LALITPUR POWER GENERATION COMPANY LIMITED

PRE FEASIBILITY REPORT

FOR

EXPANSION OF 3X660 MW COAL BASED THERMAL POWER PLANT - PHASE-2

AT

LALITPUR, UTTAR PRADESH

C O N T E N T S

EXECUTIVE SUMMARY

1. **Purpose**

   The purpose of this Pre-feasibility Report is to present the details including technical details of the proposed Expansion Project, Phase-2, 3 x 660 MW capacity coal fired supercritical thermal power plant at villages Mirchwara and Buraugaon, tehsil Mahroni in Lalitpur district in the State of Uttar Pradesh.

   This report also highlights the details of the site, coal receipt at plant site, availability and use of water, technical features of the main plant equipment, raw and cooling water system, coal and ash handling systems, electrical systems, evacuation of power, environmental aspects, schedule for project implementation of the proposed thermal power project and cost estimates of project.

2. **Scope**

   The scope of this report covers the following:

   a. Review of power and energy requirements of grid and establish the need for installation of proposed project
   b. Study site for the installation of Phase-2, 3 x 660 MW coal based thermal power plant considering topography, protection against flood, soil conditions, accessibility by road, availability of water, power evacuation plans, transport of fuel required for the plant, space availability for ash disposal etc
   c. Preparation of plant layout
   d. Brief details of the major aspects of the proposed plant and salient technical details of the major equipment / systems proposed
   e. Environmental aspects
   f. Preparation of project implementation schedule
   g. Preparation of preliminary project cost estimates

3. **Review of Power & Energy Requirements and Need for the Project**

   Based on the details of load forecast and assessment of generation capacity duly taking into account the realistic planned additions to the grid and the generation from the plants in the Northern region, as per CEA Load Generation Balance Report 2016-17 the expected power deficit in Uttar Pradesh would be 7044 MW for 2016-17. Any delay in the implementation of planned power projects due to reasons such as lack of clearances, financial constraints, non-availability of coal etc., will result in much larger deficit in subsequent years. Hence, installation of Phase-2, 3 x 660 MW thermal power plant in the existing Plant boundary at villages of Mirchwara and Buraugaon, tehsil Mahroni in Lalitpur

district in the State of Uttar Pradesh State would help to mitigate this deficit to some extent.

4. Land

The proposed power plant would be located inside existing site of Phase-1 in village Mirchwara and Buraugaon, tehsil Mahroni in district Lalitpur of Uttar Pradesh State. The identified areas as per the site map (Annexure 3) works out to be 1473 acres for both Phase-I & Phase-2 within plant boundaries, which is in possession. Only additional area of 240 acres of land would be acquired in and around plant boundary for ash disposal. Plot plan shows the layout of main plant area, transformer yard, switchyard, water system, coal and ash handling system including coal stock yard and green belt.

5. Site Characteristics

The area proposed for the power plant requires some grading. The final grade level in power plant area would be established considering HFL of Uttari River which is located on the eastern side of the plant boundary and efficient disposal of storm water drainage. A detailed geotechnical investigation of the proposed plant site has already been carried for Phase-1 and details are available with us.

6. Access to Site

The site is located at around 22 km from NH-26. There are two approach roads to the proposed site. The site can be accessed from National Highway 26 (Jhansi to Sagar) at two different locations viz a) From Bansi on NH-26 and b) From Khelgaon bypass on NH-26. Approach to the project site from Khelgaon bypass, passes through villages which are smaller in number and which are very sparsely populated. This approach from Khelgaon bypass has already been widened and strengthened, which has improved access to the project site.

7. Source of water and its Requirement

The source of raw water for the expansion project would be either from Kachnoda Dam and/or Shahzad Dam and/or Bhaoni Dam and/or Rajgahat Dam located about 10 Km, 25 Km, 5 Km and 48 Km from Project respectively. The preliminary estimated raw water make up requirement for a power plant of 3 x 660 MW capacity is about 4950 m^3/hr (118800 m^3/day). Water allocation of 80 cusec from UP Irrigation Deptt had been optimized to 4950 m^3/hr (ie 50 Cusec) as per EC of phase -1.Therefore, only 20 Cusec of additional water

allocation would be required for phase-2 expansion project. Additional water allocation of 20 cusec is proposed to be met from above mentioned dams.

A study for availability of water from dams have already been carried out and on the basis of initial study, it is seen that sufficient water is available to meet additional 20 cusec water requirement of the proposed 1980 MW expansion Power Plant.

8. Source of Coal Supply and its Transport

It is envisaged that coal for this project would be sourced from M/s Coal India Limited (CIL), preferably from their Northern Coal Fields Ltd. (NCL) and/or Central Coal Fields Ltd. (CCL). Domestic coal would be used as primary fuel, in case of shortfall of domestic coal, imported coal is proposed to be used for making up shortfall.

New coal linkage policy is under finalization by Government of India and is expected to be notified soon, Expansion projects shall also be included in the policy under consideration. Necessary documents to the effect shall be submitted once policy is in place.

The calorific value of fuel would be approximately 3300 Kcal/kg. Considering plant heat rate of 2250 Kcal/ KWH, the fuel required per day will be around 32400 Ton to generate 1980 MW Power. Coal requirement would be 10.0 MTA for the power project.

In case of any shortfall in the availability of indigenous coal, it is proposed to blend imported coal with indigenous coal and average GCV of the blended coal would be maintained at around 3300 kcal/kg. Imported coal would be received by ships at Indian ports like Pipavav port and transported to site by rail wagons. The rail line has already constructed upto plant site for phase-1 at southern boundary of the proposed expansion project site. The nearest railway station is located at Udaypura (1.5 Km) and Lalitpur (20 Km). Based on this, yearly coal requirement would be about 10.0 MTPA at 85% PLF considering a gross plant heat rate at 2250 kcal/kWh and considering transit losses of 0.8 % as per Central Electricity Regulatory Commission (CERC) norms.

9. Power Purchase Agreement

As per the tariff policy amended in 2016, the project is exempted from competitive bidding as it is expansion of existing project and one time capacity addition upto 100% of existing capacity is permitted under section 62 (as phase 1 was also on section 62). The project intends to tie-up power purchase agreement with UPPCL.

10. Coal Handling System

Coal handling system envisaged would be capable of handling coal at the rate of 3000 T/hr for three (3) units of 660 MW each considering 16 hours operation. Coal handling system would consist of a stream of conveyors and equipment from wagon tripler/track hopper to stockyard and streams of conveyors from stockyard to coal bunkers near steam generators.

11. Ash Handling System

For bottom ash, wet/dry bottom ash handling would be provided. If dry collection of bottom ash then provision for wet disposal from ash silo will be made. Dry fly ash would be evacuated through pressurized system. Fly ash from silo would be disposed in dry form. Fly ash disposal system also would have provision for disposal to ash pond by means of High concentration Slurry Disposal system in the event of emergency. LPGCL will explore possibility from cement industries located in the neighboring districts of the project site for utilization of fly ash.

12. Ash Disposal Area

The total ash generated would be 3.4 MTPA for a 3 x 660 MW power plant considering coal firing rate of 450 T/hr and GCV of 3300 kcal/kg and 34% ash in coal at TGMCR condition and 85% PLF. Additional land of 240 acres would be required for ash disposal area.

13. Main Plant Equipment

The steam generators of the 660 MW units would be 100% coal fired and would be rated to generate about 2080 t/hr each, of superheated steam of 596±5 Deg C temperature. Reheat steam temperature would be 596±5 Deg C. Steam generators would be equipped with facilities for fuel oil firing for start-up and for flame stabilization at low loads. Steam turbine would be multi cylinder tandem-compound machine, driving a turbo-generator at 3000 rpm to produce 660 MW rated output at 0.85 power factor at the generator terminals.

14. Power Evacuation

Power from the station would be evacuated at 765 kV level to the UPPTCL transmission system.

15. Environmental Aspects

The power plant is expected to use blended coal with low Sulphur content. Design of all equipment and systems is proposed to be carried out considering maximum ash content of 34 % for indigenous coal. For the selected configuration of 3 X 660 MW units, tri-flue RCC stack common for three units is proposed for steam generators to meet the requirements

of the environmental regulations. The stack height would be 275 m. The steam generators would be provided with low NOx burner. The steam generators would be provided with electrostatic precipitators to limit the particulate matter as per the latest environmental norms.

Adequate provisions are proposed for neutralizing the effluents from the water treatment plant. Effluents from the entire power plant would be treated and reused in the power plant to minimize the requirement of raw water and to maintain zero effluent discharge.

16. Project Cost and Tariff

The Project Cost of the proposed Phase-2 (3 x 660 MW) Lalitpur Power Project has been estimated as Rs. 13,900 Crores. including IDC & financing charges and considering all taxes and duties. Cost of generation at 85% PLF for saleable energy with various other considerations. Cost per MW of installed capacity works out to Rs 7.02 Crore.

17. Project Schedule

It is envisaged that the project would be executed through multi package contract basis. Based on expected deliveries of main plant and equipment, project commissioning schedule is considered as 42 months from zero date for the first unit, 46 months for the second unit and 50 months for the third unit.

PROJECT HIGHLIGHTS (Salient Features)

1.	Project	:	Lalitpur Thermal Power Project
2.	Plant capacity	:	3X660 MW(Existing) + 3X660 MW (Proposed)
3.	Plant site location	:	The project site is located in the villages of Mirchwara and Buraugaon near Uttari river in the District of Lalitpur, U.P. It is about 20 km from Lalitpur town. The nearest railway station is at Udaypura/Lalitpur town.
4.	Access to site	:	(i) By road – National Highway NH 26 then Lalitpur Mahroni road. (ii) By rail – Lalitpur Railway station on Jhansi-Bhopal route. (iii) Nearest airport – Gwalior (186 Km), Khajuraho (120 Km). (iv) Nearest sea port – Kandla (~1200 kms)
5.	Meteorological Site Conditions		
	i. Climate	:	Tropical, Very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind
	ii. Elevation above mean sea level	:	330 m
	iii. Ambient temperature (dry bulb)		
	a. Daily minimum (mean)	:	7 ^{o}C
	b. Daily maximum (mean)	:	41.8 ^{o}C
	c. Design ambient temp.	:	50.0 °C (Max) and 1.9 °C (Min)
	iv. Relative Humidity 65% (Average)		
	a. Maximum	:	90 percent
	b. Minimum	:	19 percent
	(v) Rainfall		
	a. Average per annum	:	905.9 mm (based on 10 year data)

b.	Tropical monsoon	:	June to October
c.	Wind loads	:	47 m/sec as per IS 875, Part 3

(vi) Seismic factors

a.	Seismic Coefficients	:	The project site is falls in seismic zone II (least to moderate prone area) as per IS 1893 (part-I):2002. However equipment would be designed based on seismic zone III.

6. Source of water : The make-up water requirement shall be met from Kachnoda Dam/ Shahjad Dam/ Bhaoni Dam/Rajghat Dam, approximately 10 km, 25 Km, 5 Km and 48 Km, respectively away from the site.

7. Land: Around 1473 acres land for Power Plant which is already in possession under Phase - 1, water reservoir and other facilities is already available. Additional 240 acres for ash dyke shall be acquired.

8. Make up water requirement : Approx 4950 M^3 / Hr. (Only additional 20 Cusec of Water)

9. Cooling system : Closed cycle cooling system with an Induced Draft / natural draft cooling tower using Dam water from existing raw water reservoir

10. Primary Fuel: Primary Fuel would be Domestic Coal & in case of shortfall of domestic coal, imported coal would be used.

11. Fuel consumption : Around 32400 tons per day

12. Steam generator: Super Critical, Pulverized coal fired Boilers of approx. 2080 TPH Capacity, 596±5°C temp at superheater outlet and 596±5°C at Reheater Outlet. The steam generator (SG) would be designed for firing 100% coal and would be natural / assisted circulation drum type. The SG would be provided with adequate number of coal mills along with gravimetric / volumetric feeders.

13. Steam Turbine : Condensing, multiple cylinders, multiphase, single / double re-heat 3000 RPM, 660 MW capacity, 593°±5 C/593°±5 C temperature at inlet of emergency stop valve of turbine.

14. Electrical Generator: 3000 RPM, directly coupled with steam turbine, 50 Hz., 3 single phase, 0.85 power factor (lagging), approximately 21/27 KV.

