Coarse Ash System

Coarse ash collected in economiser hoppers, will be automatically extracted and conveyed to the feeder ejectors located below each hopper. Necessary vacuum for extracting ash from the hoppers will be created by the feeder ejectors. Dry Coarse ash will be routed to the bottom ash silo.

6.1.3.3 Fly Ash System (Dry Collection)

Fly ash collected in the ESP hoppers along the flue gas path will be extracted sequentially and conveyed pneumatically in dry form to RCC silos through dust collectors located adjacent to collector tank tower. For collecting dry fly ash, fly ash streams will be connected to dust collectors air lock valves, bag filters and other accessories. The dust collectors will be connected to the mechanical exhausters.

Dry fly ash of each unit will be collected in separate silos. The storage capacity of each silo will be adequately sized to collect ash generated in 24 hours while firing worst coal.

Dry fly ash from silos will be off-loaded into the trucks through dust suppression system or through rotary feeders.

Fly ash from each hopper will be collected in dry or wet form by providing suitable remote controlled isolating valves (at the option of the operator).

6.1.3.4 Ash Disposal System

The dry fly ash collected in silos of adequate capacity and will be disposed off for ash utilization facilities.

6.1.3.5 Ash Disposal Area

Ministry of Environment and Forests (MoEF) Notification dated 3rd November, 2009 stipulate that "new coal and, or lignite based thermal power stations and, or expansion units commissioned after this notification to achieve 100 % utilization of ash within four year from the date of commissioning of the unit".

However, in line to CEA guideline and considering the ash utilization potential around Project site, the optimized land area of 800 acres is proposed for ash dyke.

Ash disposal area is located within the Power plant area and having a storage capacity of 800 acres.

6.1.4 Plant Water System

Water is required in a thermal power station for the following: -

a) Makeup to Boiler

b) Potable & Service water for plant

c) Fire fighting

d) Water for coal dust suppression

e) FGD

For 5x800 MW power plant the water requirement is about 12,000m^3/hr. The availability of full requirement of water for the power plant is assured.

6.1.4.1 Raw Water System

Raw water will be drawn from the intake water pump house at Ganga river and pumped to plant through water pipelines. In plant raw water reservoir for adequate storage of consumptive water requirement of the plant will be also provided.

6.1.4.2 Chemical Laboratory

A chemical laboratory shall be provided for the day-to-day testing of fuel samples, water quality, steam quality, blow down, flue gas and analysis, Ash analysis, Pollution monitoring.

6.1.4.3 Rain Water Harvesting System

Rain water harvesting is the process of collecting, conveying and storing water from an area that has been treated to increase the runoff of rainfall. A small area of impermeable surface can collect a relatively large volume of water. The most important components, which will be evaluated for designing the rain water harvesting structure.

The following portions are excluded from the rainwater catchment area, as rainfall in these areas are either do not come out that can be dealt with or rainfall comes out as inefficient and these are dealt separately.

- Cooling Tower
- Guard Pond / RWHP areas
- Coal Stock Pile Area
- Boiler / ESP area
- Fuel oil handling and storage area

6.1.4.4 Waste Water Management System

The Waste Water Management Scheme adopting the philosophy of 100% recycling of treated effluent for a “Zero Discharge” concept. Each identified effluent stream shall be subjected to required treatment. The treatment facilities will be such that quality of outlet from each treatment facility as well as that at the Central Monitoring Basin outlet must individually meet applicable standards for discharge of liquid effluents to surface water.

The sources of waste water effluents from a thermal power station are mainly:

- CW System blow down

- Effluents from WT Plant (Clarifiers, Filters & UF)
- Effluents from regeneration waste (DM, CPU)
- Plant drains
- Oily waste fuel oil unloading & storage areas
- Oily waste from transformer yard areas
- Coal pile area runoff
- Ash water from ash pond.

The waste will be collected, treated and then reused within the plant.

6.1.5 Air-conditioning System

Various control rooms of the plant having a group of sophisticated and precision control and protection devices; as well as computer rooms will be air-conditioned to have controlled environment for proper functioning of the equipment and operating personnel comfort. Centralized air-conditioning system, package / split air-conditioning units & window AC etc. as per requirement of the area will be provided. The air conditioning system will be common for all the units.

6.1.6 Ventilation System

Adequate ventilation system will be provided for the TG building, ESP control building (non-air conditioned areas) and other areas such as DG set room, air compressor room, A/C plant room, DM plant building, battery rooms and various pump houses such as fuel oil pump-house, DM water pump house etc. to achieve:

i) Dust free comfortable working environment.

ii) Scavenging out structural heat gain and heat load of various equipment, hot pipes, lighting etc.

6.1.7 Fire Protection System

6.1.7.1 For protection against fire, all yard equipment and plant equipment will be protected by a combination of hydrant system; automatic sprinkler spray system (emulsifier system); fixed foam system for oil handling areas; automatic high velocity and medium velocity sprinkler spray system; auto-modular inert gas based system for control rooms apart from portable and mobile fire extinguishers located at strategic areas of plant buildings and adequate Passive Fire Protection measures. The systems will be designed as per the recommendations of NFPA or approved equals in accordance with the Tariff Advisory Committee (TAC) of the Insurance Association of India stipulations.

6.1.8 Mechanical Workshop

A mechanical workshop for the regular maintenance work will be provided with necessary equipment.

