

Final Report

Environmental Impact Assessment Study

2x660 MW Coal-Based Thermal Power Plant

District Janjgir Champa
Chhattisgarh

Project by:

MB Power (Chhattisgarh) Ltd.

Moser Baer Office

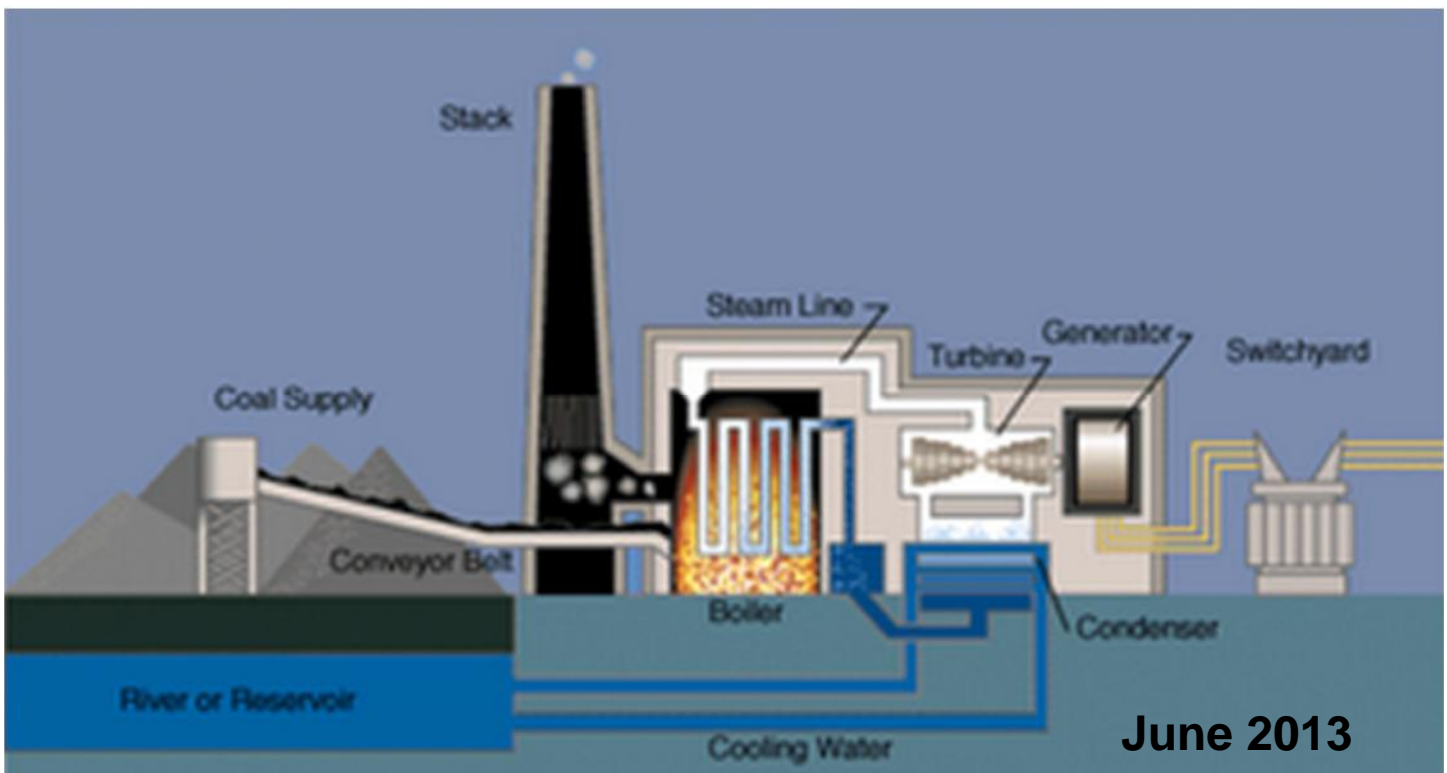
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Consultant:



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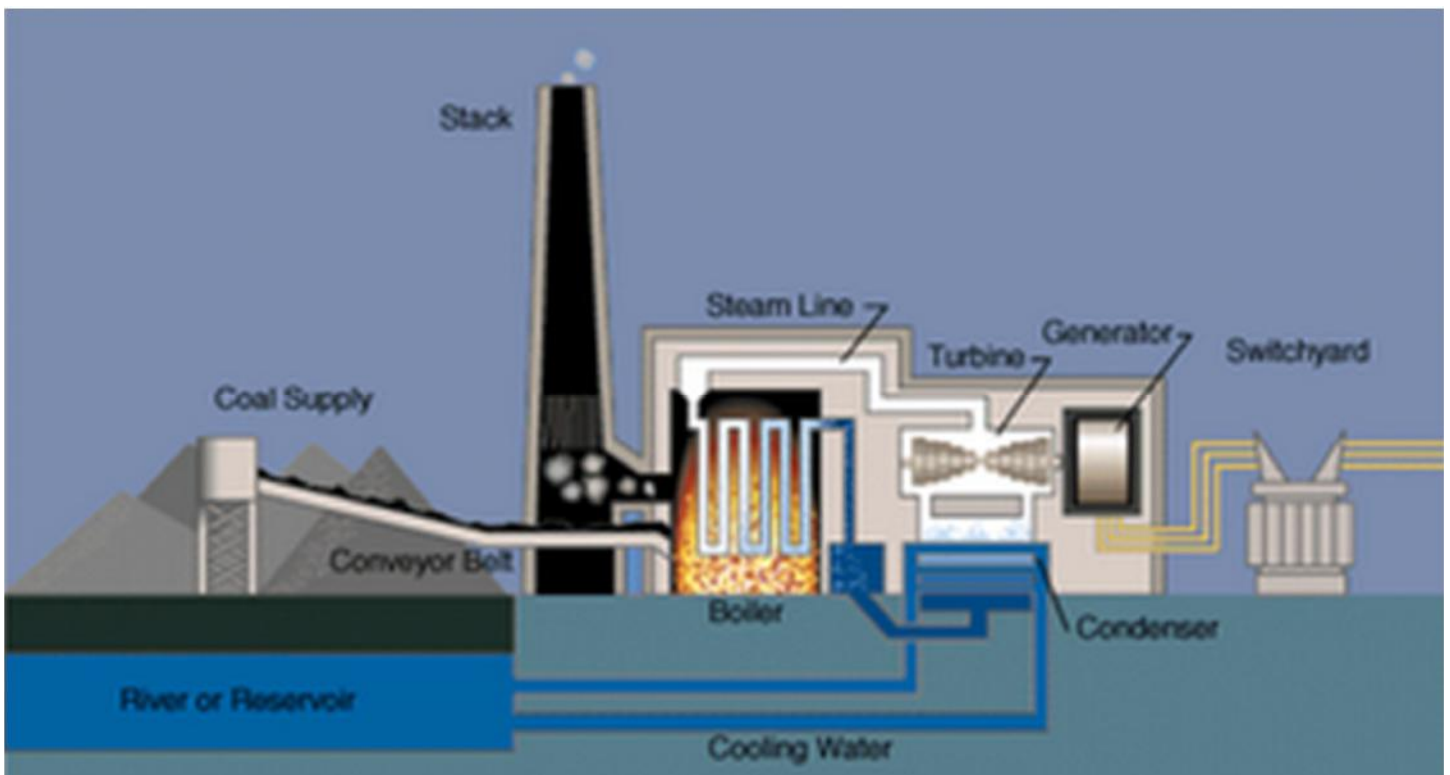
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Executive Summary



EXECUTIVE SUMMARY

INTRODUCTION

M B Power (Chhattisgarh) Ltd. (MBPCL) proposes to establish a 1320 MW (2 x 660 MW) coal fired thermal power plant in Janjgir Champa district, Chhattisgarh. MBPCL has appointed GIS Enabled Environment & Neo-graphic Centre (GreenC) to carry out Environmental Impact Assessment (EIA) study for preparation of Environmental Management Plan (EMP) for the proposed 1320 MW coal fired Thermal Power Plant (TPP).

Location: The proposed power plant site is located in the villages Birra, Siladehi and Gatwa. The site is well accessible by NH-200 which is 35 km from the site area. Champa is the nearest railway station at a distance of 32 km.

PROJECT DESCRIPTION

Land: Total land requirement for the proposed 2x660MW Thermal Power Plant is around 925 acres. This land has been acquired in the villages of Birra, Siladehi and Gatwa. The land for the project has been already optimized. The land is slightly undulating with the average altitude more than 226 m above MSL.

Around 45 acres will be required for intake well and approach roads. Additionally the company will be constructing a private railway siding for about 40 kms which will require around 325 acres.

Coordinates: The site for the project lies within the latitudinal extent from 21°45'13.24" to 21°46'26.07" North and longitudinal extent of 82°44'24.92" to 82°45'59.57" East.

Water: The source of water for the plant is Mahanadi, which is a perennial river. The water drawl point will be from barrage proposed by Water Resource Department, Chhattisgarh on River Mahanadi. The estimated requirement of make-up water for the 1320 MW capacity power project would be about 4110 m³/hr with recovery. Chhattisgarh Water Resource Department has allotted 36 MCM of water annually from Mahanadi River.

Coal: Coal requirement for the proposed plant, is estimated at 6.40 MTPA considering average GCV of 3500 kcal/kg at 90% PLF. SECL Coalfield has been considered as source of coal. Coal is proposed to be transported through Indian Railways network from SECL source to Champa Railway Station (RS) and then to site through dedicated railway siding (to be constructed).

Power Evacuation: It is proposed to adopt the evacuation voltage as 400 kV. Power Generated from each 660 MW units would be stepped up to the evacuation voltage level through suitably rated Generator Transformer and will be evacuated through 400 kV transmission lines.

Raw Water System: The Raw Water System shall be designed to supply cooling water makeup and other consumptive water requirement like service water, potable water etc. for the proposed plant. Raw water shall be pumped from the intake to the raw water reservoir located in the plant boundary. It is envisaged to provide two raw water intake pumps in the raw water pump house.

Coal Handling System: The coal from mine will be transported through Bottom Opening Broad Gauge Rail (BOBR) and / or BOXN wagons to the plant site. The coal will be unloaded, screened and crushed in coal handling plant. From there coal will be conveyed through belt conveyors up to the steam generator (SG) bunkers or stockyard for reclaiming. Two streams of

conveyors and equipments will be provided for carrying coal from track hopper and / or Wagon Tippler to the stockyard and to bunkers. Out of two streams, one will be normally operating and the other will be standby.

Ash Handling System: The quantum of ash generation has been estimated to be 2.70MTPA (90% PLF). It would depend on the plant load factor and the quality of coal being fed. Ash will be collected at the bottom of the furnace as bottom ash, economizer hoppers as eco ash, air-preheater hoppers as APH ash, electrostatic precipitator (ESP) hoppers as fly ash and stack hoppers as stack ash.

Steam Generator: The thermodynamic cycle for the 660MW units will consider super-critical steam parameters. The unit comprises the boiler, the steam turbine generator, the condenser, the condensate extraction and boiler feed system along with all other necessary equipment for single/double reheat-regenerative cycle. The steam parameters at the other end of the boiler have been considered to be 251 Kg/Cm² (abs.), 571°C with steaming capacity of about 2118 TPH as per the established practice of the units in 660 MW range.