15. Instrumentation & Controls : Distributed Digital Control and Management Information system (DDC MIS)

16. Stack : One 275 meter high RCC Chimney with tri-flue

17. Ash generation and disposal : Approx. 459 TPH, Bottom ash disposal in wet/dry form; fly ash collection in dry form in silo for utilization in various application such as cement, brick making, road embankment, filling the low lying area and for soil conditioning in agriculture activity etc.

18. Project commissioning schedule : Unit-1-42months
Unit-2-46months
Unit-3-50 months

1.0 INTRODUCTION

1.1 PROJECT DEVELOPERS

Lalitpur Power Generation Company Ltd. (LPGCL) has setup 1980 MW (3x660 MW) coal based super critical Thermal Power Station. All three units have been commissioned. Further with the desire to contribute in making Uttar Pradesh State self-sufficient on the front of Power Generation, LPGCL propose expansion of Lalitpur Thermal Power Plant Phase-2 with additional capacity of 1980 MW (3x660 MW).

Power generated by the Proposed Expansion Project shall be used to meet the increasing power requirement in the State of Uttar Pradesh.

The present demand for electrical power in Uttar Pradesh is greatly in excess of availability from its own generating capacity and its share in central generation. The power scenario in the state reveals that the demand for power will continue to out strip the available and planned generation capacity for the next few years. In order to meet the energy requirement and to reduce the large gap between the demand and availability, Government is encouraging investment in the public and the private sector in the field of power. It is in this context that Laliptur Power Generation Company Ltd. (LPGCL) proposes to set up a 3 X 660 MW coal based power plant at Mirchwara and Buraugaon villages in Lalitpur District.

1.2 GENERAL BACKGROUND

LPGCL intends expansion of Phase – 2, 3 X 660 MW coal based thermal power project in Mirchwara and Buraugaon villages as a brown field project in Lalitpur District, in the State of Uttar Pradesh.

Adding new power generation capacity of 1980 MW, Phase 2 in Lalitpur would assist in meeting the demand of power in Uttar Pradesh. Better availability of power also means better distribution of power and would reduce load shedding. Besides providing energy security to the state grid, development of power infrastructure in the rural / semi-rural areas shall also promote industrial and economic development in and around the area.

1.3 POWER SCENARIO, NEED AND JUSTIFICATION OF THE PROJECT

Power is considered to be a core industry as it facilitates development across various sectors of the Indian economy such as manufacturing, agriculture, commercial enterprises and domestic use. Indian power industry is going through a phase of radical reforms since past decade. Uttar Pradesh (UP) is committed to reforming its power sector with a view to providing commercial viability and quality power at affordable rates to all its citizens.

In the latest figures released by Central Electricity Authority (CEA) in Load Generation Balance Report for 2016-17 regarding maximum and minimum energy demand and availability, UP clocked power shortage of 9.7% (peak) against all India average of power surplus at 2.8%.

At present Uttar Pradesh has approximately 19 GW of installed power generation capacity with only annual per capita electricity consumption of 450kWH (in 2014) in comparison with average per capita electricity consumption of 1075 kWH in India (Canada- 15520 kWH, USA 12987 kWH, Australia- 10067 kWH, Japan 7836 kWH, France – 7382 KWH, UK – 5409 kWH per capita Power Consumption). Per capita Power consumption in India is increasing each year by at an average of 6%. In comparison of prospective annual net GSDP growth rate of 6% in 2014-15, significant expansion of state's power generation sector is expected.

Present Installed Generation Capacity

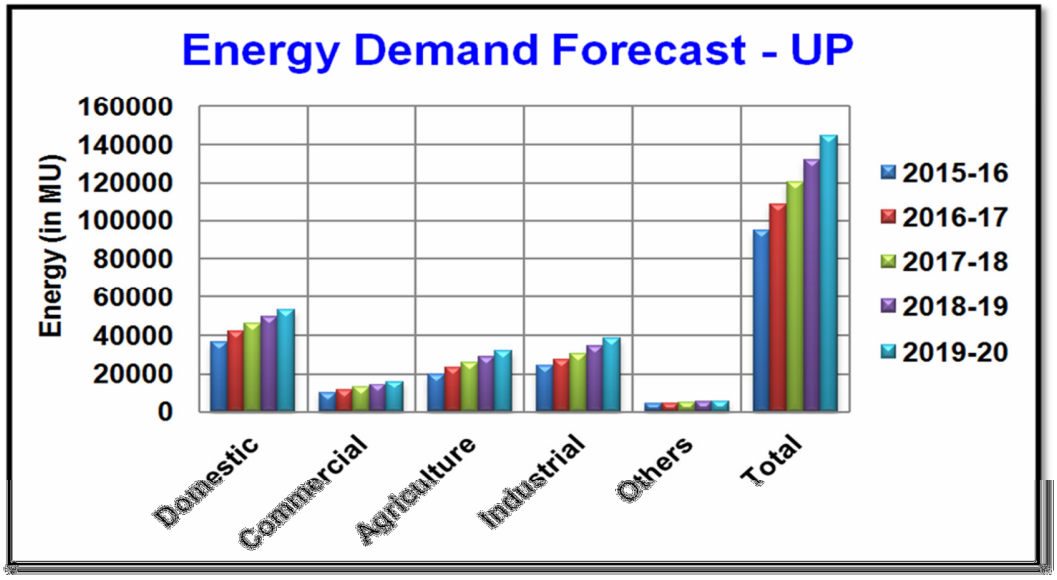
Installed Power Generation Capacity - Uttar Pradesh as on June'16							
Source		**Coal**	**Gas**	**Nuclear**	**Hydro**	**Renewable**	**Total**
		MW	**MW**	**MW**	**MW**	**MW**	**MW**
State Owned	**MW**	5923.0	0.0	0.0	501.6	0.0	**6424.6**
Private Owned	**MW**	5490.0	0.0	0.0	0.0	0.0	**5490.0**
Central Owned	**MW**	8310.0	550.0	440.0	0.0	0.0	**9300.0**
Total	**MW**	19723.0	550.0	440.0	501.67	0.0	**21214.6**

Present Power Sector Scenario of Uttar Pradesh

General growth in the economy, rapid industrialization, rural area development and domestic use of electricity are the main reasons for increase in power consumption in UP. Government of UP has formulated UP Power Energy Policy 2009 for increasing the role of public private partnership in generation, transmission and distribution, in addition to the work already being carried out under State sector.

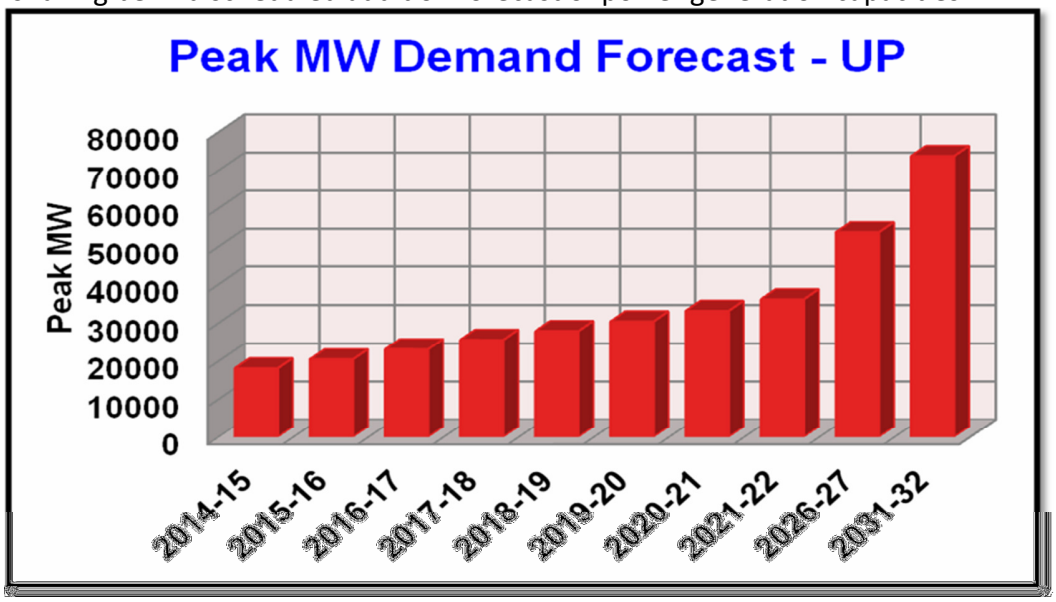
Future Demand and Generation Forecast of Uttar Pradesh (UP)

The demand for electricity has been steadily increasing in Uttar Pradesh due to rapid industrialization and large-scale use of electricity for irrigation, domestic and commercial purposes. According to the 18^{th} Electric power survey of India, the demand in the period 2009-2014 has increased at a rate of average 14% per annum and it is expected to increase at the similar rate for the period of 2015-2020. Detailed energy demand trend forecast under various utilization categories are represented below.



It is estimated that at the end of 12th five year plan, peak power demand of UP will touch 23,000MW and at the end of 13th plan power demand will be approximately 36,000MW. Long term power demand forecast according to 18th Electric power survey of India, peak power demand in UP will be 73,708MW during 2031-32. Detailed peak power demand trend forecast are represented below.

Though actual thermal power generation installed capacity of 5923MW, however state is not able to utilize its full capacity ever due poor maintenance, lack of funds, aging plants and frequent units tripping. Further due to delay in project clearances and infrastructure issues, UP is falling behind scheduled addition forecast of power generation capacities.



UTTAR PRADESH REQUIRED POWER DEMAND IN MU AND MW						
Year	**GDP(In Cr)**	**Population**	**Per Capita GDP**	**Per Capita Energy (Kwh)**	**Total Requirement (MU)**	**Capacity Required (MW)**
2010	491302	199636280	29587	600	103212	17596
2011	530606	199636280	31279	620	105221	18199
2012	573055	203948423.6	33068	641	111088	19214
2013	618899	208353709.6	34959	663	117369	20300
2014	668411	212854149.7	36958	686	124096	21464
2015	721884	217451799.4	39071	711	131303	22711
2016	779635	222148758.2	41306	737	139029	24047
2017	842005	226947171.4	43668	764	147312	25480
2018	909366	231849230.3	46165	793	156197	27016
2019	982115	236857173.7	48805	824	165731	28665
2020	1060684	241973288.6	51596	856	175963	30435
2021	1145539	247199911.7	54547	890	186948	32335

Source UPRVNL Study

In the scheduling of new generation, existing generating units are assumed to be retired at the end of their normal economic service life. Approximate power generation forecast in UP is tabulated below as per assumptions and best possible commissioning schedule.

Grid Interconnection

This section addresses the capacity of Uttar Pradesh Power Grid for integration of the proposed 3x660MW expansion plant at Lalitpur.

Power evacuation for the proposed expansion project will be to the Uttar Pradesh Power Transmission Company Ltd. (UPPTCL) grid on 765kV voltage level. There is already 2 nos. of existing 765kV transmission lines (to 765kV Agra - Fathabad substations) constructed for Phase-I of Lalitpur plant. Total generation capacity of Phase-I of Lalitpur plant is 1980MW whereas each 765kV outgoing line is having Surge Impedance Loading (SIL) of 2250MW.

It is expected that minimum 1 no. of additional 765kV transmission line of similar capacity will be constructed by UPPTCL for Lalitpur expansion project. Considering the same 3 nos. of 765kV outgoing lines (total 6750MW capacity) will be available for entire plant where maximum installed generation capacity is 3960MW. This will provide flexibility of exporting entire generation power even when one outgoing line is under maintenance.
As per present UP grid condition, 220kV and 400kV transmission networks in few load centers are found to be loaded to optimal level. This has resulted in the introduction of the 765kV

transmission line backbone projects in the state. As pre present grid scenario of UP, it is found additional 765kV and 400kV transmission lines are under construction by both PGCIL and UPPTCL to accommodate future power transmission.

As per details mentioned above, it is well established that power generated in the proposed Lalitpur Phase -2 expansion plant can be evacuated through newly constructed (at the time of plant operation) 765kV lines which will be capable of handling entire generated power for further pumping to regional load center / northern grid.

Justification for the 3x660W Lalitpur Phase-2 Expansion Project

Due to recent lower rainfall in past few years, there is a decrease in hydro power generation in the state. Further Government of UP is presently exploring new power generation sources mainly through coal based thermal power and renewable energy. Further Government is also looking forward for more investment in power sector in form of IPP developers.