6.2 ELECTRICAL SYSTEM

The electrical system will be designed to assure high reliability of operation and high availability of the power plant through use of proven equipment conforming to International Standards, Codes and Practices and adequate level of redundancy. The electrical systems & equipment will also have to comply with the guide lines issued / notified by Indian Statutory Authorities viz. the Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), Indian Electricity (IE) Rules & Act, National Electrical Code (NEC), etc.

TABLE – 1

1.	Rated continuous active power output, kW	800,000
2.	Rated Power Factor	0.85
3.	Rated terminal voltage, KV	21~27
4.	Rated Frequency, Hz	50
5.	Rated Speed, RPM	3000

6.2.1 400 kV Switchyard

Power generated will be stepped up to 400 kV for evacuation.

For evacuation of power, open outdoor 400 kV, Air Insulated Switchyard is considered. Following parameters shall be considered for the design of 400 kV switchyard.

The AIS shall comprise of following bays/ circuits:

Description	No of bays
Generator Transformer Bays	5
Line Feeder Bays	8
Station Transformer Bays	3
Bus Reactors	2
Bus VTs	2
Total	19

6.2.2 Construction Power

In the construction phase power will be drawn from Banka substation which is around 15 kms from the proposed site.

6.2.3 Emergency Power Supply

Suitable number, (at least one per unit plus one common standby) emergency diesel generator sets of suitable rating will be installed in the station to serve as emergency power source.

6.3 CONTROL AND INSTRUMENTATION SYSTEM

6.3.1 Design Philosophy

Plant Control and Instrumentation shall be through state of art microprocessor based Distributed Digital Control, monitoring and information system (DDCMIS) for the entire main plant covering the total functional requirements of modulating control, sequence control, interlocks & protection, monitoring, alarm, data logging, fault analysis, performance calculation & optimization, maintenance scheduling & machine monitoring & analysis etc., water, steam and Gas analyses, surveillance monitoring equipment, tube leak detection system, C&I laboratory etc.

The design of the control system and related equipment shall adhere to the principle of “fail safe” operation at all system levels (i.e.) the loss of signal, loss of power or failure of any component should not cause a hazardous condition; and at the same time prevent occurrence of false trips and provide reliable and efficient operation of the plant under dynamic conditions and attainment of maximum station availability.

The DDCMIS shall be an integrated control and data acquisition system for providing control and monitoring of power plant equipment from a central control room for boiler, Turbine and its auxiliaries regenerative cycle, etc. The control room operator shall be provided with color-graphic displays of the power plant equipment consisting of Large Video screens of 67 inches diagonal and 21” TFT monitors; and with sufficient details to allow proper control and monitoring of the plant functions including Electrical systems like Generator, Switchyard, transformers and motors protection.

Also suitable gateways/soft links (with necessary protocols) and time synchronization including all required software & hardware shall be

provided for all microprocessor-based (PLC) off site packages for interfacing with DDCMIS.

The system shall have facility for sequential start-up of entire main Power plant and accordingly as per process requirement, different group controls / sub-group controls shall get operational commands and in turn individual drive shall get start/stop or open/close command, whereas Functional group control hierarchy shall be devised for the major plant equipment and their auxiliaries to allow operator to select a lower level of certain system or equipment during trial runs, testing etc. The system shall have facility for control, operation, monitoring start/stop etc. from operator workstations and large video screens (LVS). No fully hardwire backup except hardwired backup for safe shut down of plant has been envisaged, the LVS should ensure operation of the plant in case of total failure of all operator stations.

The MMI between the operator and main plant shall be through Operating Stations and larger video screens. However, necessary hardware like indicators, annunciation system, Push Button Stations, Control Switches and indicators etc. for Generator Protection & control, Transformer & Switchyard control parameters etc. shall also be provided to control & monitor important electrical parameters on Electrical Backup control Panel (BUP).

There shall be a common control room for all the units with Common Engineering room, a common shift incharge room and a common C & I laboratory.

6.4 CIVIL AND STRUCTURAL ENGINEERING ASPECTS

6.4.1 Basic Design considerations

The plot of land for the proposed project is fairly level. The site elevation generally varies from 100m to 150m above MSL. The plant grade level will be formed above the HFL of the area and will be finalized during detailed engineering stage.

Type of foundations will be decided based on the geotechnical investigation.

The power station is located under Zone - IV as per IS:1893 (part-I) :2005. Analysis and design of structures to resist the seismic forces will be carried out as per the provisions of IS:1893. The applicable zone factor will be considered during detailed engineering.

The applicable design wind pressure will be computed during design of buildings and structures as per IS:875 (latest version) for the zone in which the proposed power station is located.

6.4.2 Power House Building Superstructure

The main power plant building comprising TG bay (A-B bay) and the adjacent electrical & deaerator bay (B-C bay) will be of steel framed construction upto the roof level. The floor slabs at intermediate levels will be of RCC and supported on steel beams & columns. The TG bay roof (A-B bay) and side cladding will be provided with 0.5 mm the pre-color coated cladding. The deaerator bay (B-C bay) will have side cladding of brickwork (cement plastered with architectural finishes); B-row and C-row duly painted. Floor slabs and roof covering of B-C bay will be of cast in situ RCC

construction. A-B bay will be equipped EOT cranes. B, C, row wall will be of bricks.

Doors, windows and rolling shutters will be provided.

The transverse frames will be of framed type. In the longitudinal direction, these transverse frames will be braced to resist horizontal forces.