Corresponding steam parameters at the turbine inlet would be 247Kg/Cm² (abs.) and 566°C and reheated steam parameters would be about 55 Kg/Cm² (abs.) and 600°C. The MP/IP cylinders may be of single/double casing design as per manufacturers' standard. The exhaust from HP-IP turbine will further expand in the double flow LP Turbine.

Stack Characteristics: One bi-flue RCC Chimney of height 275m is planned. The flue gas emission point shall be at the top of the chimney. Internal and external platforms shall be of structural steel construction and shall be supported from the windshield. The floors/walkways shall be of chequered plate construction. The grade level slab shall be of reinforced concrete with a metallic hardener floor finish. Necessary protection and access systems like large roll up door, access door, line hatches, test ports, water drainage system, etc. shall be provided.

Project Schedule: The first 660 MW units will be commissioned in 42 months from the Zero Date i.e. Main Plant Award. The second unit will be commissioned at an interval of 6 months.

BASELINE ENVIRONMENT STATUS

Study Area: The study area is 10 km radial distance from center of proposed plant site. All the monitoring is done in various locations within the study area during the period of October-December 2009.

Baseline Study: The findings of the baseline environmental status on land (topography, geology, soil quality, land use pattern), meteorology (Temperature, Relative Humidity, rainfall, wind speed, wind rose), air (ambient air quality- SPM, PM10, PM2.5, SO₂, NO_x, Ozone), water (surface water, groundwater), noise level, ecological environment (flora & fauna), socio economic conditions (demographic profile and households condition) were presented and interpreted with reference to environmental standards.

Topography: Topographic features of the study area are depicted in Survey of India's Topographical sheet No. 64 K/9. The land is slightly undulating with the average altitude more than 226 m above MSL. The average slope of the site varies from 220-230m. Overall there will be no requirements for cutting and filling. Leveling of land in some parts of the plot will be required before construction.

Soil: The soil cover of the study was found to be mostly brownish in colour. The texture of the soil in the study area was found predominantly sandy and silty in nature. The pH of the soil samples was found to be neutral to alkaline. Organic content of the soil samples was found to

be in the range of 0.85 to 4.14 g/kg indicating moderate fertility of soil. The permeability of the soil was found to be about 1.83×10^{-4} K(cm/sec).

Geology: The area owns the oldest archaean rocks. E-W trending Central India Shear has divided the area into two parts, Satpura province in north and Bastar province in south. Bastar province comprises Archaean Gneissic Complex where as Satpura province comprises granite gneisses, metamorphic, Deccan traps and Gondwana group. The study area belongs to Satpura province comprises the rocks of metamorphic, Deccan traps and Gondwana group

Land-Use of Study Area: The major share of the land is agricultural land which is about 263.91 sq km covering (84%) of the total land cover. Water bodies (Mahanadi and Hasdeo) occupy 6.7 percent of the land use of study area. The scrub and open grasses land are predominant in the 10-km radius study area. There are 68 villages within the 10-km study area. The land-use of the Core Zone i.e the Project site is mainly covered by agricultural land (80%), water bodies (5%) and barren land (15%). No forest land and settlement is present within the site.

Micro-meteorology: The maximum and minimum dry bulb temperatures recorded during the study period 32.9°C in October and 14.2°C in December respectively, while the average temperature was 22.6°C. During the study period, mean humidity was recorded at 66.2% while maximum and minimum humidity were observed as 78% and 43% respectively. The rainfall experienced during the study period was 8mm. The average wind velocity was observed to be 4.1 m/s and the predominant direction was North and North-West.

Ambient Air Quality: Ambient air quality at ten different locations was monitored during the study period. It was found that P_{98} value of SPM varied between 138.9 and 159.3 $\mu\text{g}/\text{m}^3$. The 24-hrs RSPM level of ambient air in all the stations during monitoring period was recorded in between 41.1 to 55.7 $\mu\text{g}/\text{m}^3$ as against allowable value of 100 $\mu\text{g}/\text{m}^3$ stipulated in National Ambient Air Quality Standards (NAAQS) for industrial, residential cum rural area. The PM 2.5 value (P_{98}) was found between 21.3 to 27.7 $\mu\text{g}/\text{m}^3$. Similarly values of SO_2 and NO_x ranging from 9.2 to 13.5 $\mu\text{g}/\text{m}^3$ and 10.5 to 13.6 $\mu\text{g}/\text{m}^3$ respectively are well within the stipulated levels of NAAQS. The range of ozone varied from 7.9 to 8.5 $\mu\text{g}/\text{m}^3$. On the whole, the prevailing ambient air quality within the study area is well within the NAAQS standard.

Ground Water: From the observation, it was found that the pH of the groundwater was found ranging from 7.18 to 7.93. The TDS values were found in the range of 72 to 348 mg/l. The hardness values were in the range of 52.6 to 352 mg/l and the calcium and magnesium were in the range of 12 to 85 mg/l and 5.5 to 37 mg/l respectively. The heavy metals such as Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, and Zinc are all found within drinking water standards. In general, the groundwater quality indicates that the groundwater bodies are not polluted and can be used for drinking purpose after necessary disinfection.

Surface Water: The pH and TDS of the surface water samples are found normal with pH range of 7.1 to 7.4 and TDS between 114 and 198. The values of hardness, calcium and magnesium, chloride, sulphate, nitrate values are also found well within the limits of drinking water standard prescribed by BIS (IS 10,500: 1991). The heavy metals such as Arsenic, Cadmium, Chromium, Copper, Lead and Mercury are all found below detection limits. Although low concentrations of iron and zinc are found, they are within drinking water standards. The BOD values observed as 3.2mg/l to 4.1mg/l are well within the prescribed limits.

Noise Level: The ambient noise levels monitored at five different locations indicate that they were within the standards. The L_{eq} were recorded between 38.5 to 45.0 dB (A) during daytime and 32.6 to 37.8 dB (A) during nighttime.

Area Drainage: The general drainage of the area is from north to south. All first and second order seasonal streams join the Mahanadi within the study area. In the core zone area there is a

seasonal nala flowing in the western part of the core zone. The nala finally drains into Mahanadi near its confluence with Hasdeo.

Ecology: There are no ecologically sensitive receptors within the study area except for one reserve forest within 5 km from the site. The flora in the study area mostly consists of khair and sal. Bamboo is also found in the area. Grasses and other undergrowths cover the maximum wastelands and vegetation of the area. Fauna in the area consists of mammals (such as wild dog, wild boar, monkeys, etc.) reptiles (such as snakes and lizards) and common avifauna (such as myna, crows, pigeons, sparrows etc). There are no Schedule I fauna in the area.

Social Background: In the 10km study area, there is a population of 87,540 persons in 15,922 households. The literacy rate of the area is average although the female literacy rate was found to be low. The Scheduled Tribe population in study area comprises of 2.16% of the total population while it is 2.10% in the impact area

PREDICTION OF IMPACTS

Impact during Construction: Based on the impact analysis, it is predicted that there will be negligible impact on environment during construction phase. During construction the likely impacts include dust due to construction, movement of vehicles, gases from engine exhaust, noise from movement of material personnel, etc. During the construction period the impact on environment will be of temporary nature, localized and short term with changes in the surrounding land use as compared to the current conditions. The potential impacts on water environment will arise due to discharge of washing of construction materials stockpiled, washing of concrete batching plant and discharge of untreated sewage of construction labourers.

Impact during Operation:

Impact on Air Quality: The maximum resultant values (in operation phase) for SO₂ and NO_x were found to be 44.7 and 26.4 µg/m³ respectively. The maximum resultant Ground Level Concentration values were 159.9, 55.9 and 27.8 µg/m³ for SPM, PM10, and PM2.5 respectively. It was found that the GLCs for all parameters in operation phase of the project will be well within the prescribed norms of CPCB.

Impact on Water Quality: Operation of the plant will not have any long-term impact on water quality as it is proposed to have a 'Zero Discharge' water system. The water system of the proposed project has been developed with maximum recycle and reuse of water, so as to minimize the water requirement for the project as well as to reduce the quantity of effluents generated from the plant.

Solid Waste: The ash disposal area for Thermal Power Plant is within the site. The ash generated (2.70 MTPA) from the power plant will be utilized in Cement Plant. All the fly ash will be utilized within the period of 4 years as per the new Notification on Fly-Ash Utilization 2009.

Impact on Noise: Noise modeling indicates the noise during daytime will be 67.5 dBA and during nights it is 55 dBA about 0.5 km from the plant site. At the boundary of the plant, it will be less than this value due to green belt proposed all around the plant site as well as the distance of plant from the boundary.

Impact on Ecology: No significant impact on terrestrial ecology is anticipated due to proper dispersion of pollutants through a chimney of 275 meters. As the area is mostly barren, there will be not much impact on terrestrial flora and fauna. As already mentioned, there are no Schedule I fauna in the area.

Impact on Socio-economic Status: Approximately 831 households across three villages will be getting affected by the project as per study. All the affected will be land-oustees as there is no homestead displacement due to the project.

Mitigation Measures:

During the operation stage the main air pollutants will be from the Coal Handling Plants, coal crusher units and the flue gases. Furnaces and boilers would be operated with minimum excess air so that fuel consumption is reduced and NO_x emissions are minimized. Low NO_x burners should be installed for further reduction in NO_x emission. The fugitive emissions of coal dust from storage facilities, crushers and at coal transfer points should be reduced by adopting appropriate measures like cyclones /bag filters/water sprinklers/fog system.

Demineralization plant will be sized to meet the internal requirement of fresh water in the proposed power plant. Product water storage tank will be provided for distribution of potable water to various consumer points. The effluent treatment plant is proposed to treat all liquid effluent so as to meet the standards as per the MoEF / CECB standards. The treated water will be utilized for green belt development.

All equipment that are major noise generating devices/machines like steam turbine generator, compressors and other rotating equipment will have material to absorb/ reduce the noise i.e. using noise absorbing material for enclosures or using appropriate design technology for fabricating/assembling machines. Proper noise barriers/ shields etc. shall be provided in the equipment whenever it required. Noisy equipment shall be adequately attenuated, by providing soundproof enclosure and insulation.

ALTERNATIVES

Site Alternatives: The site for the power plant was selected after exploring three options. The present site was selected based on various criteria such as proximity to the coal link, water source, no acquisition for forest land, extent of displacement etc.

Technology Alternatives: For the present plant super-critical technology will be used.

MONITORING PLAN

Monitoring System: A structured and certified Environment Monitoring System is suggested at the industry level for ensuring that all activities, products, and services conform to the environmental requirement. The Environment Management Cell will be responsible for managing following activities related to environment function of proposed Power Plant:

- Coordinate and manage the EMP implementation during pre-construction, construction and operation phase
- Appoint dedicated environment staff to manage environmental monitoring responsibilities
- Manage and coordinate environmental monitoring and control
- Coordination with other sections of the plant and government agencies in relation to environmental management activities
- Implement and monitor greenbelt development and plantation activities
- Safety specialist will ensure safe working practices in all the sections of the plant

Cost: The one-time cost for installing pollution control equipments, development of green belt and setting up of laboratory for sample testing will be approximately Rs. 335 crores. Other than

the above the annual recurring cost for monitoring and green belt maintenance will be about Rs. 22.5 lacs excluding salaries and maintenance.