Based on above, if the Lalitpur Phase-2 expansion project will not setup at this stage, the power shortage is expected to increase during 2021-22. In view of long term forecast the generation and demand gap will further increase implying requirement of installation of large number of power plants.

Coal based power generation projects assisted by modern technologies have lower impact on environmental, social & health. These plants require 4-5 years of construction period and can be used as base load power generation to fulfill the power demands.

The reduction in power output from old existing plants and any delay in the implementation of planned power projects would result in larger power generation shortfall from 2017 and above.

M/s LPGCL is planning to commission the power plant during 2020-21 for Phase-2. Any delay in the implementation of planned power projects due to reasons such as lack of clearances, financial constraints, etc., will result in power deficit in the coming years.

The electric power sector plays a vital role for the development of the country and social affairs. Coal based Thermal Power Plant Projects assisted by high technologies having relatively lower impact on environmental, social and health as well as medium term construction periods, are to be established in the highest power demand areas to fulfill the present power demands

Considering these scenarios, installation of proposed Phase - 2 power plant of 3x660MW in Lalitpur, Uttar Pradesh is justified and may be considered.

2. Location and Site Details

Location

The coal based 1980 MW (3 X 660 MW) Thermal Power Project is proposed to be located within the boundary of existing 3X660 MW Power Plant of Lalitpur Power Generation Company ltd at Lalitpur in UP State. The latitude and longitude for Main Plant is 24º47'25.85" N & 78º38'04.56" E, 24º48'26.76" N & 78º38'03.62" E, 24º47'10.90" N & 78º39'37.22" E, 24º47'05" N & 78º38'58" E, & 24º47'23.09" N & 78º38'47.83" E, respectively. Topo Sheet (10 KM boundary) as Annexure 1 is attached as reference.

Accessibility

The project site is located in the villages Mirchwara and Buraugaon near Uttari River in the district of Lalitpur, U.P. It is about 20 km from Lalitpur town. Lalitpur is connected by rail and road to all major cities of India. The site has road access from National Highway NH 26 via Lalitpur- Mahroni road. The vicinity map of the plant site is shown in Annexure 2 The site is located near the broad gauge line and the nearest railway station is Lalitpur, Bhopal - Jhansi route and also at Udaypura.

3. Fuel

LPGCL propose to install 3 nos. Super Critical Coal based Pulverized fuel (PF) fired Boilers of 2080 TPH Steaming capacity each, which will utilize the coal as a fuel for generation of steam.

It is envisaged that coal for this project would be sourced from M/s Coal India Limited (CIL), preferably from their Northern Coal Fields Ltd. (NCL) and/or Central Coal Fields Ltd. (CCL).
Domestic coal would be used as primary fuel, in case of shortfall of domestic coal, imported coal is proposed to be used for making up shortfall.

New coal linkage policy is under finalization by Government of India and is expected to be notified soon, Expansion projects shall also be included in the policy under consideration. Necessary documents to the effect shall be submitted once policy is in place.

The calorific value of fuel would be approximately 3300 Kcal/kg. Considering plant heat rate of 2250 Kcal/ KWH, the fuel required per day will be around 32400 Ton to generate 1980 MW Power. Coal requirement would be 10.0 MTA for the power project.

In case of any shortfall in the availability of indigenous coal, it is proposed to blend imported coal with indigenous coal and average GCV of the blended coal would be maintained at around 3300 kcal/kg. Imported coal would be received by ships at Indian ports like Pipavav port and transported to site by rail wagons. The rail line has already constructed upto plant site for phase-1 at southern boundary of the proposed expansion project site. The nearest railway station is located at Udaypura (1.5 Km) and Lalitpur (20 Km). Based on this, yearly coal requirement would be about 10.0 MTPA at 85% PLF considering a gross plant heat rate at 2250

kcal/kWh and considering transit losses of 0.8 % as per Central Electricity Regulatory Commission (CERC) norms.

4. Water

The consumptive water requirement for the proposed expansion project of 1980 MW Thermal Power Project is around 4950 m^3/hr and is proposed to be met from Kachnoda and/or Shahzad and/or Bhaoni Dam and/or Rajghat Dam. At present LPGCL have 80 cusec of water allocation from UP Irrigation. Based on environment clearance for Phase –I, water requirement has been optimized to 4950 m^3/hr (ie 50 Cusec). It means that only additional 20 Cusec of water would be required for phase-2 expansion project.

A study for availability of water from dams have already been carried out and on the basis of initial study, it is seen that sufficient water is available to meet make –up water requirement of 1980 MW Power Plant. It is pertinent to mention here that Shahzad Dam effective storage capacity is 96.06 Million Cubic Meter, whereas for Kachnoda Dam (which is new dam has been made operative this year) has live storage of 54.64 Million Cubic Meter of water. Additionally a new Bhaoni Dam which is 5 Kms from plant is under construction, which will have live storage of 23.79 Million Cubic Metre of water. In consideration of above, availability of water from all four Dams, we envisaged that additional 20 Cusec of water can be made available easily.

5. Proximity to UP Grid

The power from the proposed 1980 MW Power Project will be generated at around 24 KV and will be stepped up to 765 KV and will be connected to the UP grid at State Pooling station for further transmission of power to various consumers and utilities. For startup power, switchyard at power plant will also be connected to existing 765kV/220 KV switchyard at Phase-1 area of Power Plant (3X660 MW) which is connected to sub-station of UP Power Transmission Co Ltd.

6. Land, Demography and other Site Details

The proposed power plant would be located inside existing site of Phase-1 in village Mirchwara and Buraugaon, tehsil Mahroni in district Lalitpur of Uttar Pradesh State. The identified areas as per the site map (Annexure 3) works out to be 1473 acres for both Phase-I & Phase-2 within plant boundaries, which is in possession. Only Additional area of 240 acres of land would be acquired in and around plant boundary for ash disposal. Plot plan shows the layout of main plant area, transformer yard, switchyard, water system, coal and ash handling system including coal stock yard and green belt.

The proposed site is located at the latitude and longitude 24º47’25.85” N & 78º38’04.56” E, 24º48’26.76” N & 78º38’03.62” E, 24º47’10.90” N & 78º39’37.22” E, 24º47’05” N & 78º38’58” E, & 24º47’23.09” N & 78º38’47.83” E, respectively. The nearest town of Lalitpur is at an MSL of 330 m.

There are no houses on the proposed project site. Most of the villagers work as farm labourers, labourers at power plants in this region or simply tending the cattle. The crops cultivated include peanut, chana, wheat & sarso. The land may require to be graded at different levels to accommodate various plant structures towards minimizing the extent of site grading work.

The available land of 1473 Acres shall be used to accommodate Main plant, Switch Yard, Cooling tower, WTP, Balance of Plant equipment, Water reservoir and Coal stock (for 30 days), Coal Blending. This has been selected on the basis that LPGCL has already developed coal handling facilities in the southern side of the proposed block of 3X660 MW. This would facilitate the coal transportation through the rail link network from the designated coal mine.

Township has already constructed within the land in possession of LPGCL

Annexure 1 attached:- Topo sheet with 10 km boundary
Annexure 3 attached:- Tentative Plant layout.

7.0 Technical Features

7.1 Main Plant Equipment/System Description

7.1.1 Steam Turbine Generator (STG) set

A) **Steam Turbine and its Aux**

Each steam turbine shall be a multi cylinder, multiphase, 3000 RPM, tandem compound, single/ double reheat, condensing regenerative feed heating type unit. Each turbine shall be of MCR Capacity of 660 MW and shall be designed for Main Steam/RH parameters of 593±5/593±5°C temperature at inlet emergency stop valve of turbine. The steam turbine will consist of multiple cylinders: one single flow high pressure turbine (HP), one double flow intermediate pressure turbine (IP) or combined HP- IP turbine and one or two double flow low pressure turbine (LP). The rotors of the whole shaft line will be provided with integral expansion sleeve couplings and rigidly interconnected. At turbine valve wide open (VWO) condition the turbo-generator set will be able to operate with steam flow of about 105% turbine MCR condition. The turbine auxiliaries shall comprise of the following:-

- Turbine Seal steam system
- Turbine lube oil systems
- Turbine Control system (Control Fluid System)
- Feed pumps
- HP/LP Heaters and deaerator

- Surface Condenser
- Condensate Extraction Pumps
- LP Dosing system
- Vacuum Raising System
- Central lube oil storage & Purification system
- HP/LP bypass system
- Protection and interlock systems.

Each turbine generator shall have a complete self-lubricating oil system catering to the lubrication requirements of the bearings, turbine turning gear, jacking requirements of the turning turbine gear besides supplying oil to the generator seals under emergency condition.

The turbine shall have throttle or nozzle controlled type governing. The steam turbine generator unit shall be equipped with an electro –hydraulic governing system backed up by 100% mechanical – hydraulic or electro – hydraulic control system. The HP / LP bypass system shall be sized for 60 % of main steam flow with rated main steam parameters at upstream of valves. HP/LP bypass capacity shall be finalized based on the main equipment supplier design practices and as generally followed for supercritical units world-wide over.

The regenerative feed water heating cycle shall consist of LP heaters, one drain cooler, and deaerator and HP heaters. The number of LP and HP heaters shall be based on the optimization of feed water heating cycle. Horizontal, direct contact spray or spray cum tray type deaerator with a horizontal feed water storage tank shall be provided. The deaerator shall be capable of deaerating all the incoming condensate and HP heater drains. It shall effectively remove the dissolved oxygen in condensate and completely remove the traces of carbon dioxide.

The exhaust steam from the Steam Turbine will be condensed in a single or double pass shell & tube type surface condenser with stainless steel tubes of welded type as per ASTM-A-249-TP304, shall be adopted. The condenser shall be horizontal type with integral air-cooling section with divided water box construction. The condenser will be equipped with vacuum pumps for air evacuation and maintaining vacuum in the condenser. Provision of separate sponge rubber ball type condenser on-load tube cleaning system for each half of the condenser including ball circulation pumps, strainer, ball monitoring system etc. shall be made.

There will be Condensate Extraction Pumps (CEP) with each turbine to pump the condensate from the condenser hot well into the Deaerator through gland steam condenser, drain cooler and LP Heaters. From the Deaerator, feed water will be pumped by Boiler Feed Pumps (BFP) into the economizer of the Boiler through HP Heaters.

B) **Turbo Generator and its Aux**

Each turbo generator shall be 3000 rpm, directly coupled with steam turbine, and shall be provided with brushless excitation system, automatic voltage regulation system, interlock and protection system etc. Generator will be connected to its unit step up transformer. The auxiliary power requirement of the unit will be drawn from its unit auxiliary transformer tapped off from the generator bus duct.

7.1.2 Steam Generator (Boiler) and Its Aux.

The Steam Generator shall be Supercritical parameters with direct pulverised coal fired, dry bottom, natural/assisted circulation, single/ double reheat, top supported, balanced draft, semi-outdoor type. Each Steam Generator shall have continuous evaporating rating of approx. 2080 TPH with superheater outlet temperature of 596±5 Deg C and reheat temperature of 596±5 Deg C. The steam generating units shall comprise of water cooled furnace wall system, economizer, superheaters, reheater, air heater, ID, FD & PA fans, Milling & firing systems and start up fuel oil system. Spray type attemperator is envisaged to control the superheater outlet temperature for varying loads. The superheater and reheater tubes will be a combination of radiation and convector types. Economizer will be non- steaming type and shall be of modular construction so that addition of loops is possible.

The combustion system will be provided for pulverized coal firing with low NOx type burners. The design flue gas velocities would be carefully selected to minimize erosion of pressure parts. The steam generators would be designed in accordance with the latest provisions of Indian Boiler Regulations.

For firing high ash content abrasive coal, medium speed pulverisers of large capacity mills will be provided having low auxiliary power consumption; and relatively high life expectancy of grinding parts. The mill size and numbers will be selected such that, on an average, one mill remains standby while one of the mills is under maintenance. Raw coal from bunkers shall be fed into the mills by gravimetric feeders suitable for handling moist coal. Primary air fans of axial type shall be used for transporting the pulverized coal from mills to bunkers. The bunkers shall be of structural steel construction and shall be sized for suitable capacity.

It is proposed to provide adequate capacity FD, ID and PA fans with each boiler. The equipment will be complete with lube oil, hydraulic regulations and all other accessories required for continuous operation and all equipment will be suitable for outdoor installation. It is proposed to use LDO for start-up and for low load operation of the boiler.