All the walls and floors will be provided with approved painting and floor finishing. RCC roofs will be provided with approved water proofing treatment.

(a) **Special Foundation Requirements for Rotating Equipment**

The foundation systems for rotating equipment will be sized and proportioned not to exceed the bearing and settlement criteria and to assure satisfactory performance of the equipment. In addition to All rotating equipment will be provided with vibration isolation spring system mounted foundations. The vibration isolation system supplied will be of proven make, the vibration isolation foundation system will be provided for Turbo-generator, Boiler feed pumps, ID/FD/PA fans, Coal mills and Coal crushers.

If equipment are to be supported on building structures, floors etc. suitable vibration isolation will be provided.

Civil foundations will be designed to take into consideration soil bearing capacity and ground water table. Generally raft/spread foundations will be considered.

The minimum grades of concrete will be in accordance with appropriate class of exposure as per IS-456-2000 Concrete grade Ductile detailing of RCC structures will be as per IS:13920

All buildings will be provided with 1500 mm wide and 150 mm thick plain cement concrete paving around on the outside. The plinth protection will be laid over prepared sub-base and base.

Steel doors, windows, rolling shutters will be provided with glazing as required.

b) **Structural Works**

Structural works will be designed for dead-load plus adequate live-load plus worse of wind load and earthquake load with importance factor of 1.5 and seismic load as per IS: 1893 as applicable for zone-IV.

Mill & bunker bay will comprise of structural steel framework supporting the coal bunkers, feeder floor and tripper floor. The structural frame will be designed as a fixed joint frame in the transverse direction and braced frame in the longitudinal direction. Coal bunkers will be of structural steel plates and will be lined with stainless steel liner plates in the entire conical portion.

Stairs, platforms and galleries will be of minimum 900 mm width complete with hand-rails, toe-plate and curbing as required. Stair treads will be of 250 mm with 150/190 mm height between successive treads.

6.4.3 Roads & Culverts

The roads in the plant area will be of adequate thickness and width as per requirement of various areas. It is proposed to have wet mixed macadam (WMM) roads during construction stage and the same will be finished with asphalt surfacing during completion stage. Adequate plant roads/culverts, grading and drainage will be provided. All roads will be designed as per applicable IRC/MOR&T standards.

6.4.4 Liquid Retaining Structures

RCC Water retaining structures will be leak proof and designed as uncracked section.

6.4.5 Civil Works for Plant Water System

1. Intake Water System

The consumptive water requirement will be drawn from the source and pumped to in plant water reservoir through MS pipelines. Intake water pump house will be provided at suitable location at river-end with pumping facilities. The makeup water pumping station will be of RCC construction. The in plant water reservoir will be provided with de-sludging / maintenance system. The pretreatment plant will consist of clariflocculators, clarified water tank, sludge disposal system

2. Waste Water Management

As a part of waste water system management, adequately sized settling sump oil water separator; settling pond; waste treatment plant sumps will be provided in RCC construction lined inside with

suitable materials. Plant drainage system will be designed as per the area drainage pattern. The surface run off the power plant area and also the process water taken out of the buildings will be taken to natural drainage system through a designed storm water drains, open drains & pipes.

Plant rainwater drainage will be connected to the nearby natural drainage system.

For the power island portion of the building one no. with sufficient capacity of sewage treatment system will be provided in the vicinity and for other miscellaneous buildings local septic tanks and soak pits will be provided.

The effluent from power house building, boiler area, chemical house etc. will be taken to a central monitoring basin. The effluent will be further treated in a R.O. plant to recycle and reuse in the system.

6.4.6 Civil Works for Coal Handling System

Conveyors galleries, supporting trestles, superstructures of crusher house and transfer houses will be of fabricated structural steel work. All components will be of welded fabrication with bolted/welded joints for erection and assembly in the field. Intermediate floors and roof in transfer houses and crusher house will be of reinforced concrete supported on structural steel framing. Side cladding will be of plastered brickwork or GI sheeting; and necessary windows/louvers will be provided for natural lighting and ventilation. Crusher foundation with vibration isolation springs system for isolating the crusher house building will be of RCC frame. Conveyor tunnels will be of concrete box section with provision of appropriate water proofing arrangement.

6.4.7 Civil Works for Ash Handling Plant Works

The blower/compressor room will be separate RCC construction in flat roof construction located close to ESPs to accommodate the blowers/ compressors with its auxiliaries.

Pipe rack for conveying the ash to ash silo will be of structural steel framed construction having its columns mounted on the RCC foundations. Suitable head room clearance will be maintained below the pipe rack for free movement of the cranes and other mobile equipment.

6.4.8 Switchyard Civil Works

Civil work for 765/400 KV switchyard will consist of tower foundations, equipment foundations, foundations for lighting mast towers, control room building and cable trenches, roads, drains and chain link fencing.

6.4.9 Chimney

Two (2) – twin flue & One (1)single flue with insulation (insulated outside the flue) RCC chimney will be provided. The height of the chimney will be 275 M. Chimney will be fitted with suitable capacity elevator, staircase inside the windshield of RCC slip form construction. Chimney will be fitted with pollution measuring apparatus.

Chimney will be provided with lightning arrestor, aviation warning lights as per statutory requirement. The top of the chimney shell will be painted with alternate red and white bands conforming to aviation safety standard requirement.