ENVIRONMENT MANAGEMENT PLAN

A separate environment management cell comprising of a team of experienced and qualified personnel reporting to a very senior level executive preferably an environmental engineer is proposed. He will be assisted by well trained staffs comprising of environmental and safety specialists. Staff will be trained for environment control measures like air, water quality monitoring, solid waste management, noise abatement etc. Staff would also be trained to operate ESP and other pollution control equipment at optimum efficiency. For the proposed thermal power plant, the Environmental and Social Management System and its set up, role and responsibilities will be based on the requirement of ISO 14000 certification.

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

Rainwater Harvesting: Rainwater harvesting will be implemented at proposed plant to conserve storm water. Rainwater harvesting typically has two different approaches which are collection and storage of rainwater and channeling surface run-offs to ground water recharging structure.

Ash Disposal: Fly ash will be disposed in form of Slurry form. The fly ash shall be extracted from main fly ash silo through a pneumatic operated valve and a Dozing Screw feeder provided with variable speed drive to control its output. Fly Ash will be utilized for brick making and cement manufacturing purposes. Fly ash will further be used as light weight aggregates and for paving of roads. MBPCL is also negotiating for MoU to use the Fly Ash with cement manufacturing companies. As per the latest ash utilization notification by MoEF, 100% fly ash utilization has to be achieved within 4 years.

Green Belt Development: With a view to attenuate air pollutants, to absorb noise and to care of uptake of water pollutants, it is recommended to develop a greenbelt as per norms all around the boundary and at several locations within the power plant premises. For this project 160 acres of land has been earmarked for green belt development. Trees of local varieties, including fruit-bearing trees will be planted.

MBPCIL will take the responsibility to take up community development work at the village level so as to improve the quality of life. Development of infrastructure, educational and health facilities will be given importance as part of CSR activities.

All compensation for land oustees will be paid as per the provisions of National R&R Policy 2007 and Chhattisgarh State R&R Policy.

RISK ASSESSMENT

Risks likely to pose a risk to man, environment or property associated with various activities are addressed in this report. Such activities include transport, storage; handling and usage of fuels (Coal & LDO/ HFO), chlorine and hydrogen, Precautionary measures to be taken for preventing any hazards due these materials are proposed in the report. However through risk modeling it was found that the impact of any accident related to fuel oil or chlorine will be only within the boundary of the plant. During detailed engineering it will be ensured that the storage tanks are placed in such a way that its impact will not go beyond the plant boundary.

The following precautions will also be taken:

- All equipment vulnerable to explosion or fire would be designed to relevant IS codes and statutory regulations.
- Specific prevention will be taken with respect to hazardous chemicals and regular mock drills should be carried out to enact accident scenarios with reports sent to the top management.
- Suitable fire protection system comprising hydrants and spray systems are provided for fire protection. Fire extinguishers should be tested periodically and to always be kept in operational mode.
- Surrounding population (including all strata of society) should be made aware of safety precautions to be taken incase of any mishap in plant.
- On-site disaster management and off-site emergency plans, commands communication and controls will be established and maintained.
- Adequate provisions like emergency response, response organization, response plan, material safety data sheet, command & control, capabilities, transportation, medical facilities, mitigation measures, training, education, public awareness emergency plan review etc. to control any disaster situation will be made available.

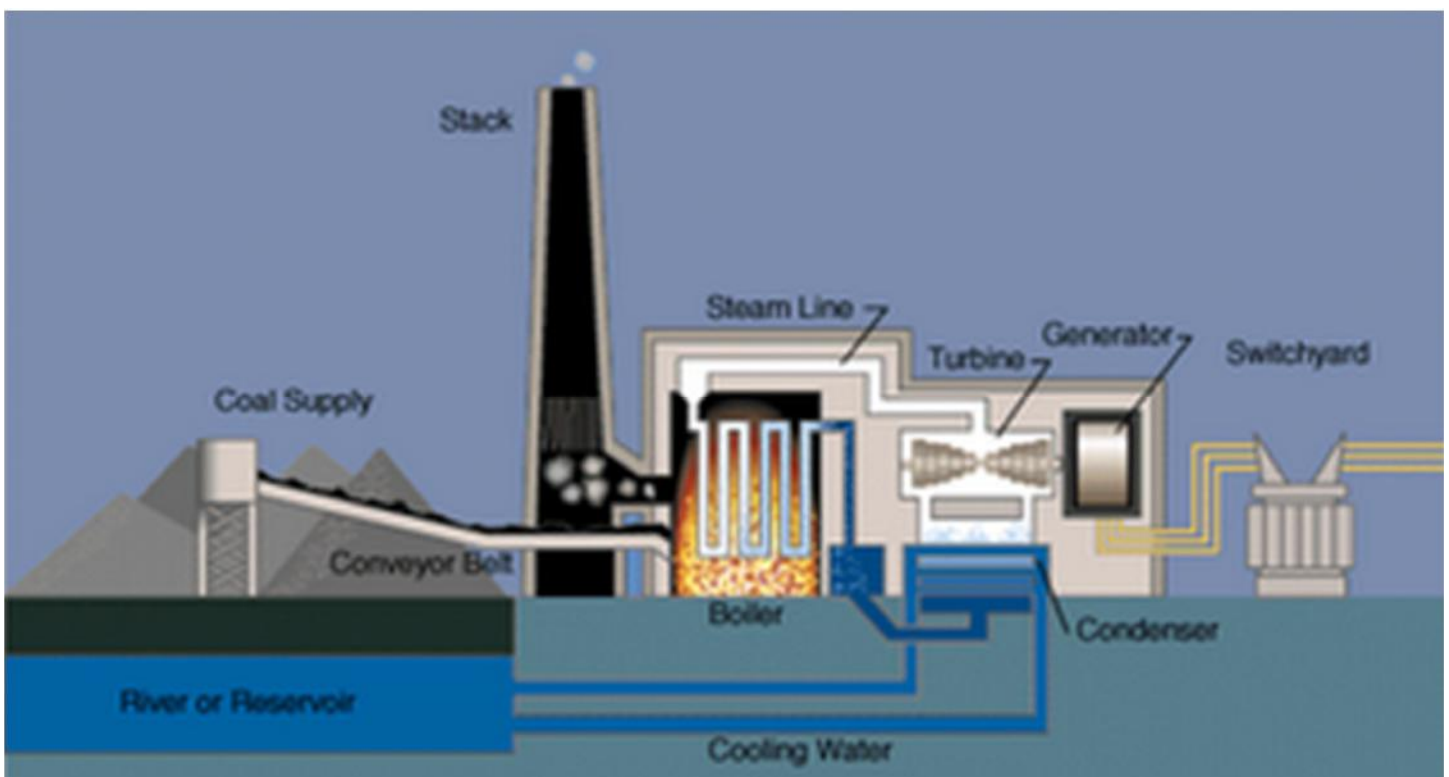
CLEAN DEVELOPMENT MECHANISM

India has high potential for CDM projects, particularly in the Power Sector. The Baseline Carbon Dioxide Emissions from power sector have been worked out by CEA based on detailed authenticated information obtained from all the operating power stations in the country. The Baseline would benefit all prospective CDM project developers to estimate the amount of Certified Emission Reduction (CERs) from any CDM project activity.

The Plant Carbon Intensity for the plant is 0.79 kg/kwh. The expected reduction in CO₂ emission is 104,069 tons/year. The intensity of the plant is less compared to the average of NEW NE grid. Hence, the proposed project will help to reduce the GHG emission, through using fuel efficient super-critical technology. However the PIN document of the project is under preparation and will be processed subsequently.

Chapter 1

Introduction



1. INTRODUCTION

1.1. BACKGROUND OF PROJECT PROPONENT

Moser Baer is a leading global technology company and is the world's second largest manufacturer of Optical Storage Device. Moser Baer has diversified in hydro electric power, thermal power, infrastructure development and other fields. Moser Baer Power & Infrastructures Limited (MBPIL), a 100% subsidiary of Moser Baer Projects Private Limited (MBPPL) is in the process of entering the power sector, both in generation and distribution. The strategy of the company is to execute Greenfield projects in various states through separate Special Purpose Vehicle (SPV). The SPV for Chhattisgarh Projects, MB Power (Chhattisgarh) Ltd. is a subsidiary of MBPIL.

MBPPL has already signed MOUs with Govt. of Madhya Pradesh and Govt. of Chhattisgarh for setting up 2520 MW and 1320 MW Thermal Power Plants respectively in these two states. In addition, MBPIL is also entering into commercial coal mining to supply coal to different end users including its own Thermal Power Plants.

1.2. THE PROJECT

1.2.1 Background of the Project

MB Power (Chhattisgarh) Ltd is proposing to develop a 1320 (2x660) MW coal-based Thermal Power Project near Birra village in Janjgir-Champa district of Chhattisgarh. Coal is expected to be sourced from near-by mining areas of Raigarh / Korba district and transported through Indian Railways network. Water will be drawn from Mahanadi River, from where water is available throughout the year. Water Resources Department, Chhattisgarh has planned to construct barrage on Mahanadi River. Water drawl point for the project will be from the barrage by underground pipelines.

The EIA/EMP study and public hearing at site was completed considering use of domestic coal. The company intends to start the construction work at site as early as possible by obtaining Environmental Clearance. Firm coal linkage is one of the prime considerations of EAC for obtaining desired environmental clearance.

However, there is a delay in grant of long term coal linkage as no meeting of SLC (LT) has happened for the 12th 5-year plan power projects. As an interim measure, company has signed a fuel supply agreement with an Indonesian Company for supply of imported coal for the above project. This will be a stop gap arrangement to implement the project on schedule. MBPCL shall again approach the Ministry of Environment & Forest for necessary amendment in EC, once the long term coal linkage for domestic coal is available.

1.2.2 Project Location

The proposed power plant site is located in villages Birra, Siladehi and Gatwa. The details of location of project site are given in **Table 1.1** and **Figure 1.1**.

Table 1.1: Profile of Project Site

Aspect	Brief Profile
Project Nature and Size	1320 (2x660)MW Coal Based Thermal Power Project
Project Site	Located in village Birra, Siladehi and Gatwa
Coordinates Latitude	21°45'57.77" N

Table 1.1: Profile of Project Site

Aspect		Brief Profile
	Longitude	82°45'50.23" E
Nearest Town		Champa: 32km(North)
Nearest Railway Station		Champa: 32km(North)
Access Road		Access from NH 200 (35km) by Major District Road
Nearest Water-body		Hasdeo River more than 640 m, Mahanadi 3 km

The project site has been selected taking into consideration siting guidelines of Ministry of Environment & Forests, Govt. of India. There is no ecologically sensitive area such as biosphere reserve, national park and wildlife sanctuary within a radius of 15 km from the project site. There are no major settlements within 15 kms of the project site. R&R issues have also been considered during selection of the project site and there is no displacement due to the project. The project site involves no forestland. The proposed project site is more than 500 m away from any riverine floodplains / State or National Highways / Railway lines.