The Boilers will also be equipped with Electrostatic Precipitator (ESP) of high efficiency. The Electrostatic Precipitators will be designed for an outlet dust emission of < 30 mg/Nm^3 under MCR conditions. The ESPs will parallel gas streams isolated from each other on the electrical as well as gas side. Electrostatic precipitators will be provided with microprocessor based programmable

type rapper control system and ESP management system to ensure their safe and optimum operation. ESP transformer rectifier sets will use high fire point oil as the cooling medium. The dust collection hoppers at all strategic locations will have a minimum storage capacity of eight hours. The hoppers will have heating arrangements to prevent ash sticking to the slope sides and down pipes. Level indicators will be provided to indicate and trip the ESP in case of high ash levels in the ash hoppers.

7.2 Description of Major Systems (BoP-Mechanical)

7.2.1 Coal handling & storage, Blending, Milling and Firing System

Coal Unloading System

Raw Coal will be brought by rail through railway wagons from coal mines and shall be unloaded at site by wagon tippler of Phase 1 or separate arrangement of wagon tippler for Phase-2/Track Hopper.

Coal Crushing System, Stacking, Blending, Transportation and Feeding System

The coal handling plant (CHP) shall be designed to operate throughout the year. The system shall be designed considering all the required redundancy to meet MCR requirement without any failure.

Crushed Coal (-20 mm) will be conveyed to the boiler bunker through crusher house and a number of transfer points. Provision has been kept for stacking crushed coal in coal stockyard from where coal is reclaimed as and when the same will be required in coal bunkers. A centralized control room with microprocessor based control system is envisaged for operation of the Coal Handling Plant. Except for locally controlled equipment like dust extraction/dust suppression/ventilation equipment, sump pumps, water distribution systems etc. all other in-line equipment would have provision of remote control. However, provision of local controls would also be considered. All necessary interlocks, control panels, MCCs, mimic diagrams etc. will be provided in the control room for safe and reliable operation of the Coal Handling Plant.

Crushed coal stockpile for 30 days storage is already available for Phase-1 inside the plant. The sub systems of Coal Handling Plants are:

- Coal Unloading System
- Crushing & Screening System
- Coal Stacking, Blending & Reclaiming
- Belt Conveyors
- Metal Detectors
- Magnetic Separators
- Belt Scale
- Coal Sampler

- Conveyor Supports, Galleries And Platforms
- Bunker Feeding System
- Dust Extraction/ Dust Suppression/ Ventilation System

Milling and Firing System

The raw crushed coal from raw coal bunker will be fed to independent gravimetric feeders at controlled rate to deliver the coal for pulverization. From the mills, the pulverized coal will be transported by means of hot primary air into burners situated at different elevations. The boilers will be provided with attemperation arrangement for superheat and reheat steam temp control.

Each boiler will be provided with oil burners for warm up and stabilization of coal flame. The boilers will be designed to handle and burn LDO oil as a secondary fuel for startup and low load operation. High Energy Arc Igniters will be provided for light up purposes.

7.2.2 Ash Handling Plant

The ash generation from each boiler will be in the range of 153 TPH, out of which around 31 TPH will be bottom ash and 122 TPH will be the Fly ash. The system envisages the following (i) Intermittent wet or dry removal and disposal of bottom ash & economizer ash (ii) Intermittent dry evacuation of fly ash (iii) Dry collection of fly ash in Silo (iv) Disposal of ash slurry.

Bottom Ash Evacuation System

In case of wet removal of bottom ash & economizer ash, Bed ash will be collected continuously in rectangular, water impounded storage type ash hopper. Each Bottom ash hopper will have effective 8 hours storage capacity. The bed ash collected in bottom ash hopper will be removed in once in every shift of 8 hours through jet pumps in the form of ash slurry. The ash slurry will be collected in slurry sump from there it will be pumped to ash dyke area through slurry pumps.

In case of dry bottom ash & economizer ash removal system, dry extraction system below boiler will be provided. Dry bottom ash from extractor will be fed to a conveyor/vessel, which will ultimately discharge to a bottom ash silo for further usage.

Fly Ash Evacuation System

The fly ash from air pre heater and ESP hoppers will be automatically extracted one after another in sequence by pneumatically system.

For dry fly ash collection, four (4) nos. silos has already constructed in Phase-1, will be used for Phase -2 in case of emergency. Fly ash will be discharged from the bottom of silo into trucks for utilizing the ash for various applications such as cement, brick making, road embankments, filling the low lying area etc.

Any leftover fly ash in the silo will be converted into ash slurry by adding water in it and the resultant ash slurry will be pumped to ash dyke area through HCSD system of Phase-1. All out efforts will be made from maximum utilization of ash in the dry form.

The water from ash dyke through a decantation well will be collected in one or two clean water reservoir(s). The water from the reservoir(s) will be pumped to ash water pond located inside plant with the help of re-circulating water pumps. The water from the ash water pond will be used in ash handling system.

7.2.3 Plant Water System

Raw Water Drawl Scheme

Raw water for make-up purpose is proposed to be met from either Kachnoda Dam/ Shahjad Dam/ Bhaoni Dam/ Rajghat Dam. The same pipe line of Phase-1 will also be used for Phase-2 requirement. River Pump house will be constructed (as extension of Phase-1) for pumping water from dam to plant raw water reservoir located inside the power plant for Phase-1.

Closed circuit cooling water system would be adopted for steam generator and steam turbine generator and common auxiliaries like air compressors, ash handling plant equipment etc. DM water would be used in the primary circuit, which in turn will be cooled by circulating water in plate type heat exchangers.

The consumptive water requirement for the proposed 1980 MW Power Project is around 4950 m^3/hr (@2.5 m^3/hr/MW) and based on the techno-economics, it is proposed to go in for a close-cycle cooling water system along with Induced Draft (ID) / Natural Draft (ND) cooling towers. It is estimated that 90000 m3/hr water (each unit) will be required for circulating through condenser and about 4000 m3/hr (each unit) will be required for the various auxiliary coolers, compressors, Evaporative Cooling & Ventilation System, Air Conditioning systems etc. Thus it is proposed to have circulating water pumps (working and 1 standby for each unit), each of capacity 30000-40000 m^3/hr and suitable head and 2 Auxiliary Cooling Water Pumps (1 Working & 1 Standby for each unit), each of capacity 4000 m^3/hr and suitable head for each units. The main cooling water pump shall be vertical mixed flow type pumps coupled with vertically mounted electric motors. The details of cooling tower for each unit is given below

a.	Number of cooling tower	:	Two (2) for each unit in case of ID and one (1) for each unit in case of ND
b.	Cooling tower type	:	Multiple cell –Mech Induced draft type or natural draft
c.	Design inlet circulating	:	90000 m3/hr water flow
d.	Cooling range of	:	9°C circulating water

e. Ambient wet-bulb temp. : 28.5 °C (for cooling tower design)
f. Circulating water makeup : Clarified Water
g. Design wind loads as per : IS:875

The clarified water shall be used for the cooling tower make-up, service water, potable water, DM plant etc. The pipelines shall be of mild steel and shall be laid buried with suitable external anti corrosive coating. Circulating water pipelines along with butterfly valves, rubber expansion joints, man-hole etc. shall be provided from cooling towers to condensers and various other coolers.

Demineralisation Plant & Heat Cycle Make-up System

Assuming average 3% makeup for the heat cycle and accounting for three hours regeneration time, demineralizing chain of 120 m^3/hr capacity addition to existing DM plant have been envisaged. The pre-treatment (PT) plant shall consist of clarifiers, along with mixing of lime and alum with raw water. Clarified water will be stored in a clarified water storage tank from where water will be distributed to different users by providing pumps. The pre-treatment plant would be designed to remove suspended/colloidal matter in the raw water. Separate pre-treatment plant shall be provided for meeting the CW system and Demineralization (DM) Plant system. A common chemical house shall be provided to store chemicals such as chlorine, lime, alum & coagulant aid, tanks, pumps etc for all the PT systems. The water treatment plant shall be consisting of clariflocculator, filtration unit, gravity filters, filtered water sump, RO based De-mineralizing Water Treatment Plant etc.

The DM plant will be sized to meet the makeup water requirement of the steam cycle, make up to closed circuit auxiliary system, hydrogen generation plant and stator water-cooling system.

Condensate Polishing Unit (CPU)

For maintaining the feed water purity, condensate polishing plant will be provided in the feed water cycle at the downstream of condensate extraction pumps. The function of the CPU will be to purify the condensate from the condenser by removing solids and dissolved salts with the intent of reducing corrosion and depositions in the steam –water cycle. A common external regeneration facility will be provided for all three units. The CPU will be provided with associated chemical feed system for preparing measuring and dosing the required chemicals.

The water from the boiler blow down and cooling tower blow down will be collected in ash water pond and shall be used for ash handling purpose. Clarifier sludge and filter back wash shall be pumped to ash slurry sump and from there it will be disposed to ash dyke along with ash slurry.

7.2.4 Effluent Treatment Plant or Waste Water Treatment Plant:

The Effluent Treatment Plant is designed for zero liquid effluent discharge. No liquid effluent will be sent out of the plant. The liquid effluents will be collected and treated/ recycled generally as per the following scheme:

i) The sludge from PT-clarifier, DM-clarifier or ash water re-circulation system will be dewatered in thickener and the solids will be disposed off-site.
ii) The waste effluent from neutralization pits of CW chemical treatment system, condensate-polishing plant and DM plant will be collected in the respective neutralization pits and neutralized before pumping to the central monitoring basin, from where it will be sent for ash water make-up and green belt development.
iii) The oily waste from main plant area will be treated using oil water separator and the treated water will be led to the tube settler provided for service water waste for further treatment. Similarly separate system will be provided for oily water in fuel oil unloading and storage area.
iv) The waste from coal handling plant would be high in suspended solids. A settling pond would be provided and wastewater from coal stockyard, transfer points etc. would be routed to the pond. The clear water from there may be used for dust suppression system.

All the plant liquid effluents will be mixed in the central monitoring basin and finally utilized for ash handling system and green belt development.

The rain water is collected in the storm water drain running all around the project, Rain water harvesting pit is connected to the storm water drain.

The plant sanitary waste will be treated in the sewage treatment plant.

7.2.5 Fire Detection & Protection System

It is proposed to provide a Fire Detection and Protection system in line with the requirements of TAC and also to protect equipment from fire hazards. This system will generally conform to the recommendations of TAC guidelines and NFPA – 850 for firefighting protection systems. This will consist of hydrant systems, automatic and manual high velocity water spray system, medium velocity water spray system, foam system and portable fire extinguishers suitable for the respective areas being served. The list of areas to be covered and the type of system is given in following table:-

S.No	Areas to be covered	Type of System
1.	General Plant area covering TG Building, Fire Water Pump House, CW Pump House, Compressor House, Fuel Oil Storage & Handling Area, Ash Pump House, Transformer Yard Area, Switchyard Area, Water Treatment Plant Building, Transfer Points & Junction Towers, Coal yard etc.	Hydrant System (External & Internal Hydrant System)
2.	Transformers	Automatic High Velocity Water Spray System
3.	Turbine Lube Oil Tank & associated piping	Manual High velocity water spray

S.No	Areas to be covered	Type of System
		system
4.	Boiler Feed Pump lube oil equipment & associated piping	Manual High velocity water spray system
5.	Cable Galleries	Automatic Medium velocity water spray system
6.	Coal Conveyors, Junction Towers, Crusher House	Sprinkler System, hydrant system
7.	Fuel Oil tanks	Automatic Foam System
8.	Control Room	Inert Gas/Portable Fire Extinguishers
9.	Other Strategic locations inside the Plant	Portable Fire Extinguishers

The fire pumps of adequate capacity and head will also be provided to supply water to the above systems. It is also proposed to provide micro-process based addressable intelligent fire alarm system.

7.2.6 Air-conditioning & Ventilation System

Air conditioning system will be provided for all those areas, which require close control of environment conditions. All air-conditioned areas will be maintained at a temperature of 23°C ± 1.5°C. Centralized vapour compression/absorption type air –conditioning units along with air handling units, ducting, dampers, piping etc. shall be provided for main control room and other room located in TG building. Packaged air-conditioners of various capacities shall be provided for ESP control rooms and DM Plant control rooms. Window air-conditioners shall be provided for ash handling control rooms and coal handling plant control rooms.

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 a stipulated maximum temperature is considered essential. All evaporating cooling system shall be designed to maintain an inside temperature of 5 deg C below maximum design ambient during summer. All mechanically ventilated areas shall be designed to a maximum inside temperature of 3 deg C above maximum design ambient during summer.