6.4.10 Auxiliary Buildings

In addition to the power plant technological structures/buildings, following non-technological buildings/structures will be also provided.

a) Fire house
b) Service building
c) Administrative building
d) Workshop, canteen, store
e) Security gate and time keeping office
g) Guard / watch towers spaced adequately around the boundary wall
h) Motor car shed etc.

7.0 PLOT PLAN AND GENERAL ARRANGEMENT

7.1 Plot Plan

Annexure – 7.1 shows the overall plot plan of the 5 x 800 MW Power Plant.

The Plot Plan of the project shows the location of main plant equipment with its auxiliaries, MGR, coal storage area, switchyard, raw water storage reservoir & Colony. The plant layout has been developed keeping in view the following:

i. Location within the designated area best suited from the point of view of available land offering least site grading costs.
ii. Wind rose directions
iii. Proximity to road network.
iv. Accessibility to water source and intake system.
v. Accessibility to power evacuation corridor.

The Plot Plan has been developed considering the location of available land, its approach, proximity for coal transportation and water conveying facilities etc.

Coal brought by trucks to the stock yard in the plant premises is fed into hoppers, crushed further and conveyed to the boiler bunkers. Facilities have been provided for 30 days Coal stock at power plant end.

Raw Water storage for 15 days consumption has been provided.

Ash silos have been provided from where ash will be removed in dry form by trucks for ash utilization facilities.

Except for the semi- outdoor boiler and outdoor transformers and switchyard, all other equipment will be located indoors.

The main plant equipment and auxiliary system are located based on the unit system design concept except for common facilities such as 230 KV switchyard, water system, coal and fuel oil unloading and handling facilities, ash disposal system.

The layout provides for:-

i. Dedicated Raw Water Reservoir
ii. Storage space for coal and secondary fuel.
iii. Space for future FGD Plant
iv. Coal Handling Plant.
v. Green belt all around the plant.
vi. Administrative building.
vii. Adequate space for built-up and open area for construction offices, stores, fabrication yard, pre-assembly yard etc.

Power Plant roads will be laid and connected to provide access to various areas of the proposed station, taking due care for convenience of movement of materials. Water intake & disposal points indicated are provisional. These will be finalized during detailed engineering.

7.2 General Plant Layout

The general disposition of furnace with its supporting columns; FD, PA and ID fans with drives and handling columns; Rotary air pre-heaters etc. will be located as applicable to 2-pass construction, front wall fired/corner fired/down-shot burner configuration boiler. The layout is subject to revision based on the final selection of the steam generator (either single pass tower type or 2-pass conventional type). In any case, the pulverizers will be

located in between the boiler air heaters and Electrostatic precipitator for better maintenance access and to reduce the critical piping lengths. The flue gas ducts from the air heater pass below feeder floor for connection to ESP and then will be connected to a 275M high RCC twin flue / single flue stack, connected through two (2) ID fans.

ESP control room will be provided separately.

8.0 ENVIRONMENTAL CONSIDERATIONS

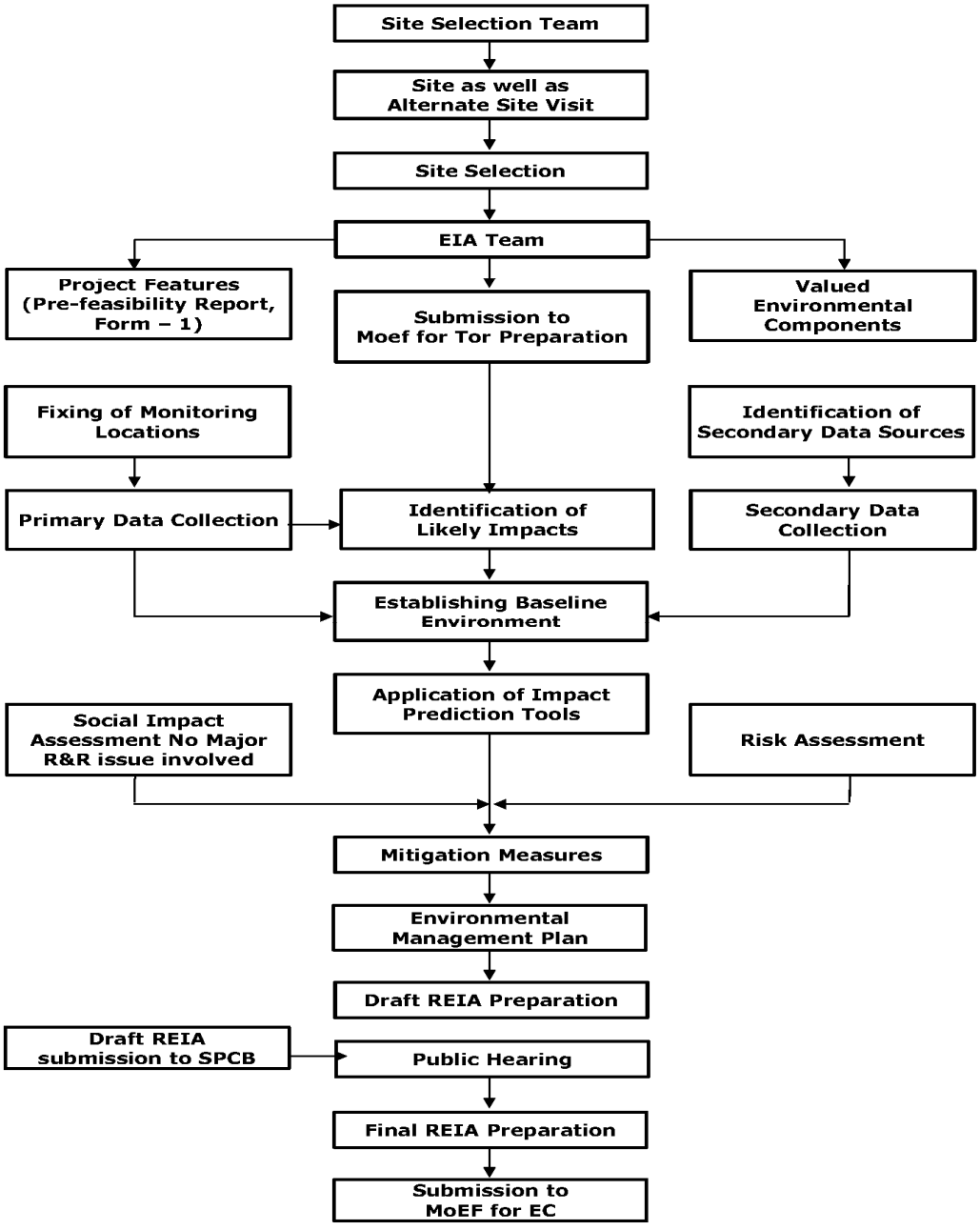
The Environment (Protection) Act of the Ministry of the Environment and Forests (MoEF) is an umbrella act that covers the EIA notification. The proposed thermal power project attracts Environmental Impact Assessment (EIA) requirement of the notification and thus requires Environmental Clearance. The MoEF has recently re-engineered the process of Environmental Clearance vide its Notification dated 14th September, 2006 suppressing the EIA Notification of 27th January, 1994 and its various amendments.