1.3. PROJECT JUSTIFICATION

1.3.1 Power Situation in India

The power situation in India is characterized by demand in excess of supply, high Transmission and Distribution (T&D) losses, low Plant Load Factor (PLF), peak demand and energy shortages, poor financial situation of the State Electricity Boards (SEBs) and severe resource crunch. The power sector reforms in the country and consequent privatization of generation have been sluggish, due to the official complexities involved. The Ministry of Power has been making continuous efforts for promoting reduction of T&D losses and re-structuring of SEBs.

Table 1.2: Projected Region-Wise Energy Requirement & Peak Load

Region	Requirement (GWh)			Peak Load (MW)		
	2011-12	2016-17	2021-22	2011-12	2016-17	2021-22
North	294841.33	411513.16	556767.63	48136.90	66582.93	89912.79
West	294859.69	409805.05	550021.72	47108.38	64348.65	84778.06
South	253442.99	380068.15	511658.91	40367.14	60432.58	80484.97
East	111802.29	168941.67	258215.49	19088.44	28400.91	42711.60
North-East	13328.51	21143.26	36997.02	2536.61	3759.80	6179.95
Islands	401.78	594.76	847.00	88.36	135.55	150.93
Total	968676.6	1392066.05	1914508.23	157325.83	223660.42	304218.30

Source: 17th EPS, CEA (2009)

Wide spread requirement of power generation has created the need for a cheap and readily available commercial fuel for generation of electricity at low cost. Coal as a fuel dominates the power generation in India. Central Electricity Authority (CEA) had initially projected a shortfall of 1,50,000 MW in 15 years and therefore, a capacity addition target of 10,000 MW every year were set. However, the actual capacity addition has been far short of targets. The CEA has recently revised the capacity addition target to 1,00,000MW from the earlier targets. This implies an annual capacity addition of 8,500 MW as against the earlier figure of 10,000 MW. Capacity addition in the last five years including financial year 2009 was on an average 7,000 MW per year. The projected region-wise energy requirement is given in **Table 1.2**.

1.3.2 Installed Capacity in India

The installed capacity of power plant in India as in March 2010 is 1, 59,398.49 MW. Coal is the major source for power generation followed by hydro-power. The break-up of sector-wise and region-wise installed capacity, as on March 2010 are given in **Table 1.3** and **Table 1.4** respectively.

Table 1.3: Sector-wise Installed Capacity (All India)

Sector	Thermal				Nuclear	Hydro	RES	Total
	Coal	Gas	Diesel	Total				
State	44977.00	4046.12	602.61	49625.73	-	27065.00	2701.12	79391.85
Private	8056.38	6307.50	597.14	14961.02	-	1233.00	12819.99	29014.01
Central	31165.00	6702.23	-	37867.23	4560.0	8565.40	0	50992.63
Total	84198.38	17055.85	1199.75	102453.98	4560.0	36863.40	15521.11	159398.49

Source: CEA (March 2010)

(All figures in MW)

Table 1.4: Region-wise Installed Capacity (All India)

Region	Thermal (in MW)				Nuclear (in MW)	Hydro (in MW)	RES (in MW)	Total (in MW)
	Coal	Gas	Diesel	Total				
Northern	21275.00	3563.26	12.99	24851.25	1620.00	13310.75	2407.33	42189.33
Western	28145.50	8143.81	17.48	36306.79	1840.00	7447.50	4630.74	50225.03
Southern	17822.50	4392.78	939.32	23154.60	1100.00	11107.03	7938.87	43300.50
Eastern	16895.38	190.00	17.20	17102.58	-	3882.12	334.76	21319.46
NE	60.00	766.00	142.74	968.74	-	1116.00	204.16	2288.90
Islands	-	-	70.02	70.02	-	-	5.25	75.27
Total	84198.38	17055.85	1199.75	102453.98	4560.00	36863.40	15521.11	159398.49

Note: Captive generating capacity connected to the Grid (MW) = 19509.00

Source: CEA (March 2010)

1.3.3 Power Scenario in Western Region and Chhattisgarh

Chhattisgarh State was carved out of Madhya Pradesh on 1st November, 2000. Since then, there has been a steady increase in demand for electricity. The demand in November 2000 in the state was about 1100 MW which stands today at approximately 2500 MW. Due to policies of the State Government and also the provisions of the Electricity Act 2003, there has been substantial growth in the capacity of power plants in the State. In fact today the power generation in the state is more than the installed capacity of Chhattisgarh State Electricity Board. The per capita consumption of electricity in the state is higher than the national average, at nearly 1100 Kwh per annum and the demand is further growing. Although nearly 97% of villages in the state are officially electrified yet the number of households electrified is only 54%. The installed capacity and actual power position of the region and state is provided in **Table 1.5** and **Table 1.6** respectively.

Table 1.5: Sector-wise Installed Capacity (WR)

Sector	Thermal				Nuclear	Hydro	RES	Total
	Coal	Gas	Diesel	Total				
State	16357.50	1804.72	17.28	18179.50	-	5480.50	354.48	24014.48
Private	4810.00	2805.50	0.20	7615.70	-	447.00	4276.26	12338.96
Central	6978.00	3533.59	-	10511.59	1840.00	1520.00	-	13871.59
Total	28145.50	8143.81	17.48	36306.79	1840.00	7447.50	4630.74	50225.03

Source: CEA (March 2010)

(All figures in MW)

Table 1.6: Sector-wise Installed Capacity OF Power Utilities (Chhattisgarh) including allocated shares in Joint & central Sector Utilities

Sector	Thermal				Nuclear	Hydro	RES	Total
	Coal	Gas	Diesel	Total				
State	2060.00	-	-	2060.00	-	120.00	19.05	2199.05
Private	1600.00	-	-	1600.00	-	-	199.90	1799.90
Central	723.00	-	-	723.00	47.52	-	-	770.52
Total	4383.00	-	-	4383.00	47.52	120.00	218.95	4769.47

Source: CEA (March 2010)

(All figures in MW)

In-spite of addition in generation capacity, there is still a deficit of power in Chhattisgarh and more so in the Western zone (Table 1.7). With the projected energy requirement on the increase (Table 1.2), there is a dire need to develop large power projects, so that the deficit can be reduced. The State has high potential for coal based thermal generation of electricity According to Power Finance Corporation; Chhattisgarh has the potential of producing 35000 MW for 100 years. The State Government is making all the efforts to convert the state as a power hub in the country. Due to presence of coal in the vicinity, Chhattisgarh has become an attractive option for setting up thermal power plants.

Table 1.7: Sector-wise Installed Capacity (Chhattisgarh)

	Requirements (MU)	Availability (MU)	Deficit		Requirements (MW)	Availability (MW)	Deficit	
			MU	%			MW	%
West Region	258528	223127	35401	13.7	39609	32586	7023	17.7
Chhattisgarh	11009	10739	270	2.5	2819	2703	116	4.1

Source: CEA (March 2010)

(All figures in MW)

With the above background of easy availability of coal as raw fuel and the growing gap between demand and supply in the region, MB Power (Chhattisgarh) Ltd. has proposed to set up the 1320 MW coal-based thermal power plant at Janjgir Champa district of Chhattisgarh.

1.4. THE STUDY

1.4.1 Purpose of the Study

According to the EIA Notification of 14th September 2006, the new projects or activities related to construction, expansion or modernization of existing projects or activities listed in the schedule to the notification in any part of India, require prior environmental clearance from the Central Government or as the case may be, by the State Level Environment Impact Assessment Authority, duly constituted by Central Government. The proposed 1320 MW coal based Thermal Power Plant falls under Category 'A' which requires prior Environmental Clearance from MoEF.

In line with the EIA Notification 2006, Terms of Reference (TOR) for the proposed plant was issued by Expert Appraisal Committee for Environmental Appraisal of Thermal Power and Coal Mine projects on December 04, 2009.

The purpose of the report is to integrate different environmental factors into project planning and decision making by studying probable changes in the various socio-economic and bio-physical characteristics, which will result from the proposed project, so as to achieve ecologically sustainable development. The purpose of the study is to identify environmental risks, reduce conflicts by promoting community participation, minimize adverse environmental impacts and keep decision-makers informed, thus laying base for an environmentally sound project, such that the benefits shall be observed at all the stages

of the project starting from conceptualization to planning, design, construction and operation.

The process of EIA has been developed in compliance with the prevalent laws and local practices. inter-linkages and dynamics between various activities, in order to assess direct, indirect and cumulative impacts of the proposed plant on physical and social environment and for evaluating the nature of impacts and provide suitable mitigation measures.

1.4.2 Scope of the Study

MB Power (Chhattisgarh) Ltd. has retained the services of GIS Enabled Environment & Neo-graphics Centre, Ghaziabad, to carry out EIA / EMP study and assist in regulatory clearance from Chhattisgarh Environment Conservation Board (CECB) and MoEF.

The baseline monitoring study for the project has been carried out during post monsoon season of 2009 (October to December) for various environmental components so as to assess the anticipated impacts of the proposed project on the environment and suggest suitable mitigation measures for likely adverse impacts due to the proposed project (Refer to **Table 1.8**).

The scope of the study is as per the TOR issued by the Ministry of Environment and Forest, Govt. of India (**Annexure I**). This EIA report addresses the environmental impacts of the proposed project in addition to the findings of the Risk Assessment study and the On-site Disaster Management Plan. The statement for TOR compliance is given in **Annexure II**.

Table 1.8: Environmental Attributes and Frequency of Monitoring

Sl. No.	Attributes	Parameters	Source and Frequency
1.	Ambient Air Quality	RSPM (PM ₁₀ , PM _{2.5}), SO ₂ , NO _x , Ozone.	24 hourly samples twice a week for three months at ten locations.
2.	Meteorology	Wind speed and direction, temperature, relative humidity and rainfall	Near project site continuous for three months with hourly recording and from secondary sources of IMD station at Champa.
3.	Water quality	Physical, Chemical and Bacteriological parameters	Grab samples were collected at 6 ground water and 4 surface water locations once during study period.
4.	Ecology	Existing terrestrial and aquatic flora and fauna within 10-Km radius circle.	Secondary data was collected from the Forest department.
5.	Noise levels	Noise levels in dB(A)	At 5 locations data monitored once for 24 hours during EIA study.
6.	Soil Characteristics	Physical and Chemical parameters	Once at 6 locations during study period
7.	Land use	Trend of land use change for different categories	Based on Survey of India Toposheet and Satellite imagery
8.	Socio-Economic aspects	Socio-economic and demographic characteristics, worker characteristics	Based on secondary sources data like primary census abstracts of Census of India 2001.
9.	R&R Study	Household	Separate R & R study conducted through household survey
10.	Hydrology	Drainage area and pattern, nature of streams, aquifer characteristics, recharge	Based on data collected from secondary sources as well as hydrology, hydro-geology study report

Table 1.8: Environmental Attributes and Frequency of Monitoring

Sl. No.	Attributes	Parameters	Source and Frequency
		and discharge areas	prepared separately
11.	Risk assessment and Disaster Management Plan	Identify areas where disaster can occur by fires and explosions and release of toxic substances	Based on the findings of Risk Modeling done for the Risk Associated with LDO / HFO Fire and Chlorine Leakage

Source: GreenC (October – December 2009)

1.5. BRIEF LEGAL FRAMEWORK FOR EIA STUDY

1.5.1 Procedure for Environmental Clearance

Environmental clearance of any new project or expansion of existing projects is now done as per the new notification of the Ministry of Environment and Forest (MoEF), Govt. of India dated 14th September 2006. The new notification requires prior environmental clearance of all projects from competent central govt. or state govt. authorities, as may be the case. The projects are now classified into Category A or Category B projects based on spatial extent of potential impacts on human health, natural and man-made resources. The Category 'A' projects require prior clearance by the MoEF, Govt. of India while the Category 'B' projects have to get clearance from the State level Environment Impact Assessment Authority, constituted by the Central Government for this purpose. The environment clearance procedure for new projects will require maximum of four stages all of which may not be applicable to all the projects.