7.2.7 Plant Air & Instrument Air System (Compressed air system)

To meet the requirements of instrument and service air, it is proposed to install air compressors of adequate capacity with air drying plants (common for three units) at 8.4 kg/cm^2(g) discharge pressure. The compressors will be provided with suitable capacity air receiver, intercoolers, after coolers and air-drying plant along with piping, valves and microprocessor based control system. Compressor air requirement will also be considered to meet the requirements of the pneumatic conveying ash system.

7.2.8 Piping, Valves, Fittings and Specialities

Piping, valves, fittings, hangers, anchors, supports, guides etc. shall be provided as required. All high pressure, medium pressure and low pressure lines will be of proven quality materials and suitable for conditions of operation encountered at the specific points. Pipelines running outside the power house will be routed over trestles as far as practicable in order to avoid maintenance and other problems encountered with trench piping and buried piping. However, large diameter water pipes will be buried with proper coating and waterproofing.

7.2.9 Elevators, Cranes and Hoisting Equipment

One goods-cum-passenger elevator of about 2000 kg carrying capacity will be provided for each of the steam generators units. One elevator each at Height transfer point of CHP and at Chimney.

An EOT crane will be provided in the turbine hall for maintenance of the TG hall equipment. Lifting of generator stator/rotor can be carried out by providing 2 EOT cranes in tandem operation. Capacity of these cranes will be decided at detailed engineering phase.

Conventional and special type of cranes required for maintenance of certain SG and TG equipment such as FD/PA/ID fans, condenser water box, ESP transformer rectifier sets etc. will be provided.

Maintenance cranes / handling devices of suitable capacities will be considered for all other pumps houses and other places such as coal handling plant transfer points, DM plant etc. Monorails for lifting heavy motors and other equipment within the power house not covered by EOT crane such as air compressors, miscellaneous pumps, heat exchangers etc. will also be provided.

7.2.10 Hydrogen Generation Plant

Hydrogen gas with a purity of 99.9% (by volume) is required for cooling of the generators. It would be required for the initial filling and continuous make-up during normal operation for maintaining the required purity in the generator.

7.3 Description of Major Systems (Electrical)

7.3.1 Basic Design Concept

For designing the various electrical systems and equipment, the following basic concepts will be followed:-

a) Design ambient temperature: The design ambient temperature shall be 50 degrees centigrade.

b) System voltage levels: System voltage levels in the proposed plant shall be 21 to 27 kV for generation, 765KV for power export, 11.0 kV for large auxiliaries drives (>1500 kW and above), 6.6kV for auxiliaries (>160 kW and ≤ 1500kW, and 415 volts for small auxiliaries (less than 160 KW). DC auxiliary voltage shall be 220 volts for main electrical system controls/protection and indications. For C&I systems and generator excitation system controls, 24V DC and 240V AC supply from UPS will be employed. Single phase AC motors shall not be used except in very special cases for which panel mounted 415/240 Volt transformers shall be used.
c) Supply variations: Equipment along with generator shall be suitable for continuous operation with voltage variation of ±10%; frequency variation of -5,+3% and combined voltage & frequency variation of +/-10%.
d) Power supply to Intake Pump house, shall be drawn from 33 KV system, which will be further stepped down to the desired voltage as required.

7.3.2 765 KV SWITCHYARD

Generator voltage (21-27KV) will be stepped up either to 765KV for power evacuation. The Generator Transformer HV side (765KV) shall be connected to 765KV switchyard.

The existing 765KV system will be extended to phase-2. Suitable transmission system will be provided by UPPTCL for phase-2 power evacuation at 765KV

Switchyard shall be provided with SCADA system.

7.3.3 GENERATORS

The generator coupled with the steam turbine will have the following salient technical features.

- Type : Synchronous machine
- Quantity: Three (3) Nos.
- Rated capacity : Shall match with the maximum continuous rating of the steam turbine but not less than the guaranteed rating of 660 MW
- Rated power factor : 0.85 lag
- Voltage :21-27 kV (As per manufacturers standard practice)
- Insulation : F (temperature rise class limited to Class-B)
- Frequency : 50 Hz
- No. of phase : 3
- Speed : 3000 rpm
- Voltage Variation and Frequency Variation as per relevant standard
- Cooling : Stator –Water cooled/H2 cooled, Rotor-H2 cooled

- Short circuit ratio shall be 0.48 (minimum)

Generators shall be provided with brushless excitation system or static excitation system, Automatic Voltage Regulation system (Digital Voltage Regulation) , interlock and protection system etc.

7.3.4 GENERATOR CIRCUIT BREAKER (GCB)

In order to derive station start up auxiliary power from 765 kV system, the Turbine Generators (TGs) will be connected to respective step-up transformers through Generator Circuit Breakers. The unit transformers will be fed from the tee off bus-ducts of the generators. Generator circuit breaker (GCB) will be used to perform the following functions:
- In GCB open condition, start up power will be made available from the grid via the generator transformer.
- Synchronizing the generator with the grid system
- Carry the load current including full load current of the generator
- Interrupt load currents during shut offs, thereby facilitating shut down of the Unit
- Break the Generator source short circuit currents.

7.3.5 Generator Step-up Transformer
a) Each Generator step-up transformer (GT) (3 nos. single phase for each unit) shall be 275 MVA rated, oil-immersed, outdoor type with OFAF cooling, having voltage ratio of around 21 -27/ 765KV. The Generator transformer rating shall be selected on the basis of continuous maximum rated output of the offered generator with one Unit Transformer out of service.

b) LV side of the transformers shall be connected to the generator through Isolated Phase Bus duct (IPBD). HV side shall be suitable for termination of ACSR overhead conductor.

7.3.6 Station Transformer

2nos Station Transformers of rating 100/50/50MVA, 220/11KV to be provided for station power consumption and to support unit auxiliaries in case of UT outage.

7.3.7 Unit transformer

Two numbers Unit Transformers of rating approximately 40 MVA, 21-27KV/11KV shall be provided for each unit to meet the loads for auxiliaries.

7.3.8 Unit Auxiliary Transformers (UAT) & Station Auxiliary Transformers (SAT)

The unit Auxiliary Transformers feed the 6.6 kV switchgear connected to unit load viz ESP, turbine MCC, Boiler MCC etc. The Station aux transformer shall feed the 6.6 KV switchgear connected to station loads of CHP, compressor etc

7.3.9 Switchgears

a) 11 kV and 6.6 kV Switchgears

i) 11 kV and 6.6 kV Switchgears shall be vacuum type metal-enclosed, vertical, single front, draw-out type suitable for indoor installation. Degree of protection shall not be lower than IP-4X of IS:12063.

ii) Incomers, tie feeders, transformer feeders and all motor feeders shall be protected/controlled by HV circuit-breakers.

b) 415 Volt Switchgears

i) 415 volt switchgears shall be metal enclosed, vertical, single/double front (as applicable) , draw-out type, suitable for indoor installation with degree of protection not lower than IP-41 and pollution degree 4 as per IS:13947. Three phase 4 wire system shall be provided for 415 Volt switchgear/MCCs.

ii) The incomers, bus ties and motors of 110 KW and above shall be controlled by circuit breakers.. Other feeders shall be controlled by MCCB, contactor and overload relay with single phasing preventer for motor feeders and MCCB for other feeders.

7.3.10 Electric Drive Motors

Electric drive motors shall be 3 phase, 50 Hertz, squirrel cage induction type operating at nominal voltages of 11000/ 6600 or 415 volts. Motors rated 37 KW & below shall be energy-efficient type conforming to IS:12615. Motors rated above 37 KW shall have higher efficiency and higher power factor. Motor insulation shall be Class-F for HT and LT motors with temperature rise limited to Class-B insulation. Motor shall have IP-55 enclosure for outdoor application and IP54 enclosure for indoor application and shall be designed for direct-on-line starting.

7.3.11 Protection

Microprocessor based intelligent relays shall be provided for protection of main equipment such as generator, GT, UT, ST, UAT, SAT and large motors (110 KW and above). 765 KV equipments shall be controlled from Switchyard Control Room.

7.3.12 Control Room

There shall be one (1) control room common for three (3) units at the operating floor of TG building in which control panels for the steam generators, steam turbine, generator & auxiliaries

control panels, generator relay panels, transducer panels, auxiliary power supply boards shall be housed.

7.3.13 DC System

a) Plant DC system shall essentially cater for control/monitoring, protection/alarm/annunciation, spring charging and operation of all circuit breakers, emergency lube oil pump motors and emergency lighting.

b) The system shall comprise two (2X100%) banks of 220V DC nickel cadmium batteries or plant type lead acid batteries with one (1) main float cum boost charger and one (1) standby float cum boost charger and DC distribution boards using circuit breakers in incomer circuits and switchfuse units in other feeders.

7.3.14 Emergency DG set:

One no 1500KVA , 415V, 0.8pf Emergency DG set shall be provided for each unit and one no stand by DG set of same capacity shall be kept as standby for all the 3 units.

7.3.15 Power and Control Cables

a) Power cable sizes for breaker controlled feeders shall be determined on the basis of rated feeder current with overall derating factor of around 0.7 (for ambient/ground temperature, thermal resistivity of soil, grouping and proximity of cables), starting/running voltage drop or required short circuit current capacity for a duration of 1 second for incomers and ties and 0.16 sec. for other feeders, whichever gives a larger rating.

b) Power cables for 11 KV and 6.6 kV system shall be UE grade, single/three core stranded aluminum conductor of various suitable cross sections, XLPE insulated, provided with semi-conducting screens for conductor and insulation, PVC inner sheath, aluminum (for single core) or galvanized steel (for three core) flat/wire armouring and overall FRLS PVC sheath.

c) Power cables for 415V system shall be of 1100V grade, single / three core stranded aluminum conductor of various suitable sections. The cables shall be XLPE insulated, PVC inner sheathed, aluminum/ steel/flat/wire armoured and overall FRLS PVC sheathed.

d) Control cables shall be 1100 volt grade, multi-core, stranded copper conductor, PVC insulated, PVC inner sheathed, armoured and overall FRLS PVC sheathed with minimum 2.5 mm2 conductor size.

e) Special cables shall be used wherever required for special applications.

7.3.16 Safety Grounding

a) Station ground grid for power station shall be provided for grounding of equipment and structures maintaining step and touch potentials within safe limits to protect personnel from potentials caused by ground fault currents and lightning discharges.

b) Separate grounding, independent of station grounding bus shall be provided for electronic systems.

c) Grounding conductors and accessories shall be designed to carry the maximum fault current for one second.

7.3.17 Lightning Protection

a) All the equipment and areas in the power house shall be protected against direct lightning stroke. For this purpose all the electrical equipment shall be designed and tested to withstand specified impulse voltage.

b) Protection against direct lightning strokes shall be provided for all the buildings and structures viz. main building, Fuel oil tank, Boiler, ESP, Chimney, etc.

7.3.18 Lighting

a) Lighting fixtures shall be suitable for 240 volt AC for normal and emergency lighting and 220 Volt DC for back-up emergency lighting.

b) Supply for AC lighting shall be obtained from 415 V, 3 phase, 4 wire, 50 Hz bus of main lighting distribution board which will receive power from 415V switchgear. Lighting distribution transformers shall be provided along with lighting DBs in various plant area.

c) Suitable number of lighting panels located in various plant area will be fed from main lighting distribution board. Incomers and outgoing feeders of LDBs/LPs/sub DBs shall be provided with HRC fuses/MCCB for short circuit protection.

d) Besides normal lighting system, emergency AC & DC lighting system shall be provided in the power station complex.

7.3.19 Communication System

The plant shall be provided with effective and reliable intra site communication system comprising a public address (PA) system and a intercom telephone (PABX) system with necessary hand sets and Cabling. Interconnection with existing telephone system will also be provided.

7.4 Instrumentation and Controls

a) Basic system

The basic purpose of control & instrumentation is to provide a simple, effective and fail-safe means for reliable and efficient operation of the plant under dynamic conditions and for attainment of maximum station availability. The principle design objective for the C&I system shall be optimization of fuel consumption and station operation & maintenance personnel.

b) DCS System (Integrated) and Unified for BTG with latest series State of Art Technology Microprocessor based Distributed Digital Control and Management Information System (DDC MIS) shall be provided for control of boilers and TG sets. Different sub-systems of DCS shall be as follows:

a. Input/ Output system
b. Closed Loop Control sub-system.
c. Open loop & Sequential control sub-system.
d. Data Acquisition System.
e. Historical Storage System.
f. Performance Calculator station.
g. Engineering & Configuring station.
h. Operator's station and LVS.
i. Data Highway.
j. Bus Couplers & Gateway for Interfacing with other systems.
k. Management Information system.
l. Sequence of Event Monitoring System.
m. Plant Optimisation.
n. Alarm analysis & Event Management.
o. Displays and Logs.
p. OPC Compliance.
q. TMR SIL-3 Compliance for Boiler/Turbine Protection.