The new procedure has defined four stages of environmental clearance process. These stages in sequential order are as follows:-

- Stage (1) screening
- Stage (2) scoping
- Stage (3) public consultation
- Stage (4) appraisal

The above notification requires industries to carry out EIA study in accordance with MoEF & State environment guidelines after scoping and determination of the Terms of Reference (ToR) on likely impacts on the existing environment. Based on studies carried out in respect of identified activities including atmospheric emission and effluent discharge, predictions are made on the anticipated effects. To ensure that expected levels fall within prescribed limits, delineation of mitigation including environmental management plan is necessary for compliance. The notification also provides public consultation to mitigate public concerns for the proper compensation and rehabilitation of project affected persons.

In order to obtain environmental clearance for the project, an Environmental Impact Assessment (EIA) study has to be carried out. The steps broadly involved are indicated below:



An application seeking prior environmental clearance is made in the prescribed Form- I along with a copy of the pre-feasibility project report for initial clearance of the scope of work and terms of reference.

Based on the application submitted, the Expert Appraisal Committee (EAC) determines detailed and comprehensive Terms of Reference (ToR) addressing all relevant environmental concerns for preparation of EIA report.

The EIA report thus prepared will be appraised by the EAC before considering issue of Environmental Clearance.

Appraisal is made by Expert Appraisal Committee (EAC) in a transparent manner in a proceeding to which the promoter can furnish necessary clarifications in person or through an authorised representative. The committee makes categorical recommendations to the regulatory authority for grant of prior environmental clearance on stipulated terms and conditions or rejection of the application along with reasons for the same.

The regulatory authority considers the recommendations of the EAC and conveys its decision to the applicant within forty five days of the receipt of the recommendations. Normally, regulatory authority accept the recommendations of the Expert Appraisal Committee.

Coal fired thermal power station contribute to environmental pollution as follows:

a) Atmospheric pollution through particulate and gaseous emissions.

b) Thermal pollution of the surroundings.

c) Pollution due to discharge of liquid and solid wastes.

d) Noise pollution.

8.1 Air Pollution Control System

As per the MoEF notifications (S.O. 3305(E) dated 7th December, 2015), all new plants to be installed after 1st January, 2017 shall have to meet the following Emission Standards:

- Particulate Matters : 30 mg/Nm3
- Sulfur Dioxides (SO2) : 100 mg/Nm3
- Oxides of Nitrogen (NOx) : 100 mg/Nm3
- Mercury (Hg) : 0.03 mg/Nm3

The entire system will be therefore designed to keep the pollutant emission within specified norms under worst operating condition. To control the emission of particulates electrostatic precipitators (ESPs) will be provided. The ESPs will be so designed as to limit the particulates emission <30 mg/Nm3 under worst operating condition.

To control NOx emission, supercritical boilers having advanced low NOx generation system will be installed. In addition, Selective Catalytic Reduction (SCR) system will be installed.
Wet FGD system will be provided to bring down SO2 emission to comply with the standards now specified.

For a proper dispersion of the pollutants, Two (2) no. twin flue & One (1) single flue stack of 275 m height has been considered at in accordance with the EPA Notification G.S.R. 742 (E), dated 30th August 1990. In the latest MoEF&CC Notification S.O.3305(E) dated 7th December, 2015, stack emission of NOx and SO_2 have now been brought down to 100mg/Nm^3 which is substantially lower than the limits acceptable earlier. In view of this stricter emission norm, if the Ministry recommends lowering of chimney height, then the chimney height will be revised accordingly. For the control of

fugitive dust emission within and around the coal handling plant, coal dust extraction and suppression systems will be provided.