Stage 1 - Screening: It refers to the definite assignment of environmental category to projects or activities where the same is not completely specified. The projects are categorized as 'A', 'B1' and 'B2'. Category 'A' projects are scrutinized and cleared through the EAC at MoEF, Govt. of India. In case of Category 'B' projects scrutiny of application at State level to categorize project in 'B1' or 'B2' is done. The 'B2' projects do not require preparation of EIA Reports. The proposed power project comes under Category 'A' project.

Stage 2 - Scoping: It refers to the process where EAC or SEAC determines detailed and comprehensive TOR for the EIA report and can also include site visits by the committee if required. But this process excludes the construction projects such as township/ commercial complex / housing complex, etc.

Stage 3 - Public Consultation: It refers to the process by which concern of local people and other stakeholders are ascertained and their views taken regarding the project. The Public Consultation takes part in two steps: Public hearing and written responses. The public hearing of the present project will take place as per the stipulations of Chhattisgarh Environment Conservation Board.

Stage 4 - Appraisal: This refers to detailed scrutiny of the application and EIA report to make categorical recommendations to the regulatory authority.

1.5.2 Environment Legislations

The environmental regulations, legislations and policy guidelines and control that may impact the project are the responsibility of a variety of Government agencies. The principal environmental regulatory agency in India is the Ministry of Environment and Forest (MoEF), Delhi. MoEF formulates environmental policies and also accords environmental clearance for different projects.

Many State and Central legislations have a bearing on environment but laws on environment protection have been notified recently. These legal enactments can be

broadly classified in the terms of focus areas, viz. pollution, natural resources and linkages between pollution and natural resources. The important environmental legislations related to environmental clearance for new projects are briefly described in the **Table 1.9**.

Table 1.9: Key Environmental Legislation

Name	Scope and Objectives	Key Areas	Operational Agencies
Water (Prevention and Control of Pollution) Act 1974	To provide for prevention & control of water pollution and enhancing water quality	Control of sewage and industrial effluent discharges	Central and State Pollution Control Boards
Air (Prevention and Control of Pollution) Act 1981	To provide for prevention and control of air pollution	Controls emission and air pollutants	Central and State Pollution Control Boards
Forest Conservation Act 1980	To halt rapid deforestation and resulting environmental degradation	Restriction on de-reservation & using forest for non-forest purpose	Central Government
Environment Protection Act 1986; Environment Protection Rule 1989.	To provide for protection and improvement of environment	An umbrella Legislation; supplements pollution laws	Central Govt. MoEF, can delegate power to Deptt. of Environment
Noise Pollution (Prevention & Control) Rules 2000	To control and take measures for abatement of noise and ensure that level does not cross standard	Noise in urban area and around industrial sites	Central Government, nodal agencies MoEF, State governments
Wildlife Protection Act 1972	To provide for protection of wild animals, birds and plants; and for matters connected therewith	Wildlife protection in forest areas	Central Govt.
Hazardous Waste Management and Handling Rules 2008	To impose restrictions and prescribe procedures for management, handling and disposal of hazardous waste	Any facility producing hazardous waste	Central and State Pollution Control Boards
Public Liability Insurance Act, 1991	To provide for public liability - insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto	To provide public liability insurance during risk material handling	Central Government, Nodal Agencies MoEF, State Govt.

1.5.3 Pollution Standards

The MoEF is the nodal agency to set up policy and standards for the protection of environment, along with Central Pollution Control Board (CPCB). This includes air, noise, water and hazardous waste standards. The relevant standards for Coal-based Thermal Power Plants, which are of significance to the proposed project, are given in **Annexure III**.

1.6. REPORT LAYOUT

The overall contents of the EIA report has been prepared as per the generic structure prescribed in the Gazette Notification on “Environmental Clearance” issued by Ministry of Environment & Forests, Govt. of India vide no. SO 1533 dated 14th September 2006.

This report has been updated after incorporating the observations/ suggestions of Expert Appraisal Committee members during the appraisal held in the 50th meeting of the reconstituted Expert Appraisal Committee (Thermal) during June 2012 for Birra Thermal Power Plant: 2 X 660 MW Coal based Thermal Power Plant in District Janjgir Champa, Chhattisgarh by M B Power Chhattisgarh Limited. **(Annexure VI)**

The report consists of twelve chapters and the content is briefly described in this section.

Chapter 1- Introduction: This chapter gives the basic information about the project and project area. It also discusses the justification of the project and the purpose of the EIA study including the scope of the study.

Chapter 2- Description of the Project: This chapter provides information related to various feature of the proposed power plant incorporating power generation process, fuel type and quantity, utilities, land, water and power requirements and other proposed infrastructure facilities.

Chapter 3- Baseline Environmental Status: The methodology for assessing various baseline environmental components in the study area prior to the commencement of the project has been identified in this chapter. The various parameters of present environment status are identified under different aspects, which include location and regional setting of the area, topographical aspect which include land use, land cover and soil quality of the study area. Drainage aspect consists of surface and ground water quality. Meteorological aspect contains all the climatic factors and ambient air quality of the study area. Ecological environment describes the flora and fauna of the region. Human aspect includes the demographical features, socio-economic environment and infrastructure facilities of the study area.

Chapter 4- Environment Impacts Assessment: This chapter provides the details of the Environmental Impact Assessment of the project during construction and operation stages. It ascertains the impacts of the proposed project on the various components of environment. The mathematical modeling exercises pertaining to ground level concentrations of air pollutants have been presented in this chapter with suitable mitigation measures.

Chapter 5- Alternatives: This chapter describes systematic comparisons of feasible alternatives for the proposed project site, technology, and operational alternatives. Alternatives have been compared in terms of their potential environmental impacts, capital and recurrent costs, suitability under local conditions, and institutional training and monitoring requirements.

Chapter 6- Environment Monitoring Plan: This chapter emphasizes the formation of an Environment Management Cell with trained staff under Senior Environment Engineer equipped with all monitoring facilities for monitoring of all environmental Parameters during construction as well as Post project monitoring. Organization structure for environmental management and frequency of monitoring has also been provided.

Chapter 7- Additional Studies: A summary of the additional studies / activities conducted as per the requirements of the TOR is given in this chapter. For the particular project Socio-economic and R&R Study, and Area Drainage Study were conducted. A brief description of the Public Consultation is also given in this chapter.

Chapter 8- Project Benefits: The benefits that will be accrued from the project in the locality in particular and society in general as well as development will be identified and described in this chapter.

Chapter 9- Environmental Management Plan: This chapter deals with the management plan incorporating recommendations to mitigate the adverse impact likely to occur on environmental parameters during construction and operation phase of the proposed power plant. Post project monitoring and organization structure for environment management have been provided in the chapter.

Chapter 10- Risk Assessment and Disaster Management Plan: This chapter provides information regarding the activities associated with the project likely to pose a risk to man, environment or property. Such activities include displacement, transport of raw materials, storage, handling and usage of fuels (Coal, HFO and LDO), hazardous chemicals, acids and alkali. It also provides details regarding precautionary measure to be taken. On-site disaster management describing the on-site and off-site emergencies commands and controls have also described in this chapter.

Chapter 11- Clean Development Management: This chapter deals with the concept of CDM and describes the methodology for calculating carbon intensity and carbon reduction. CO₂ emission of the proposed power plant has been also calculated in this chapter.

Chapter 12- Disclosure of the Consultant: The detailed profile of the consultants along with their capabilities, professional expertise and work experiences are highlighted in this chapter.