Sequential start-up and interlock protection system shall be provided for control of various parameters from the highest level of unit operation down to the individual drive level. DDC MIS shall take care of closed loop control, open loop control and data acquisition functions, control

panel with conventional primary man-machine interface (MMI) devices or CRT/KBD for man-machine interface.

Other Monitoring & Protection systems envisaged are as under:

a. Rotating Machinery Monitoring system.

b. Machinery Protection system.

c. Machinery/ Asset Condition Management.

d. SWAS

e. Oxygen & CO2 Analyzers, CEMS

f. Turbo Supervisory System (TSI)

g. Turbine Stress Evaluator (TSE)

h. FSSS

i. HP/LP Bypass system

j. APRDS, Soot Blower, MFT, Ignition system & Flame Scanners.

c) Visual Annunciation System

a) For a quick grasp of the critical abnormal status for operator guidance, this system shall annunciate only the most critical parameters which have gone into an abnormal status and shall act as a back-up to the elaborate annunciation provided as part of the plant monitoring functions of the Distributed Control System. Contacts which are connected to such visual annunciation system shall be shared with the Distributed Control System through diode auctioneering networks or other digital signal fan out networks.

b) It shall be ensured that besides redundant controllers for the Distributed Control System (DCS), power supplies for the entire Control and Instrumentation System are provided with complete redundancy. This critical power supply can in turn be extended from an Uninterruptible Power Supply (UPS) system which itself is configured in redundant mode. DCS shall provide all facilities to start under hot, warm or cold conditions, synchronize, load, regulate and shutdown the unit administratively or under emergency conditions from Unit Control room without any need for local operation or intervention.

7.5 Civil and Structural Works

Civil works required for the complete construction and efficient operation and maintenance of the power plant include works required for infrastructure and enabling works, foundations, structures, buildings and their architectural finishes, service facilities like paving roads, drains and cable trenches.

The civil works will include site grading and levelling works, excavation and backfilling, plain and reinforced cement concrete works, structural steel works, all architectural and functional finishes, water works and plumbing, sanitary services including septic tank, waste water treatment, drainage system, paving and roads, landscaping and horticulture and any other services required for the completion of the project.

The main power plant building shall be a structural steel framed structure. The operating floor level shall be around 17 M with RCC floors. The structure will be designed to cater for two (2) EOT Crane to handle heaviest load required in handling TG set. The doors and windows shall be of metallic frame with glazing to avail of natural light. The auxiliary and ancillary buildings will generally be in Steel framed structure, Sheeting/RCC roof slabs, side cladding and brick walls.

The general criteria for various Civil engineering designs shall be as follows:-

A) Natural Phenomena Design Criteria

The design criteria based on the natural phenomena are given below:-

i) Wind Speed

The design wind speed shall be considered as 47 m/sec. based on IS-875 (Part-3).

ii) Temperature

Systems and system component design criteria which require ambient temperature extremes shall use the range from 8°C to 50°C for dry-bulb temperatures.

iii) Relative Humidity

The average annual relative humidity shall be considered as code.

iv) Seismicity

IS:1893 Zone III shall be applied for the plant site.

v) Design Loads

Design loads for all structures shall be determined according to the criteria described below:-

i) Dead Loads: Dead loads shall consist of the weights of the structure and all equipment of a permanent or semi-permanent nature including tanks, silos, bins, wall panels, partitions, roofing, piping, drains, electrical trays, bus ducts and the contents of tanks measured at full capacity.

ii) Live Loads: Live loads shall consist of uniform live loads and equipment live loads.

Floors and supporting members which are subject to heavy equipment live loads shall be designed on the basis of the weight of the equipment in addition to a uniform load of 500 kg/m^2, or specifically defined live loads, whichever is greater. Live loads shall be used as follows:-

a) Ground Floors: Ground floor slabs shall be designed for a minimum of 3,000 kg/m^2 in unloading area & 1,500 kg/m^2 in other area.

b) Intermediate Floors: Intermediate concrete floor slabs shall be designed for a uniform load of 1000kg/m2, except for the following:-

i)	Control room areas	:	1500 kg/m^2.
ii)	Storage areas	:	Mass of stored material, but not less than 1500kg/m^2.
iii)	Turbine generator	:	Determined by loads of laydown area major components, but not less than 1,500 kg/m^2.

Intermediate grating/chequered plate floors shall be designed for a loading of 500kg/m^2 to the supporting members.

c) Roof Loads: All roof areas shall be designed for wind loads as indicated in IS:875 (Part-3). All roof areas shall be designed for imposed loads as per IS:875 (Part-2) in addition to calculated dead loads.

d) Impact Loads: Impact loads shall be added to other loads for components supporting reciprocating or rotating machines, elevators, hoists, cranes, or other equipment creating dynamic forces. The impact loads shall be as per IS:875 (Part-2).

e) Pipe Hanger Loads: Pipe hanger loads for the major piping systems, such as the main steam, feed water and extraction systems shall be specifically determined and located.

f) Access Walkways, Staircase, Handrails and Ladders: The walkways shall be designed for the dead loads of the structure plus a superimposed live load of 500 kg/m2 uniformly distributed, or a concentrated load of 150 kg at any point, whichever produces the most severe effect.

g) Stair case shall be designed for a uniform distributed load of 500 kg/square meter. Handrail forces shall be 100 kg applied outward at the center of the span and vertical between posts. Ladders shall be designed to withstand a live load of 100 kg.

h) Wind Loads: Wind loads for all structures shall be based on IS-875 (Part - 3). Basic wind speed shall be 47 m/Sec. A step function of pressure with height under different Exposure conditions shall be used. The building classification shall be with risk coefficient of 1.08 and terrain Category 2.

i) Seismic Loads: The seismic risk zone for this site is Zone III as determined from the IS:1893. Seismic loading shall be used in the design of structures only when they are greater than the computed wind loads.

B) Exterior Architecture

General design criteria for the exterior architectural systems shall be as follows:-

1. Walls/Cladding: Brick walls shall be provided for initial height of 3 m main power plant building and other steel buildings. Metal cladding shall be provided above initial height.

2. Doors, Windows / Ventilators: Door, Window and Ventilator frames shall be made of extruded aluminum, steel, or other tried and proven material which is resistant to the corrosive environment. All windows shall be fully flashed and sealed for weather tightness.

3. Equipment Access Doors: Large access exterior doors of vertical lift Rolling shutter type with weather seals and windlocks shall be provided.

4. Roofs: RCC slabs over metal deck with proper water proofing shall be provided for main TG building and other critical building. Galvanised/Multi colour steel sheets shall be provided on the room of other buildings with adequate slopes and roof drainage.

5. Floor Coverings: Floor coverings on the Main Plant Building turbine operating floor shall be tiles/ laid over concrete. All other high traffic areas shall have heavy-duty tile flooring.

6. Painting: Inside masonry walls and ceilings of all buildings shall be provided with white wash, color wash, oil bound distemper, plastic emulsion paint as per the requirement. Steel structures, doors, windows, steel rolling shutters, gangways, stairways railing, grating rain water pipes etc., shall be painted with synthetic enamel paint over primer paint.

7. Sanitary Facilities: Toilet and shower facilities shall be provided for personnel in all major buildings and in other areas as determined by project requirements.

C) Steel and other Metals

1. Structural Steel: Steel framed structures shall be designed in accordance with IS:800 Code of Practice for Construction in steel adopting allowable stress design and plastic design.

2. Design: All steel framed structures shall be designed as "rigid frame" or "simple" space frames utilizing single-span beam systems, vertical diagonal bracing at main column lines and horizontal bracing at the roof and major floor levels.

3. Corrosion-Resistant Steel: Corrosion-resistant steel shall be used where corrosion, abrasion, or appearance requires the use of special steels. Stainless steel shall be used only where extreme corrosion conditions warrant its use. Stainless steel shall conform to AISI - 304 or 304L.

4. Tests: The fabricator shall be required to submit mill test reports for all material and shall confirm to specifications requirement.

Power House Building

The superstructure would be of structural steel framing with brick wall up to 3 meters and color coated galvanized sheeting above the brick wall and floors will be of RCC. Roof of TG Bay will be of in-situ RCC slab over permanently colour coated galvanized MS trough metal sheet supported on purlins and steel trusses. The turbine-generator pedestal would be of reinforced concrete and would be isolated from the building foundations and superstructure. The design of steel structures shall conform to IS: 800 and RCC structures shall be designed to IS: 456. The structures will be designed to be earthquake resistant.
Architectural finishes appropriate to the area shall be provided including mosaic flooring, surface hardened floors, plain concrete floors, glass blocks, louvers, glazing etc. For access to the maintenance bay, motorized steel rolling shutters shall be provided

Steam-Generator, ESP and Bunker Bay Area

The boiler structure shall be steel structure, housing/supporting the boiler and related equipment including primary and secondary air fans, burners, air heaters, economizers, hoppers, ducts, piping etc.

The stairs, platforms and walkways provided for utility and safety shall be of gratings and chequered plates with toe plates and hand railing. Temporary access openings shall be provided for erection of boiler and its accessories.

All boiler, electrostatic precipitators, fans, mills, duct supports shall have reinforced concrete foundations with the heavy equipment foundations designed
for static and dynamic loadings.

The mill bunker bay would be of structural steel-framed construction, supporting circular steel bunkers. The bunker bay would have Mill at ground level and floors for the raw coal feeders and for the bunker feeding conveyors provided with trippers. The bunker bay would be located on either side of Boiler (Side mill arrangement) or any other suitable arrangement depending on the manufacturer's standard. Concrete paving would be provided in the steam-generator area with necessary drains and trenches. Pipes and cables in this area would, in general, be routed on overhead pipe/ cable racks.

Chimney

One multi flue RCC chimney common for three units has been envisaged for the proposed thermal power plant. The total height of chimney envisaged is 275 m height. This would meet the requirement of Indian emission regulations. The flues would be of mild steel construction of suitable exit diameter with glass wool insulation. The chimney windshield shall be of RCC construction. Appropriate aviation warning system would be provided for the chimneys as per regulatory requirement.

Transformer Bay

The transformer foundations shall be of RCC construction having fire walls to compartmentalize the bays but open from the front side so that the transformer can be brought in or taken out on rail tracks at the time of installation as well as for maintenance. Fencing shall also be provided around the transformer area as per the norms.

Switchyard

Galvanised steel structures shall be provided to support the conductors, current and voltage transformers, circuit breakers, insulators etc.

RCC isolated footings and pedestals shall support these structures. Towers supporting the gantries for stringing shall have mat foundations accommodating the four pedestals / legs of the towers. RCC cable trenches shall be fitted with pre-cast covers; gravel will be laid out in the switchyard area.

Miscellaneous Buildings

Auxiliary buildings such as CHP, AHP, Cooling Tower, CW pumps, PT-DM plant, DG Set, pump houses, stores, etc. will be of RCC/Steel frame structure construction with brickwork/cladding and normal architectural finishes with crane facility provided as per building requirement.

Parking area

Parking areas for Dozer, Heavy equipment's, truck, ambulance, tankers, bus, cars, motorcycles and cycles shall be provided with concrete / interlock tile paving with RCC / steel roof structure.

Roads and drains

The main approach roads inside the plant boundary shall be same of Phase-1. The other roads shall be suitably wide to meet the norms. Open drains shall be provided to carry the surface run-off. These drains shall run alongside the roads and shall lead to the final disposal point. A network of drains would be provided covering the entire plot. Garland drains would be provided around all buildings to connect to the road side drains.The drains shall normally be in Bricks/RCC construction. Reinforced concrete culverts or concrete pipe culverts shall be provided at road crossings.