8.2 Water Pollution Control System

The reservoir water will be used to meet the entire consumptive water ($2.5m^3$/MWh) requirement. Treatment facilities will be provided in all wastewater streams so as to ensure collection of treated wastewater.

A state-of-the-art rain water harvesting system will be provided to collect the run -off for ground water recharging.

Effluent management scheme will be implemented with the objective of optimization of various water systems so as to reduce intake water requirement which will result in lesser waste water discharge. Adequate treatment facilities will be provided to all the waste streams emanating from the power plant to control water pollution.

8.3 Noise Pollution

Ambient noise inside and outside the plant area will conform to the prescribed noise levels for various land use categories as per National Standards for Ambient Noise. This will be ensured through proper designing of the equipment with adequate acoustics permitting the ambient noise levels without exceeding the specified criteria from the source.

Green belt of adequate width will be provided around plant boundary and strategic locations.

8.4 Solid Waste Management

The ash management scheme for the ash generated from power plant will involve dry collection of fly ash, supply of ash to entrepreneurs for utilization, promoting ash utilization and disposal of unused ash.

8.5 Ash Management

Ministry of Environment and Forests (MoEF) Notification dated 3rd November, 2009) stipulate that "new coal and, or lignite based thermal power station and, or expansion units commissioned after this notification to achieve the target of fly ash utilization as per Table III given below:

Table

Sl. No.	Fly ash utilization level	Target date
1.	At least 50% of fly ash generation	One year from the date of commissioning
2.	At least 70% of fly ash generation	Two years from the date of commissioning
3.	90% of fly ash generation	Three years from the date of commissioning
4.	100% of fly ash generation	Four year from the date of commissioning

The unutilized fly ash in relation to the target during a year, if any, shall be utilized within next two years in addition to the targets stipulated for these years and the balance unutilized fly target) shall be utilized progressively over next five years in addition to 100% utilization of current generation of fly ash."

Considering the above guidelines & stipulations regarding utilization of fly ash the project proponent will take necessary steps.

Terms of Reference (TOR) for conducting EIA studies is being processed by the Environmental Impact Assessment Authority and the report will be prepared based on the TOR and submitted for MOEF clearance.

8.6 ENVIRONMENT MANAGEMENT PLAN

During the construction process, the impact will be minimal and temporary in nature. So the scope of EMP during the construction phase will be limited to dust suppression and noise attenuation. Care has to be taken to reduce the SPM level of the project area.

8.7 SOCIO-ECONOMIC ASPECTS

For the project, 2440 acres of land will be acquired from 15 villages namely, Dona, Paprewa, Dhanbaran, Sihulia, Butwaria, Mohaliadih, Amhara, Basantpur, Garbaran, Tilwari, Medha, Kadragora, Tekuadih/ Nandirai and Mania.

Out of the 15 villages, two villages will be completely rehabilitated. Tola Basantpur and Tola Kauriani are un-inhabited. From the total 2440 acres of land, 1259 acres are private and 1181 acres are government land. These Private lands are mainly cultivated agricultural unirrigated/irrigated land.

Impact of Built-up Properties

Out of the 15 villages, two villages namely Tola Tekuadih/Nandirai and Tola Butwaria will be completely rehabilitated and resettled where near about 147 households as per the census data 2011 will be affected.

Impact on Community Structures

There are few numbers of community structures such as religious buildings or schools which will be getting affected by the project.

RESETTLEMENT

- Resettlement and rehabilitation in this project consists of the following broad entitlements of the entitled person/family/group:
- Compensation for the loss of property (in case of titleholders and person occupying land for period more than 3 years);
- Additional relocation support for the displaced titleholder families; R&R assistance to the non-titleholder affected/displaced families;
- Livelihood and income restoration support and assistance to the project affected and displaced families/persons.

9.0 EXECUTION AND MANAGEMENT

For a project of this magnitude, it is essential to have an effective project management and control system to ensure that the project is implemented within the stipulated time frame, budgeted cost and required quality levels. Despite a well prepared schedule, in practice, it is common to see undue delays in the execution of projects due to improper planning and inadequate control during the various phases of execution. To avoid such pitfalls, BMPL shall use reasonable endeavors for monitoring the achievement of the development milestones assessing program towards the plant implementation and will attempt to resolve any difficulties that may arise during the course of implementation.

BMPL will take all the necessary measures to meet the commissioning schedule for the boiler, steam turbine generator and the unit as a whole.

BMPL will engage an experienced engineering consultant for consultancy and for project management activities. In order to execute the project effectively, adequate staff of BMPL will be stationed at project site.

9.1 Construction

BMPL will mobilize the infrastructure such as offices etc. to start work at site for arranging construction power & water supply and for construction of temporary offices etc. immediately on making the decision to implement the project.

BMPL will mobilize to execute the project through a well-defined turnkey EPC contract. The EPC Contract will be finalized through competitive bidding. The contract will be a fixed price EPC contract with an entity with substantial financial backing and significant experience in the engineering, procurement and construction of similar plants.

The Engineering-Procurement-Construction (EPC) contract will include provisions necessary to attract project financing and ensure the prescribed cost and performance for the term of the contract. This contract will incorporate completion guarantees, performance guarantees and liquidated damage provisions sufficient to preserve the project's ability to service its debt and meet its obligations to its customers if the facility does not achieve commercial operation in time or does not meet expected performance levels.

The construction workforce and all sub-contractors will be hired by the EPC contractor. The construction workforce will be sourced from the nearby areas.