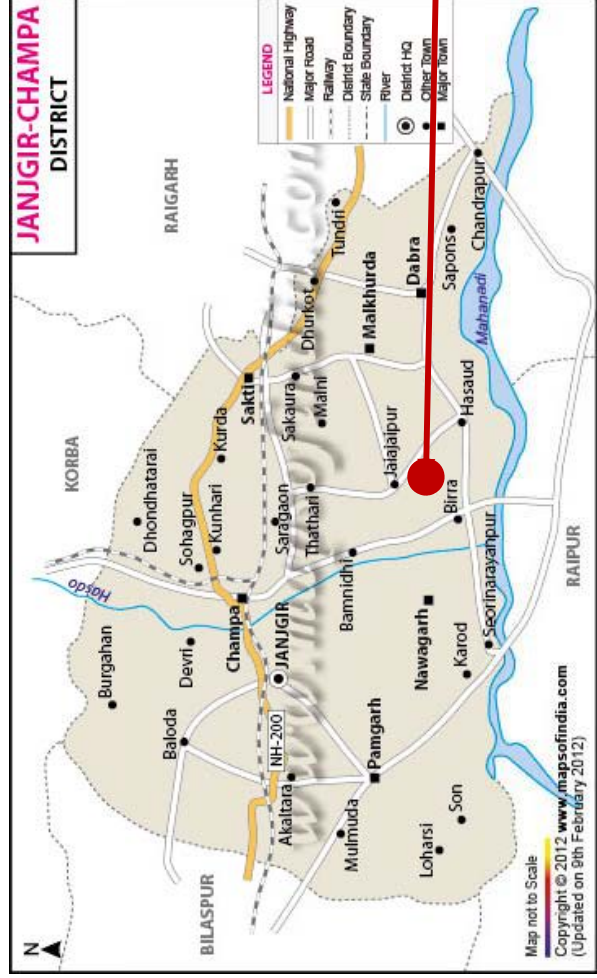
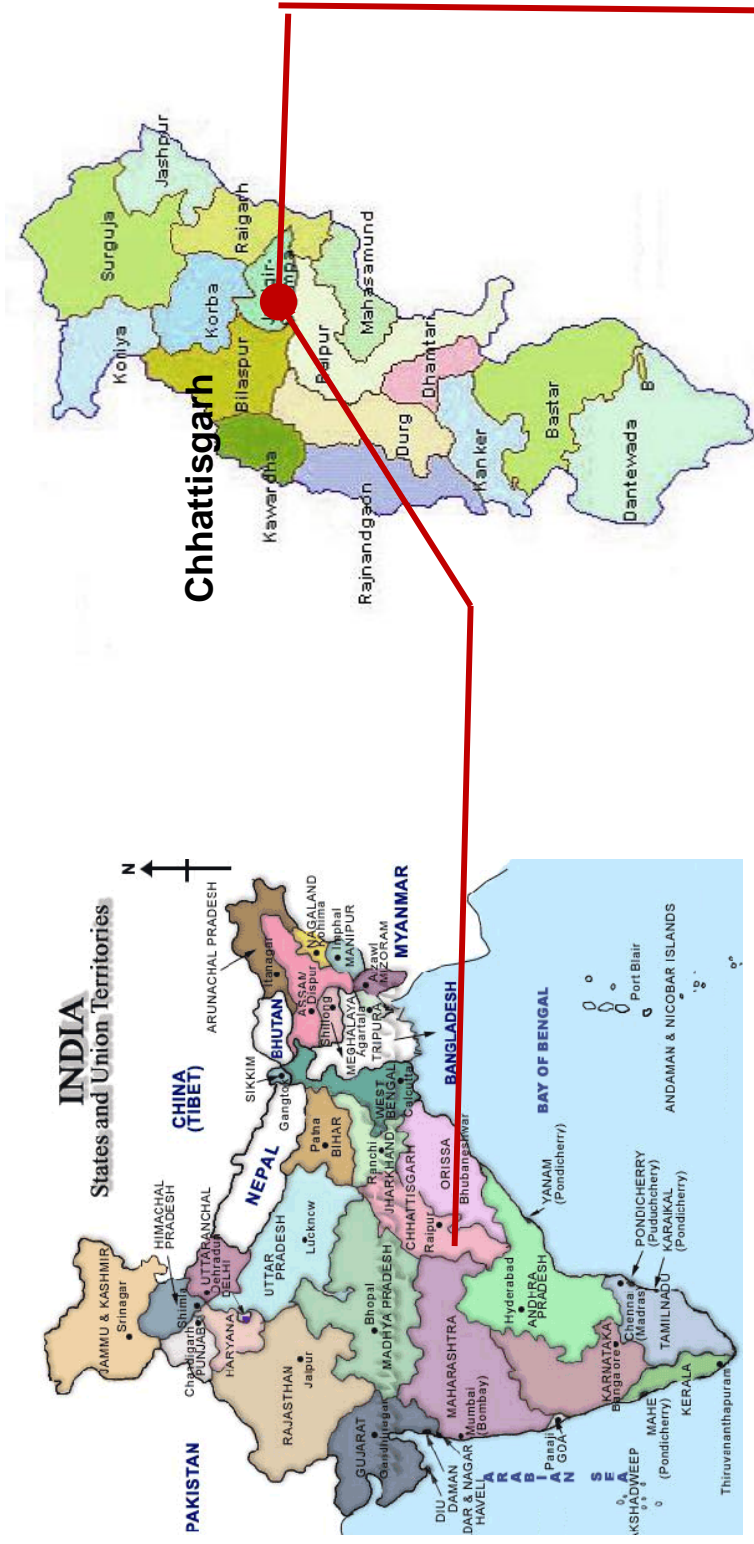
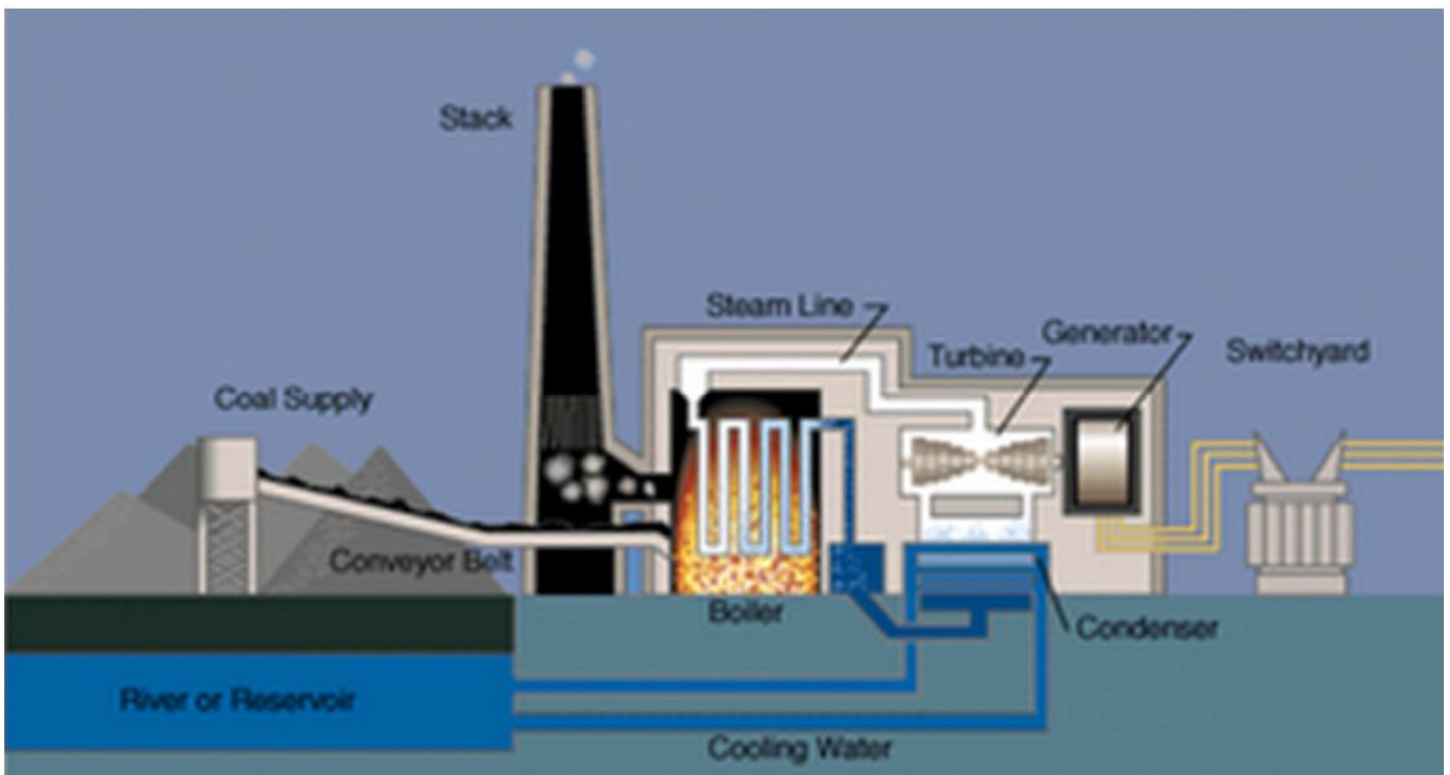


Fig 1.1- Location Map

Chapter 2

Project Description



2. PROJECT DESCRIPTION

2.1 FEATURES OF THE PROJECT

Moser Baer Power and Infrastructures Ltd., through its SPV, MB Power (Chhattisgarh) Ltd. propose to set up a 1320 MW (2 x 660) coal-based Thermal Power Project near Birra village in Janjgir-Champa district of Chhattisgarh. The brief outline of the features of the plant and allied information are given in **Table 2.1**.

Table 2.1: Project Features

Item	Main Design Parameters
Net capacity	1320 MW
No. of Units and configuration	2 x 660 MW
Technology	Super critical
Steam Generator	Pressure at Super-heater outlet: 251 kg /cm ² Temperature at Super-heater outlet 571°C
Turbo Generator	Turbine – Pressure: 247kg/cm ² (a), Temperature: 566°C/ 600°C or above for MS/ Reheat respectively,3000rpm Generator - 660 MW (Each unit) Generator Transformer -777 MVA (3 Phase Bank)
Fuels	
Main Fuel: Coal	Requirement – 6.40 MTPA at 90% PLF Source- SECL Mines/CIL Grade - "E/F" Grade, Avg. GCV- 3500 K Cal/Kg
Stacks	
No. of Stack and flues	Single stack bi-flue
Stack Height (meter)	275
Additional equipment (attachment)	Electrostatic Precipitator
Manpower Utilization	500 Persons during Operation Phase
Water	
Annual requirement	36 MCM
Cooling System	Induced draft cooling system proposed
Total Discharge	Zero Discharge guidelines will be followed

Source: Detailed Project Report

2.2 LOCATION OF THE PROJECT

The main plant site is located at villages Birra, Siladehi and Gatwa. The site is approachable from NH-200 located at a distance of 35 kms. Champa Railway Station is also located 32 km away from the site. The salient features of the project site are given in **Table 2.2**.

Table 2.2: Salient Features of the Project Site

Features	
State	Chhattisgarh
District	Janjgir-Champa
Tehsil	Champa
Impact Villages	Birra, Siladehi and Gatwa
Present land use	Mostly single crop agricultural land or barren land

Table 2.2: Salient Features of the Project Site

Project Coordinates	
Project Site Co-ordinates	Within the latitudinal extent from 21°45'13" to 21°46'14" North and longitudinal extent of 82°44'24" to 82°45'56" East (Detailed coordinates given in Chapter 3)
Land Type as per Revenue Records	The land has private and government revenue lands and does not have any forestland within plant area.
Geological & Meteorological Features	
Average Altitude	226 m
Seismicity	Zone II
Mean Annual Maximum Temperature: °C	30.8
Mean Annual Minimum Temperature: °C	24.3
Mean Wind Speed: m/s	1.6
Average Relative Humidity, %	56.5
Annual Rainfall (Avg.): mm	1354.1
Predominant Wind Direction	N, W
Present land use of project site	Mostly single crop agriculture land or barren land
Nearby Locations	
Nearest Railway Station	Champa 32 kms
Nearest major Water body	Hasdeo River more than 600m, Mahanadi River, 3 kms away from the plant
Nearest Major Road	NH-200 at a distance of 35km
Nearest Town	Champa, 32 km from the site
Ecologically sensitive zones like wildlife sanctuaries, National Parks and biospheres	No sensitive zone within 15 km radius
Archaeological Monuments	No Archeological monuments within 15 km radius
Socio-economic Factors	Land oustees will be present in three villages, viz. Birra, Siladehi and Gatwa, while no homestead displacement is involved.

Source: GreenC 2010

2.3 BASIC RESOURCES AND REQUIREMENTS

2.3.1 Land

Land requirement for the Birra Thermal Power Plant is as per CEA September 2010 Guidelines for Thermal Power Projects. Around 1300 acres of land will be required both outside and inside the plant boundary.

The land requirement of the proposed 2x660 MW Thermal Power Plant is around 925 acres (private land: 882 acres and government land: 43 acres). There is no Forest Land involved in the Main Plant area. Certificate of Non forest Land in Plant area. (Annexure XII).

Table 2.3: Area Break-up Details

Particulars	Area in Acres
Main Plant Facility and BoP	180
Coal Handling Plant	240
Land for Ash Pond	190
Green Belt	160
Raw water reservoir	70
Colony	40
Miscellaneous	45
Total Area	925

* Excluding MGR and water pipeline corridor

While planning, utmost care has been taken to acquire optimum land for the project. The plant will be located in such a manner so as to minimize disturbance of the villagers. No homestead displacement is expected. The land requirement break-up for the project is given in **Table 2.3**.

Three villages, namely Birra, Siladehi and Gatwa will be affected by the project. The land acquisition process is in progress in all the three villages affected by the project. The Rehabilitation and Resettlement of these PAHs is being done as per the National R&R Policy, 2007 and Chhattisgarh State R&R Policy.