Landscaping

Landscaping shall be done for the entire plant area. A green belt of minimum 50 M width will be provided all around the plant inside boundary. The various services / utility areas within the plant area would be suitably graded. Area in front of building, parking area, entrance of power plant

area would be landscaped with ground cover, plants, trees based on factor's like climate, adaptability etc. A green belt of at least 30% area is proposed to be provided for plant as per guidelines of MOEF. Plants and tree saplings shall be planted and maintained irrigated by sprinklers using trough water from the first phase-clarified water. Trees are also provided between coal stockpiles / ash dyke and power block which would minimise the dust and noise pollution

8.0 ENVIRONMENTAL ASPECTS

Types of Pollutants

The various types of pollution likely to be created by the proposed coal based power plant can be broadly classified into the following categories:

a) Air pollution: Atmospheric pollution through particulate and gaseous emissions
b) Water & Sewage pollution: Pollution due to discharge of liquid and solid wastes
c) Noise pollution.

These said pollutants are discussed below.

A) Atmospheric Pollution

Contribution to atmospheric pollution can be from:

a) Particulate emission in flue gas from the stack
b) Sulphur dioxide emission in flue gas from the stack
c) NOX emission in flue gas from the stack
d) Coal dust particles during storage/handling of Coal
e) Dust in the ash disposal area

Current requirements guidelines of MOEF and requirements of Central Pollution Control Board for Air, water and noise pollution are already available. Proposed project will put all mitigation measures to meet proposed guidelines.

Particulates emission from fly ash in flue gas

As per the Pollution Control Board norms, the standard for particulate emission applicable will be adhered. The electrostatic precipitators (ESP) proposed for this project will be designed to limit the emission level of the particulate matter to this value.

Sulphur-di-oxide (SO2) emission in flue gas

As per the norms, the minimum stack height for 660 MW units shall be 275 meters. Therefore, one stack (chimney) of height 275 meters with tri flue has been proposed for effective dispersal of sulphur di-oxide.

Nitrogen oxides (NOX) emission in flue gas

To reduce NOx emissions, the steam generators will be fitted with advanced low NOx burners with over fire air systems. The NOx emissions will be maintained as per norms.

Coal dust particles due to storage/handling of coal

Coal dust will be suppressed by water spraying arrangements using cooling tower blow down at suitable locations such as transfer points, loading and unloading stations, coal piles etc. Transfer towers and Crusher houses will be provided with dust extraction systems. In addition, water sprinklers will be provided in the coal storage area to suppress the coal dust generated during stacking and re-claiming of coal.

Coal dust is generated wherever there is transfer of coal from one elevation to another. Hence, all coal transfer points and coal stock yard shall be provided with coal dust suppression / dust extraction facilities. Further, in order to arrest the coal dust generation, all conveyors shall be provided with enclosed galleries.

Bunker ventilation system shall be provided, also, to evacuate dust and hazardous gases like methane from the coal bunkers. Collected dust shall be returned either to the associated belt conveyor or to coal bunkers.

Coal for the project shall be procured from close vicinity coal blocks and shall have low sulphur content.

Fly ash dust particles from ash silos and ash disposal area

Fly ash evacuated from the ESP hoppers is transported in closed pipelines by pneumatic means. At the time of unloading fly ash in to the silo, some ash laden air gets vented out. In order to restrict the fly ash dust particles, a bag filter will be installed on top of fly ash silo.

To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash shall be conditioned with water spray. It is proposed to use covered trucks to prevent flying of fine ash during transportation.

High concentrate slurry disposal (HCSD) system shall be adopted, in which case the concentration of ash would be as high as 60%. This solidifies quickly and forms a hard crust; hence there shall not be any generation of fugitive fly ash and no pollution of the air in the vicinity. As the quantity of water in the sump is also very little and it gets evaporated, there will not be any pollution of

ground water. Therefore lining below the ash disposal area is not envisaged. Further, as the ash forms a hard layer, there will not be any carryover of the ash even during monsoon season.

MOEF notification dated 3rd Nov'2009 specified that fly ash utilization has to be 100% from within 4 years of commissioning of the plant. The ash utilization will be partial during the initial period and will be gradually increased to 100% within 4 years.

B) Water & Sewage pollution: Pollution due to discharge of liquid and solid wastes

The sources of water pollution are:

a) Effluent from the water treatment plant
b) Steam generator blow down
c) Cooling tower blow down
d) Effluent from run-off area from coal handling
e) Sewage from various buildings in the plant
f) Effluent from ash disposal area
g) Air pre-heater wash water effluent
h) Plant washes down water
i) Floor and equipment drainage effluent
j) Rain water drainage

Effluent from the water treatment plant

Effluents from the DM plant resin regeneration circuits, generally acidic from the cation units and alkaline from the anion units, will be neutralized in a neutralizing pit. The neutralized effluent shall have less than 100 ppm suspended solids and a pH value of about 6.5 to 8.5 in line with UPPCB standards. The neutralized effluents will be led into the ash water pond and/or shall be used in HCSD System.

Steam generator blow down

The boiler blow down (generally during start-up of unit) does not require treatment to achieve the limits but relies on operating at sufficient blow down levels to prevent the build-up of contaminants. The salient characteristics of the blow down water from the point of view of pollution are the pH and temperature of water since suspended solids are negligible. The pH shall be in the range of 9.5 to 10.3 and the temperature of the blow down water shall be about 100° C when it is flashed into an atmospheric flash tank. Boiler blow down water shall be led to the effluent guard pond.

Cooling tower blow down

The cooling tower blow down water shall be led for reuse in the coal and ash handling system.

Effluent from run-off area from coal handling

The run-off from the coal handling area will flow into the drains which will be suitably provided at various places in the coal yard. The run-off collected in this manner will be led to a common sump where it will be pumped into the storm water drain and ultimately into the ash slurry sump for suppression of dust.

Sewage from various buildings in the plant

It is proposed to dispose the sewage from the various buildings in the power plant as well as the colony through a combined sewage treatment tank. The effluents from the sewage treatment plant (STP) will be disposed off suitably.

Effluent from ash disposal area

All efforts will be made for maximum utilisation of fly ash produced from the power plant in the dry form. The bottom ash and remaining fly ash will be disposed off in slurry form into the ash dyke. The water from ash dyke through decantation well will be collected in one clear water reservoir. The water from the reservoir will be pumped to ash water pond located in the plant with the help of re-circulating water pumps. The water from the ash water pond will be re-used in ash handling system.

Floor and Equipment Drainage System Effluent

The function of this system is to provide a means for collecting and draining water from floors in process areas of the plant and collecting and disposing of water and other liquids from process equipment and oil storage tanks. In the turbine building, the ground floor slabs would be sloped to drain out floor drains. The equipment drains are piped directly to the drain system. Drains are collected and directed to sumps outside the buildings from where it would be pumped to the guard pond.

Rain (Storm) Water Drainage

The rain (storm) water removed from the building roofs and yard area grade level surfaces would be directed through open drains, ditches and culverts to the storm drainage piping. All drains, ditches would be of brick/RCC concrete and located along the roads. All drainage ditches would be located to provide the shortest practical drainage path while providing efficient drainage for the yard. Grade level would be contoured such that storm water run-off is directed on the ground by sheet flow, to well defined drainage paths leading to the drains or ditches.

It is planned to provide a properly designed rainwater harvesting scheme. In order to conserve the rainwater and reuse the collected water, a rainwater pond is planned in the plant layout within the

plant area. The surface runoff from the plant area would be discharged into the rain water harvesting pond. The collected water would be treated and used in the plant mainly for spraying for coal stockyard and gardening. Rain water recharge pits which help in replenishing the ground water table would also be provided at suitable locations. The excess flows from the rainwater harvesting pond would be led into the nearby natural drainage or nallah.

C) Noise Pollution

Source of Noise Pollution in a power plant are:

a) Steam turbine generator
b) Other rotating equipment
c) Combustion induced noises
d) Flow induced noises
e) Steam safety valves

Indian standard for noise level specifies the limiting value of an overall noise level for a specified area. However, OSHA standard calls for regulations of noise level around the noise emitting equipment. All equipment in the proposed power plant would be designed / operated to have a noise level not exceeding 85 dBA in line with the requirements of OSHA.

The major noise generating units in a power plant are turbines, turbo generators, compressors, pumps and fans. Noise is continuously generated from such sources. Proper encasement of noise generating sources will be done to control noise level. Also, all necessary measures shall be taken to limit the noise levels at the plant boundary within the stipulated limits. Besides, ear muffs / plugs will be provided to the personnel in the close vicinity of noise sources.

Green belt would be developed to attenuate noise and the extent of green belt would be as per CPCB guidelines.

POLLUTION MONITORING AND SURVEILLANCE SYSTEMS

Particulate matter emission would be maintained within the limit stipulated by the Central / State Pollution Control Board. The minimum stack height for keeping the sulphur dioxide levels in the ambient to within the required air quality standards would be maintained as described above.

The characteristics of the effluent from the plant would be maintained so as to meet the BIS/ EPA rules and requirements of the Uttar Pradesh Pollution Control Board and the minimum National Standards for Thermal Power Plants stipulated by the Central Board for Prevention and Control of Water Pollution.

AIR QUALITY MONITORING PROGRAMME

The purpose of air quality monitoring would be acquisition of data for comparison against prescribed standards, thereby ensuring that the quality of air would be maintained within the permissible levels. It is proposed to monitor the following from the stack emission:
a) Suspended particulate matter
b) Sulphur dioxide
c) Nitrogen oxides

For this purpose, it is proposed to acquire the following monitoring equipment:
a) High volume sampler for monitoring particulate matter
b) Sulphur dioxide monitor
c) Nitrogen oxides monitor

It is also proposed to monitor particulate emission qualitatively and quantitatively using a smoke detector on the stack and with the aid of a continuous particulate stack monitoring system. The stack monitoring data would be utilized to keep a continuous check on the performance of the ESPs.

9. System Design and Operation & Maintenance Philosophy

Issues regarding use of Super Critical technology

The Indian electricity sector has matured over the years. The teething troubles and the stabilization period required are no longer as significant as they were earlier. The 660 MW unit size is expected to stabilize much quicker than was the case with the lower capacity units. The Indian manufacturers are also able to adapt the technology received from others to suit Indian conditions. Significant adaptations have been carried out in boiler designs and the milling systems to address the problems with Indian coal. Further, the Indian market today has much more depth in terms of manufacture of components and use of newer materials. Special steels are also being manufactured in India and therefore there is much more experience available in the country to absorb new technologies than in earlier periods.

The other reason to believe that supercritical technology can be absorbed reasonably quickly is that India has already chosen to introduce sufficient number of such plants. This means that there would be sufficiently large number of units to build up the requisite manufacturing and support infrastructure. Therefore, introduction of super critical units does not introduce any major technology risk.

Availability of contractor for maintenance

Supercritical technologies introduce only a small number of special components requiring specific skills for maintenance. By and large, O&M operations for the supercritical plants are the same as for sub critical plants. Maintenance persons are familiar with new materials used in supercritical plants as they are already in use in Indian plants. The operational flexibility with super critical

technology is more than for subcritical units and should pose no major problems. Therefore, the ability of the Indian electricity sector to absorb supercritical technology should pose no major hurdle for its introduction. However, as a necessary measure, it is important to provide extensive training to the plant personnel and also using training simulators.

Availability of critical spare, tools and tackles in India

No major problems can be foreseen on this count. Given the number of such plants and projects to be set up, the availability of critical spares, tools and tackles are unlikely to be a constraint on the introduction of supercritical technology in India.

Design Philosophy

a) System design for high Unit availability
b) Sizing of Critical equipments with margins & redundancy/standby
c) Design for efficient operation
d) Spare Part Management system
e) Special Tools & Tackles
f) O&M Training
g) O&M Manuals

Operation and maintenance play an important role in power plants since these plants run continuously. Any stoppage due to some snag in the plant results in proportionate loss of revenue. Therefore, it is important to keep the maintenance department as a full-fledged department.

The O&M team of the proposed plant will be headed by an Executive Director/VP, under whom separate groups for operation and maintenance staff will function. In addition to these groups, operation and efficiency improvement team will monitor the efficiency in operations and suggest plant improvements.

O & M Procedure

Operation

The facility will be manned on 24 hours a day, 365 days per year basis. A management person, in the capacity of Shift Charge Engineer will be on site available all the times.

With the need to monitor the plant at all times the staffing requirements reflect a four-shift operation. Each shift would consist of 8 hours shift assignment. The level of manpower is necessary in order to satisfy training requirements as well as allowing for offs, leave etc. Each shift operation personnel will consist of the following:

- Shift Charge Engineer responsible for entire plant operation–3 shifts/day.