9.2 Operation & Maintenance

The O&M organization will be headed by plant Manager having overall administration as well as technical control of the power plant. Optimum level of suitable technical and administrative personal will be placed.

9.3 Completion Schedule

The project will be scheduled for the first unit to go into commercial operation in 52 months after the' zero date' & subsequent units at four (6) months interval thereafter.

10.0 PROJECT COST

The tentative project cost has been worked out and the figures are as under:

Cost of Project including IDC	₹ 30,000 Crores
Cost per MW	₹ 7.50 Crores

The above estimates are for the purpose of Pre-Feasibility Report without any detailed estimation of bill of quantities. However, the detailed cost estimates and financial analysis will be carried out during Detailed Project Report stage, based on the specific data.

Annexure - 3.1

Site Alternative Analysis

S.No.	Parameters	Site – 1: Kakwara (Banka District)	Site – 2: Rajauli (Nawada District)	Site – 3: Malwathan (Banka District)
1.	Location with Latitude & Longitude	24°46'32" N 86°51'41"E	24°37'35" N 85°29'07" E	24°41'01" N 86°51'18"E
2.	Land Availability	About 2500 Acres	About 2400 Acres	About 1850 Acres
3.	Land consisting of Villages	Dona (Kakwara), Sihulia Mohaliadih, Amhara, Nandirai, Garbaran and Tilwari etc. 2 No. are un-inhabited	Saraiya, Satgir, Sirodabar, Baliya, Chautna, Jogiyamaran, Bhanrra,Khusiyalibhita and Bakhor etc.	Malbathan, Bokanwa, Jamua, Katahara, Kulharia, Sarua, Palania etc.
4.	Type of Land	Govt. and Private dry barren/waste land with small patches of rain fed single crop cultivation.	Govt. and Private single /double crop land mostly used for agriculture. On the other side high hills with dense Sirdala protected forest exists.	Govt. and Private land with patches of rain fed single crop cultivation.
5.	Densely populated or built-up area	Banka town - 14 Km	Rajauli - 2.5 km hence Nawada town - 40 km.	Banka town - 20 Km
6.	Requirement of R&R	About 200 households will be displaced	About 1328 households will be displaced	About 500 households will be displaced
7.	Forest Land	Nil	About 90 acres	About 140 acres
8.	Water Intake Location	Ganga River Near Sultanganj about 70 km	Phulwaria Dam on river Tilaiya- 5 km, but sufficient water is not available	Ganga River Near Sultanganj about 80 km
9.	Seismic / Cyclone History	None	None	None
10.	Industries Around	None	None	None
11.	EHV Substation	About 25 km – PGCIL Substation	About 60 km – PGCIL Substation	About 35 km – PGCIL Substation
12.	Mode of Coal Transportation	By rail to site from Rajmahal group of coal fields located in Bihar/Jharkhand border at a distance of about 85 km.	By rail to site from Rajmahal group of coal fields located in Bihar/Jharkhand border at a distance of about 220 km.	By rail to site from Rajmahal group of coal fields located in Bihar/Jharkhand border at a distance of about 100 km.
13.	Land Grading Requirement	Levelling required in some areas	Levelling required in some areas	Levelling required in patches
14.	Road Access	NH-333A, about 0.5 km, Banka - Deoghar road	NH-31, about 0.5 km, Kodarma - Nawada road	NH-333A, about 8 km, Banka - Deoghar road
15.	Environmental Aspects	Mainly uncultivable land. Forest area non-existent. No major R&R issues are involved.	The land is fertile with populated villages and will require major R&R. Flooding of the area identified is anticipated as the site is located on the downstream side.	Land involves about 140 acres forest area. R&R issues are involved. The village road connecting Jogiabandh and Malbathan village,

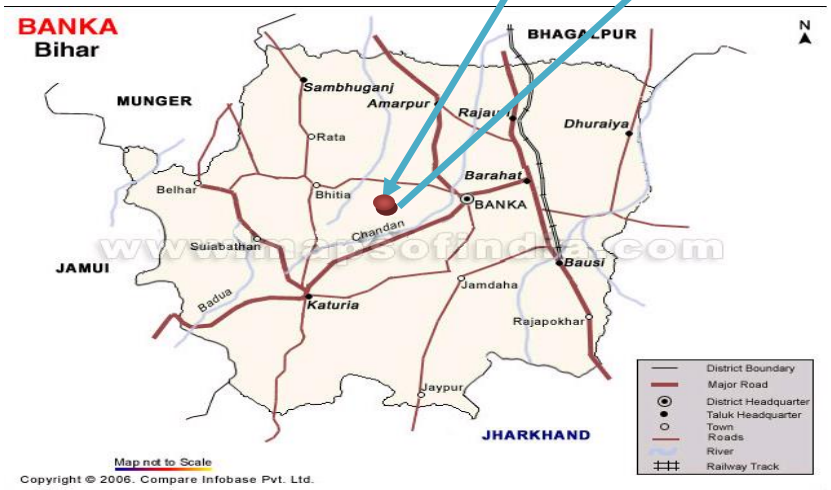
S.No.	Parameters	Site – 1: Kakwara (Banka District)	Site – 2: Rajauli (Nawada District)	Site – 3: Malwathan (Banka District)
		A road connecting Karjhausa and Menda village to be suitably rerouted. There are no ecologically sensitive areas or wildlife within 15 km distance from the site.		which is Jeepable in dry season, will be required to be diverted. There are no ecologically sensitive areas or wildlife within 15 km distance from the site.