Around 45 acres will be required for intake well and approach roads. Additionally the company will be constructing a private railway siding for about 40 kms which will require around 325 acres which comprises of 320 acres of government and Private Land. It also includes about 5.35 acres of revenue forest land for which Forest Diversion is under process for linear acquisition. The dedicated railway line will cross around 25 villages.

2.3.2 Source of Water and Availability

The source of water for the plant is Mahanadi River, which is a perennial river. Water Resource Department, Chhattisgarh has planned to construct a barrage on Mahanadi River. Water drawl point for the project will be from the barrage. The estimated requirement of make-up water for the 1320 MW capacity power project would be about 36 MCM (4110 m³/hr or 40 cusec) with recovery. Chhattisgarh Water Resource Department has allotted 36 MCM of water annually from Mahanadi River (**Annexure VIII**).

In March 2013, WRD Chhattisgarh has confirmed that the water for the proposed project will be stored in Basantpur Barrage being built on River Mahanadi. The barrage is around 5 kms from the project boundary.

The requirement of construction water for the project would be met from Hasdeo River. The construction water requirement will be about 1.75 cusecs.

2.3.3 Fuel Requirement, Availability and Transportation

2.3.3.1 Coal (Domestic)

Coal requirement for a 1320 MW plant, is estimated at 6.40MTPA considering average GCV of 3500 kcal/kg at 90% PLF. SECL Coalfield has been considered as source of coal. Coal is proposed to be transported through Indian Railways network from SECL source to Champa Railway Station (RS) and then to site through dedicated railway siding (to be constructed). The likely source of coal is SECL Coal field about 100 km away (Application is already given to SLC, Ministry of Coal). Station Heat Rate has been considered as 2152 Kcal/kwh. The coal quality considered for the plant is given in **Table 2.4**. Whereas, the concentrations of heavy metal present in coal are given in **Table 2.5**.

Table 2.4: Coal Quality from SECL Coal Mines

Proximate Analysis (as Received)		
Parameter	Unit	Value
Total Moisture	%	15
Ash	%	42
VM	%	21
Fixed Carbon	%	22
Ultimate Analysis (Equilibrated Basis)		
Carbon	%	35.48
Hydrogen	%	2.62
Nitrogen	%	0.65
Oxygen	%	3.88
Sulphur	%	0.37
HGI		55.00
GCV	Kcal/Kg	3500
AFT	°C	> 1400

Table 2.5: Heavy Metal Analysis of Coal

S. No.	Metals	Unit	Results
1.	Lead (Pb)	ppm	1.74
2.	Arsenic (As)	ppm	<0.01
3.	Cadmium (Cd)	ppm	<0.01
4.	Chromium (Cr)	ppm	6.67
5.	Mercury (Hg)	ppm	<0.01

2.3.3.2 Coal (Imported)

However, there is a delay in grant of long term coal linkage as no meeting of SLC (LT) has taken place for the 12th 5-year plan power projects. As an interim measure, MBPCL have signed a fuel supply agreement (**Annexure IX**) with an Indonesia firm Pt. Mitra Setia Tanah Bumbu for supply of imported coal for the above project. The imported coal will be transported from Dhamra Port in Odisha. This will be a stop gap arrangement to implement the project on schedule. MBPCL shall again approach the Ministry of Environment & Forest for necessary amendment in EC conditions, once the long-term coal linkage for domestic coal is available.

The imported coal requirement for the proposed 2x660 MW Thermal Power Plant with an typical GCV of 3800 kcal/kg and station heat rate 2152 kcal/kwh at a plant load factor (PLF) of 90% is estimated to approximately 5.9 MTPA. The imported coal requirement is on lower side compare to the domestic coal requirement, which was estimated at 6.4 MTPA on an average GCV of 3500 kcal/kg. The expected analysis of imported coal is indicated in the **Table 2.6** below.

Table 2.6: Coal Analysis of Imported Coal

Parameter	Unit	Range	Typical	Rejection
Moisture	%	22 – 35%	28.5	Above 40%
Ash	%	15 – 25%	20.0	Above 30%
Volatile Matter	%	25 – 40%	32.5	Above 45%
Total Sulphur	%	0.1 – 0.4%	0.4	Above 0.5%
Gross Calorific Value (kcal/kg)	kcal/kg	3500 - 4000	3800	Below 3200

2.3.3.3 Support Fuel

Light Diesel Oil (LDO) will be used only for cold start-up and heavy furnace oil (HFO) will be used as support fuel at low loads and for flame stabilization. The requirement of furnace oil for 2 x 660 MW Power Plant has been estimated as 9829 KL per annum. These fuels will be transported by either rail tankers or by road tanker. Seven days of oil storage is being considered. The specification of LDO will be as per IS-1460 and HFO is as per specification of IS-1593.

Table 2.7: Analysis of HFO and LDO

No.	Particulars	Units	(HFO)	(LDO)
1	Flash Point	°C minimum	66	66
2	Viscosity	Centistoke at 50 °C	370	2.5-15.7
3	Ash Content	% maximum	0.1	0.02
4	Water Content by volume	% maximum	1	0.25
5	Sediments by weight	% maximum	0.25	0.1
6	Total Sulphur by weight	% maximum	4.5	1.8
7	Acidity in Organic	-	Nil	Nil

8	Density	Kg/m ³ at 15°C, max.	890-950	850-870
9	Pour Point	°C minimum	20	21
10	Relevant Indian Standard		IS 1593	IS 1460
11	Gross Calorific value	J/g	41868	41868

2.3.4 Power Evacuation

It is proposed to adopt the evacuation voltage as 400 kV. Power Generated from each 660 MW units would be stepped up to the evacuation voltage level through suitably rated Generator Transformer and will be evacuated through 400 kV transmission lines.

2.4 TECHNOLOGY AND PROCESS DESCRIPTION

2.4.1 Technology

The proposed plant will be using super-critical technology. The thermal efficiency of the power plant can be improved by using the steam at super critical condition. The improvement in overall efficiency of the plant compared to sub critical parameters will be at least 2%. The "efficiency" of the thermodynamic process of a coal-fired power describes how much of the energy that is fed into the cycle is converted into electrical energy. The greater the output of electrical energy for a given amount of energy input, the higher the efficiency. A thermal power plant based on supercritical technology is more efficient than a subcritical plant, producing more power from less coal and with lower emissions.

The critical condition of water: Critical pressure = 221bar

Critical temperature = 374° C

At most elevated condition the steam is supercritical. Thus, if water is at a supercritical pressure and is heated the temperature will increase continuously. At a particular value the water will flash instantaneously into steam and super heating will commence. There is no change of specific volume from the liquid to the dry steam state.

Benefits of Supercritical Thermal Cycle Technology: The benefit of Super-critical Technology is listed as below:

- Reduced fuel consumption due to improved plant efficiency.
- Significant reduction in CO₂ emissions.
- Excellent availability, comparable with that of an existing sub-critical plant.
- Low Coal consumption results to low NO_x, SO₂ and particulate emissions compare to subcritical plant
- Overall reduction in Auxiliary Power Consumption
- Reduction in requirement of ash dyke land and consumptive water.
- Sliding pressure operation due to once through system.
- Uniform distribution of heat due to spiral wall arrangement leading to less boiler tube failure, thereby improving system continuity and availability of the station.
- Less start up time of the boiler
- Can be fully integrated with appropriate CO₂ capture technology.

In summary, highly efficient plant with best available pollution control technology will reduce existing pollution levels by burning less coal per megawatt-hour produced.

2.4.2 Process Description

In a thermal power plant, the chemical energy of the fuel (coal) is first converted into thermal energy (during combustion), which is then converted into mechanical energy

(through a turbine) and finally into electrical energy (through a generator). It has the following steps.

- The coal is transferred from the coal handling plant by conveyor belt to the coal bunkers, from where it is fed to the pulverizing mills, which grind it to fine powder. The finely powdered coal, mixed with air is then blown into the boiler by a fan where it burns.
- The process of combustion releases thermal energy from coal. The boiler walls are lined with boiler tubes containing high quality demineralized water (known as boiler feed water). The combustion heat is absorbed by the boiler tubes and the heat converts the boiler feed water into steam at high pressure and temperature. The steam, discharged through nozzles on the turbine blades, makes the turbine to rotate, which in turn rotates the generator coupled to the end of the turbine. Rotation of generator produces electricity, which is passed to the step-up transformer to increase its voltage so that it can be transmitted efficiently. The power is evacuated via switchyard through a Transmission System.
- During combustion, the non-combustible part of coal is converted into ash. A small part of ash (about 20%) binds together to form lumps, which fall into the ash pits at the bottom of the furnace. This part of ash, known as bottom ash is water quenched ground and then conveyed to pits for subsequent disposal to ash disposal area or sale.
- Major part of the ash (about 80%) is in fine powder form, known as Fly Ash, and is carried out of the boiler along with the flue gas. The flue gas, after heat recovery, is passed through the electrostatic precipitators, where the ash is trapped by electrodes charged with high voltage electricity.
- The flue gases exiting from the Electrostatic Precipitators (ESPs) are discharged through a tall chimney for wider dispersal of remaining ash particles and gases. The ash collected in the ESP hoppers is extracted in dry form and conveyed to dry ash storage silos from where it is supplied to user industries. Unused part of fly ash shall be taken to ash ponds for disposal.
- The steam, after passing through the turbines, is condensed back into water in condensers and the same is re-used as a boiler feed water for making steam. The reasons for condensing and reusing the steam are following: -
 - The cost of boiler feed water is very high as it is very pure demineralised water hence reuse is economical.
 - The use of condenser lowers the temperature at the exit end and hence increases the efficiency of the turbine.
- ❖ The condenser contains tubes through which cold water is constantly pumped. The steam passing around the tubes of condenser loses heat and condenses as water. During this process, the steam gets cooled while cooling water gets heated up (by about 10°C). This hot water is cooled in a cooling tower and recycled for cooling. However, in order to control dissolved solids, a certain amount of blow-down is required from the cooling towers, which is used in the plant for other usages such as service water, coal dust suppression etc.

2.5 PLANT LAYOUT

The Plot Plan for the project has been developed considering the following aspects:

- a) Area of the land, its shape and size
- b) Predominant wind direction
- c) Rail and road approach
- d) Surrounding features like transmission line, villages

- e) Location and direction of water intake point
- f) Location of water reservoir, ash disposal area
- g) The switchyard orientation has been planned taking into consideration the requirement of power evacuation.

The predominant wind directions are from north and west. The expansion of main power house has been contemplated from south to north. Service building has been located towards south of main power house. Permanent facilities like workshop, O&M stores etc. located towards north of the main plant. The ash slurry / ash water pump house is kept towards south of chimney. The intake / discharge ducts have been routed in the corridor between transformer yard and switchyard and location of CWPH is chosen, so as to minimize the length of CW ducts. Space provision for FGD has been kept towards west of main plant behind chimney.

The induced draft cooling towers have been located south west of main plant sufficiently away from main plant and switchyard. The water treatment plant and the DM water facilities are located close to main plant and towards west of main plant.

The coal handling plant and the coal stockyard are located towards south west of the main plant. Presently, track hopper has been considered for coal unloading from BOBR wagon. However, in case BOBR wagons are not available wagon tippers can be installed in lieu of track hopper.