- Plant Control Room Operators responsible for Boiler and TG Operation – 3 shifts / day.
- Operators responsible for ash handling, boilers, turbine auxiliaries, compressors and other facilities - 3 shifts / day.
- Mill handling operators per shifts – 3 shift operation.
- One Chemist plus one operator for raw water, clarified water and DM water control requirement of the plant.

All the plant operators will implement an operating system as designed to ensure that equipment in the Plant is inspected at appropriate intervals. This will allow identification of problem at the earliest possible time. The operating team will maintain records of plant data and will develop characteristics generation profile for the various mode of operation. Operating procedures shall be as per the manufacturers recommendations and will be consistent with the industry standards. Approx. 200 manpower will be required for the O & M of the plant. Further, some of the activities such as major overhaul, maintenance, security etc shall be given on contracts.

Maintenance

Maintenance activities will focus on predictive / preventive practices in order to minimize the overall operation and maintenance costs. A team headed by Head O&M will look after the total facility and will be assisted by Manager of Electrical, Mechanical and Instrumentation Maintenance. They will be assisted by maintenance engineers and technicians.

A computerized maintenance system, based on SAP, will administer the optimized facility maintenance plan. The repair and maintenance department for each component provides a basis for decisions about maintenance cycle and for planning and budgeting.

OEM / other contract services will be utilized for scheduled major equipment overhauls / outages. The turbo generator is planned at 4 or 6 year maintenance program, unless otherwise called for unusual circumstances. Typical 4 or 6 years maintenance program shall be done as per the recommendation and procedures set up by OEM.

Boiler and auxiliaries is normally based on 1-year program based on statutory requirement. During overhauls, pressure parts, auxiliary system, safety relief valve etc. are verified for all operations.

10. SAFETY AND RISK ASSESSMENT

Safety shall be the corner stone of all operating practices. All plant safety requirements shall be regularly reviewed for compliance and statutory requirements. Plants personnel shall be trained in the use of safety equipment etc. A safety committee headed by the Plant Operation Head, will look after the safety aspects of the complete complex.

Assessment of Risks

The risks associated with the setting up of supercritical thermal power plants are, generally, the same as for any other thermal plant. The risks, briefly, are stated below:

Sl.No	Risk Factor	Mitigation measure
1	Site conditions (i) High temperatures, high humidity (ii) High seismicity	 Proper design of equipment Proper civil engineering design
2	Input - Coal (i) Long term availability (ii) High ash content, abrasiveness of ash (iii) Low GCV of coal	 • Obtain coal linkage • For imported coal (for blending in case of shortfall of indigenous coal), have long term firm supply agreements Proper design of boiler by the manufacturer
3	Input - Water (i) Water quantity (ii) Water quality	Ensure adequate availability throughout the year. Site storage for supply disruption (dam closure) Provide necessary treatment measures
4	Equipment procurement Limited number of manufacturers, Full order books – long delivery periods	 All manufacturers are available and delivery is not an issue
5	Project implementation (i) Project schedule and monitoring (ii) Transport of heavy equipment's (iii) Welding for newly introduced materials and two dis-similar materials at site. (iv) Delay in commissioning and cost over-run	Ensure realistic project schedule. Initiate rigorous project monitoring system with modern tools. Already Phase-1 is installed. Already welded in Phase-1 Provide cushion in project cost
6	Power evacuation Capacity of local, state and regional grid for evacuating plant output	Will be Finalized with UPPTCL
7	Marketing risks - sale of power output	Would tie-up long term PPAs with UPPCL.
8	Operation and maintenance	Already working and available in Phase

	(i) Scarcity of maintenance contractors and skilled operators (ii) Problem of tools and tackles (iii) Problem of spares	-1.
9	Demand management: Demand fluctuation and shut-down requirement envisaged in present high inequality between peak demand and base load	Provide for quick start-ups and high ramp-up rates in design of equipment
10	Approvals/Clearances	Early action to obtain all the statutory and non-statutory clearances will minimize delay in project completion
11	Project Cost/time overrun	Continuous monitoring using software like Primavera/MS Project etc. Financial results (IRR, DSR, ROE) should remain within limits and minimum time overrun.
12	Force Majeure	1. Will prepare a Disaster Management Plan and form a Disaster Management Team during the project development phase to deal with any eventuality. 2. Will ensure suitable provision in contract with EPC/ non EPC contractor for "Force Majeure" situations.
13	Fuel transportation	Firm agreement with transporters /railways should be in place prior to commissioning of the project.

It is difficult to quantify the impact of the risks in the present conditions of uncertainty regarding the location of the plant, source of inputs like coal and water and developer's preference for unit size.

11. IMPLEMENTATION SCHEDULE

1st Unit is expected to be commissioned within 42 months from zero date,
2nd Unit within 46 months, and
3rd Unit within 50 months

12. PROJECT COST

The Project Cost of the proposed Phase-2 (3 x 660 MW) Lalitpur Power Project has been estimated as Rs. 13,900 Cr. including interest during construction and financing charges and considering all taxes and duties. Cost per MW of installed capacity works out to Rs 7.02 Crore.

This has been arrived considering costs of recently commissioned/proposed projects, current prices for major plant and equipment, in-house data and information from on-going projects of similar size.

BASIS OF COST ESTIMATES

1) The project cost includes:
    a. A Power house building and all other plant structures for 3 x 660 MW.
    b. Heavy structures/ foundations such as Power house building, TG, chimney, steam generator, cooling tower etc. are proposed on Open foundations. Also assumed for lightly loaded buildings/structures
    c. Cost of roads inside plant boundary and associated drains, culverts has been considered for Phase-2 area only.
    d. Cost of railway tracks and marshalling yard within the power plant
    e. Cost of spares for mechanical and electrical equipment is considered at 2.5 % of landed cost.
    f. Cost of pollution control equipment and measures.
    g. Considering latest UPERC norms & MOEF requirements.
    h. Cost of Transmission line has not been considered in the cost estimates
    i. Rain water harvesting cost has been considered in the cost estimates.
    j. Taxes and duties of various items at rates indicated based on the prevailing rates in the current financial year have been included. Service tax on civil costs is computed assuming 70 % as supplies and 30 % as services.
2) The project cost excludes
    a. Cost of transmission system ,
    b. Cost of plant water reservoir, canteen, warehouse, workshop, administrative building

MEANS OF FINANCE

a) The funding of the project cost is proposed at a debt to equity ratio of 75: 25

b) Long term loan will be available from relevant financial institutions with average cost of financing assumed as 12% p.a. The same may change at the time of financial closure.

c) Long-term loan is presumed to be repayable in ten (10) years with moratorium for six months till after construction period.
d) The rate of interest on working capital loan has been taken as 13%.

PARAMETERS FOR OPERATIONAL EXPENSES

For estimation of operational expenses, following considerations have been taken into account:

1. Annual plant load factor (PLF) = 85%
2. GCV of coal = 3400kCal/kg
3. Plant heat rate = 2250 kCal/kWh
4. Auxiliary power consumption = 6 % of gross generation
5. Specific fuel consumption = 1 ml/kWh
6. Cost of coal = Rs. 4500 per ton (average)
7. Cost of fuel oil as received at site : Rs. 35000 / tonne

ESTIMATED PROJECT COST AND COST OF GENERATION

The estimated Capital Cost, Capitalised Project Cost (including IDC) has been taken as Rs. 13,900 Cr and Cost of Generation at 85% PLF for the saleable energy with various other considerations

13. EMPLOYMENT POTENTIAL

Setting up of this project will create a direct employment of about around 200 employees for normal operation and maintenance of proposed 1980 MW Power Plant. Additional about 600 people shall be employed indirectly for the project for material handling, coal handling, preventive maintenance, cleaning, gardening, security and other activities. During the execution / construction of the project, atleast 6,000 people shall be employed. Most of this staff shall be from the locality of the proposed project or from nearby villages. This project shall help in solving unemployment in that region substantially and for well being of the people in the nearby region.

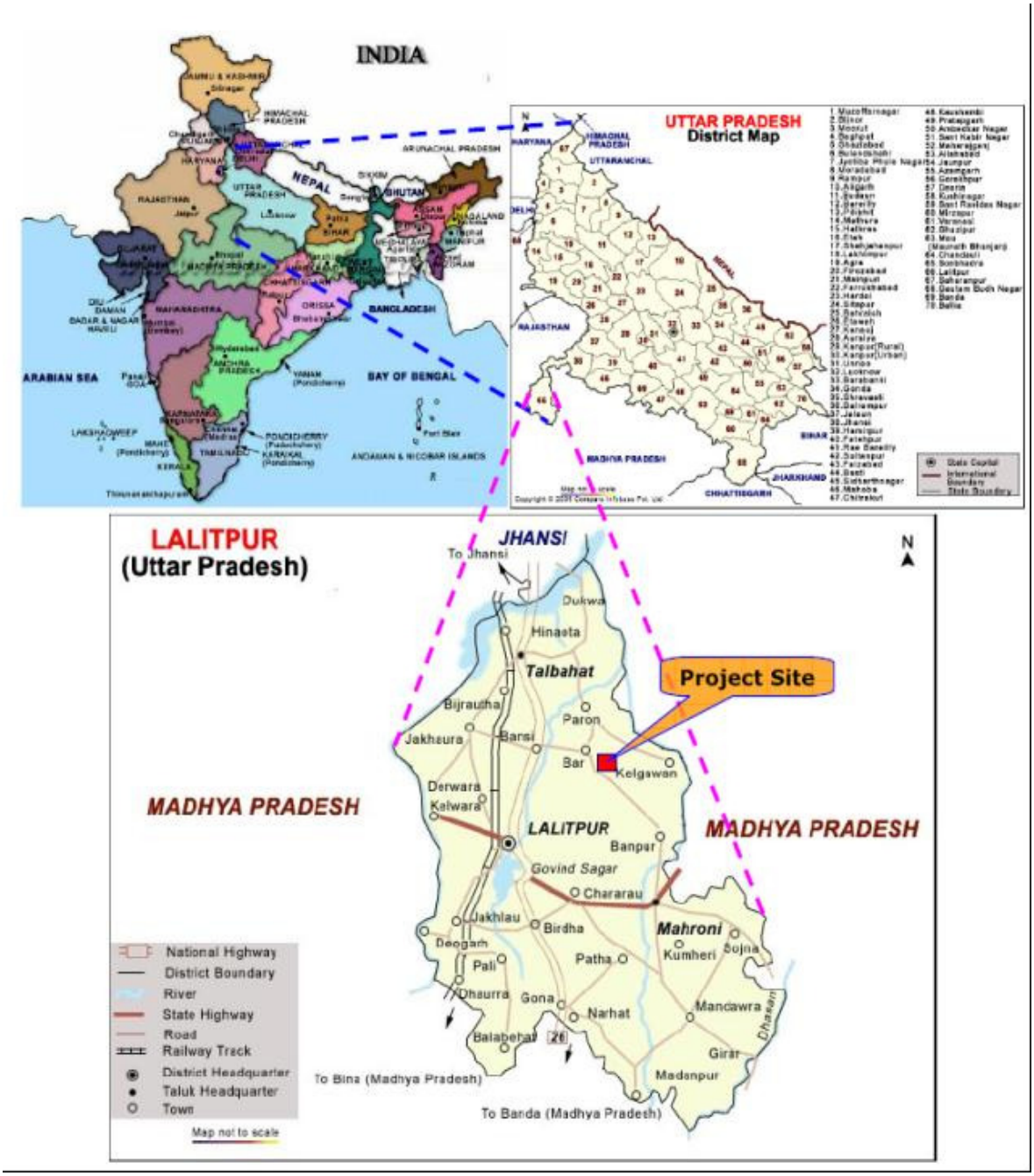
14. CATALYST FOR INDUSTRIAL DEVELOPMENT

With the addition of this proposed 1980MW Power Plant, we will be able to supply power at most economical prices. This 1980 MW Power Generation project shall give a thrust to the upcoming / planned medium and small scale industries in the vicinity and shall develop an industrial hub in the area which shall facilitate the industrial growth / development in this region which is highly backward and short of power. The proposed plant shall act as a catalyst towards the progress of the region as well as for development of the country.

ANNEXURE-1
TOPO SHEET 10 KM RADIUS

Already uploaded separately

ANNEXURE-2
THE VICINITY MAP OF THE PLANT SITE



ANNEXURE-3
SITE MAP/ PLANT LAYOUT

Already uploaded separately