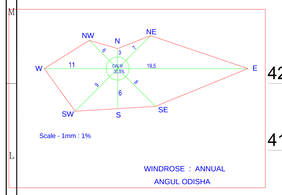
SITE LOCATION MAP

Annexure – 3.2

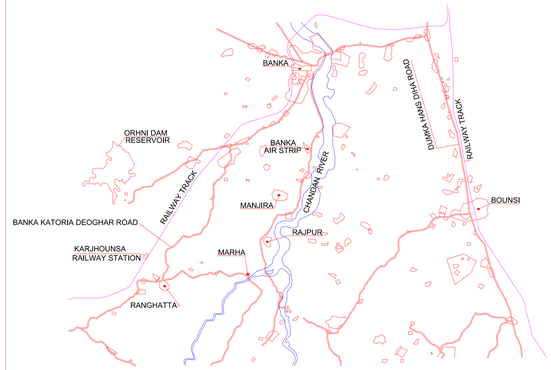
INDIA MAP

4000 MW BANKA UMPP (PROPOSED)





WINDROSE : ANNUAL
ANGUL ODISHA



KEY PLAN

LEGEND

ITEM NO.	DESCRIPTION	SIZES(M)
1.0	POWER BLOCK AREA	
1.1	POWER HOUSE BUILDING	
1.2	BOILER HOUSE	
1.3	MILL BAY	
1.4	ELECTROSTATIC PRECIPITATOR (ESP)	
1.5	CHIMNEY	
1.6	SPACE FOR F.G.D.	
1.7	DG & COMPRESSOR BLDG.	
1.8	E.S.P CONTROL ROOM	
1.9	CONDENSATE STORAGE TANK/CONDENSATE TRANSFER PUMP HOUSE	
2.0	ELECTRICAL FACILITIES	
2.1	SWITCHYARD	
2.2	TRANSFORMER YARD	
2.3		
3.0	WATER SYSTEM	
3.1	COOLING TOWER	
3.2	C.W. PIPE CORRIDOR	
3.3	CW/ACW PUMP HOUSE	
3.4	RAW WATER RESERVOIR	
3.5	RAW WATER PUMP HOUSE	
3.6	E T P	
3.7	C.W.FOREWAY	
3.8	CHLORINATION & CW TREATMENT PLANT	
3.9	CLARIFIER	
3.10	FIRE STATION BUILDING	
3.11	CW CHLORINATION	
3.12	CW SIDE STREAM FILTRATION PLANT	
3.13	DM PLANT & CPU REGN.	
3.14	CHEMICAL HOUSE OF PT PLANT	
3.15	COMPRESSOR HOUSE	
3.16	PRE-TREATMENT PLANT	
4.0	COAL HANDLING PLANT	
4.1	WAGON TIPPLER	
4.2	TRACK HOOPER	
4.3	PENT HOUSE	
4.4	CRUSHER HOUSE	
4.5	CHP CONTROL ROOM	
4.6	COAL STOCK PILE	
4.7	COAL PILE RUNOFF SETTLING POND	
4.8	LOCO SHED	
4.9	--	
4.10	LAYDOWN AREA	
5.0	ASH HANDLING PLANT	
5.1	ASH SILO	
5.2	--	
5.3	--	
5.4	--	
5.5	ASH DYKE	
5.6	--	
5.7	--	
6.0	FUEL OIL SYSTEM	
6.1	HFO & LDO TANK FARM AREA	
6.2	HFO & LDO PRESSURIZING PUMP HOUSE	
6.3		
6.4		
7.0	NON-PLANT BUILDING	
7.1	ADMN. BUILDING	
7.2	SERVICE BUILDING	
7.3	STORE	
7.4	CANTEEN	
7.5	WORK SHOP	
7.6	WEIGH BRIDGE	
7.7	CHECK POST	
7.8	MAIN GATE	
7.9	CAR PARKING AREA	
7.10	--	
7.11	LAYDOWN AREA	
7.12	TIME OFFICE CUM SECURITY OFFICE	
7.13	CONSTRUCTION & FABRICATION YARD	
7.14	SECURITY CABIN	
7.15	--	
7.16	AAQMS SHED	
7.17	CHEMICAL LAB (PCRI)	

FOR PFR ONLY
ANNEXURE - 7.1

SR. No.	PARTY
PRINT DISTRIBUTION	

REFERENCE DRAWINGS.

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
3. POWER HOUSE BUILDING FINISHED FLOOR LEVEL (FFL) 0.00M CORRESPONDS
4. BUILDING SIZES SHOWN ARE PRELIMINARY AND SUBJECT TO CHANGE DURING DETAILED ENGINEERING.

ZONE	MARK	PARTICULARS	DATE
	0	PRELIMINARY	07.04.16

REVISIONS

DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.

APPROVED

DRAWN	DESIGNED	CHKD	APPRD.	SCALE
H.LAL	L.N.KHANNA	POONIYA	S.SANTHANAM	

JOB. No. D-0433

PROJECT CONSULTANT: DESEIN PRIVATE LIMITED
CONSULTING ENGINEERS,
NEW DELHI, INDIA

PROJECT: BANKA ULTRA MEGA POWER PROJECT, BIHAR

TITLE : PLOT PLAN

DWG.No. 111-29-0200

REV. 0

Sheet No. of