Construction office and stores have been provided in the area available towards west of CHP. Pre assembly and lay down area has been provided in west of WTP area. Peripheral green belt has been provided all-round except in front of switch yard.

The plant layout is depicted in **Figure 2.1**.

2.6 PLANT WATER SYSTEM

As discussed earlier, water requirement for the station is proposed to be drawn from Mahanadi flowing at a distance of 3 km from the plant site. The station would deploy re-circulating cooling water system using cooling towers. The power plant envisages as closed cycle type of cooling water system utilizing four Induced Draft Cooling Towers. The water requirement for the project will be limited to 4110 m³/hr and Water Balance Diagram is shown in **Figure 2.2**.

As per the available data of water quality, a cycle of concentration of 5.0 will be considered for the CW circuit. Appropriate acidulation and chemical dosing shall be adopted for this purpose. Utmost care has been taken to maximize the recycle / reuse of effluents and minimize effluent quantity as well as the water consumption. In view of the Corporate Responsibility for Environment Protection, plant will follow the 'Zero Discharge Norms' i.e. no effluent will be discharged outside the plant boundary.

The oily wastes from fuel oil handling area and main plant area shall be treated using oil water separator and the treated water shall be led to the tube settler provided for service water waste for further treatment and reuse in service water system.

Water mainly be used for condenser cooling, cooling of SG & TG auxiliaries and various other requirements like SG makeup, fire protection system, air-conditioning and ventilation system and plant potable and service water etc.

2.6.1 Make-up Water System

The make-up water for the plant will be provided through raw water reservoir constructed at plant site. From the pump house located at the Mahanadi River, raw make-up water will be

made available to the reservoir. The reservoir shall be sized to store 29,59,200 m³ i.e. about 30 days requirement of the make-up water of the plant. For pumping of raw water from reservoir two pumps of capacity with margin 2600 m³/hr each have been proposed.

2.6.2 Water Pre-treatment System

Since the turbidity of the river water is high especially during monsoon and the quality of influent water required by various systems in the plant is clarified water with turbidity less than 50 ppm, it is proposed to provide two clarifluculator type clarifiers of capacity (2x60%) 2500 m³/hr each considering total clarified water required as 3480 m³/hr for CW system, and DM water plant taken directly from the reservoir. The raw water from the reservoir will be pumped to the clarifiers. The clarified water from the clarifiers will be stored in a clarified water storage tank of capacity 12000 m³. The clarified water storage tank will be in two compartments feeding to a common sump to facilitate cleaning and maintenance. Clarified water from clarified water storage tank will be pumped to the cold water channel of CW system. Two (1W+1S) pumps for each units of capacity 2800 m³/hr each will be provided for this purpose. The clarified water shall be the source of water for:-

- a) Service water system
- b) CW system
- c) Cooling tower make up

Service Water System: An overhead service water storage tank will be located near the clarified water pump house and will be fed by 2 (1W+1S) service water pump of capacity 250m³/hr each with clarified water from the clarifier water storage tank. The service water required for air conditioning, ventilation system makeup and all other area of plant will be taken from this over head service tank by gravity. Potable water from filtered water reservoir will be pumped to potable water overhead storage tanks one inside plant and another inside colony. Two sets of (1W+1S) pumps of capacity 25 m³/hr & 60 m³/hr will be provided to meet the potable water requirement of plant & colony.

Circulating Water System: Clarified water will be supplied as make-up water for closed cycle type CW system. Clarified water shall be supplied from clarified water storage tank to the cold water channel of CW system. Water from cold water channel will enter into the CW pump house through bar screens / trash racks at low velocity to filter out debris. Isolating gates shall be provided after the screens to facilitate maintenance. The total water requirement for the condenser and auxiliary cooling is estimated to be approximately 80,000 m³/hr per unit, considering temperature rise of circulating water, across the condenser of about 10°C.

The Cooling water from the common (for both the 660 MW units) fore-bay channel will be pumped to the condensers located in the station building by 5 (4W +1S) CW pumps of capacity 42000 m³/hr each through MS pipe. The hot water from the condensers is proposed to be conveyed back to the cooling tower through MS pipe under pressure.

The cooling water requirements for the Auxiliaries of Steam generator and Turbine generators each unit would be tapped from the CW pipe at the upstream of condenser and the return water from the circuit would be led to the CW discharge pipe after condenser. Re-cooled water after cooling tower will be led to the CW pump house through the cold water channel by gravity. CW System blow-down would be drawn from Condenser return header. Suitable chemical treatment of CW water needs to be done for inhibiting growth of algae etc.

2.6.3 Condenser Cooling Water System

The proposed CW pump house shall have five CW pumps (4 working and 1 standby). The water is pumped from the pump house to the condenser through approximately 2200mm

steel lined concrete encased pipe for each unit. Hot water from condenser shall also be conveyed through a similar pipe of same size to induced draught cooling towers. The cooling towers (2) shall be of induced draught type which includes cooling water basin made up of RCC with suitable foundation system.

2.6.4 Potable, Service & Other Water Systems

The service water system shall cover clarified water requirements of HVAC, Seal water for AHP (Ash Handling Plant) and Plant service water etc. 3X100% capacity service water pumps (2 for Unit I and 1 for Unit II) will be used to pump water from the clarified water storage tank to service water overhead tank. Service water Pumps and Fire water Pumps will be located in a common pump house near clarified water storage tank. One each service water overhead tank will be provided for each unit. Water from the overhead tank to the different consumption points would be distributed by gravity.

Potable water for colony and plant will be pumped from water treatment plant to potable water storage tank through filters. For distribution to plant and colony separate pumps will be provided. A pipe network for distribution of potable water for plant shall be provided from the potable water storage tank.

2.6.5 Water Treatment Systems

The Water Treatment System of the project comprises Chlorination Plant, Condensate Polishing Plant, Effluent treatment plant and Ash Water re-circulation / recovery System as described below

Chlorination Plant: Chlorination plant shall be provided for chlorine dosing in the CW system to avoid the growth of algae and bacteria. CW chlorination system would consist of three chlorinator evaporator sets each of 100 Kg capacity. Complete chlorination plant shall be located indoor. A chlorine leak absorption system shall be provided for chlorination plant to neutralize chlorine leakage from chlorine tonner. Chlorination plant shall be provided with required chlorine tone containers, instrumentation, panels, chlorine leak detectors etc.

Condensate Polishing Plant: For maintaining the feed water purity condensate polishing plant shall be provided in the feed water cycle at the downstream of condensate extraction pumps as per the existing practice. The condensate polishing plant shall be of full flow, deep mixed resin bed type consisting of capacity service vessels for each unit. The resins to be used would be strong acid cation and strong base anion type, appropriate for condensate polishing system. A common external regeneration facility shall be provided. The exhausted charge of resins from the service vessel shall be hydraulically transferred to the resin separation / cation regeneration vessel for regeneration and reuse. Spare charge of resin shall be kept in the mixed resin storage tank for immediate exchange of resins with the exhausted ones. One additional charge of resin shall be procured for use during start up of both the units. Acid, Alkali and DM Water Storage for regeneration, and Wastewater Neutralisation facilities shall be provided separately for the external regeneration facility. To avoid separation of cation & anion resin due to long length of pipe line, condensate polishing plant shall be installed between both units.

Effluent Treatment Plant: The clarifier blow down collected in a sludge sump. From there it will be pumped to a thickener. The overflow from the thickener will be sent to the CMB and the sludge will be led to the common sludge pit. The filter backwash waste water will be led to the same waste recovery tank. The supernatant water from waste recovery tank will be pumped to the CMB and the sludge will be led to the common sludge pit. The plant waste drain water from the various area i.e. boiler blow-down, transformer yard & fuel oil tank will be collected in a sump and from there it will be pumped to the oil separator. From the oil separator the clear waste water will be sent to the CMB and the oily waste sludge

will be collected separately and disposed. The D M plant neutralization pit effluent and a portion cooling tower blow-down will also be sent to CMB. From CMB, water will be pumped for gardening & dust separation system for coal & ash silo. Major part of cooling tower blowdown will be utilized directly in bottom ash & fly ash disposal.

2.7 COAL HANDLING SYSTEM

The coal from mine will be transported through Bottom Opening Broad Gauge Rail (BOBR) and / or BOXN wagons to the plant site. The coal will be unloaded, screened and crushed in coal handling plant. From there coal will be conveyed through belt conveyors up to the steam generator (SG) bunkers or stockyard for reclaiming. Two streams of conveyors and equipments will be provided for carrying coal from track hopper and / or Wagon Tippler to the stockyard and to bunkers. Out of two streams, one will be normally operating and the other will be standby.

Design criteria and Assumption:

- Coal required for two units at maximum continuous rating (TMCR) condition based on Gross Calorific Value (GCV) of 3500 Kcal/kg is 730 TPH at 90% P.L.F considering heat rate 2152 kcal/ kWh
- The maximum lump size of the coal received at power plant will be (-) 300 mm. and crushed to (-) 150mm by primary crusher and then to (-) 20mm size by secondary crusher at crusher house.
- A coal stockyard is considered for stacking of coal for 30 days.
- Coal handling system is sized to operate for about 16 hrs per day.
- Coal handling system would be designed for 2x660 MW units.

Two streams of conveyors and equipments will be provided for carrying coal from track hopper to the stockyard and to bunkers. Out of two streams, one will be normally operating and the other will be standby.

The schematic diagram of the coal handling plant is given in **Figure 2.3**.

2.8 ASH HANDLING SYSTEM

The ash is generated due to combustion of coal as residue. For the proposed plant, the total ash generation, taking ash content in coal to be 42%, will be about 306.6 TPH at 90% PLF. Ash is collected at the bottom of the furnace as bottom ash, economizer hoppers as eco ash, air-preheater hoppers as APH ash, electrostatic precipitator (ESP) hoppers as fly ash and stack hoppers as stack ash. The quantum of ash generation would depend on the plant load factor and the quality of coal being fed.

Bottom Ash: The bottom ash resulting from the combustion of coal in the boiler shall fall into a W-type water impounded (water filled) ash storage hopper provided under the furnace bottom. The bottom ash hopper discharge gates shall be opened once in a shift of eight (8) hrs for 1 hr 30 minutes and the stored ash shall be removed by means of jet pumps and transported through slurry pipe lines to the ash slurry sump integral in the ash slurry pump house for its further disposal to the dump area by means of ash slurry disposal pumps. Each section of the bottom ash hopper shall be provided with two ash gates, two clinker grinders and two jet pumps complete with feed gate housings. Only one set of equipment under each section shall be in operation during the ash removal operation, with the other set as standby. The schematic diagram of the bottom ash handling system is given in **Figure 2.4**.

Fly Ash: The fly ash system will be designed to collect fly ash fully in dry form in silos or fully in slurry form in slurry sump using vacuum cum pressure pneumatic conveying system. The fly ash collected at the ESP hoppers, air pre-heater hoppers, and stack will be conveyed by vacuum system to either intermediate FA surge hopper for further transportation to silos or to the slurry sump through collector tank and wetting unit as shown in the flow diagram. The fly ash will be sequentially extracted from the FA hoppers by creating vacuum in the extraction piping circuit with the help of vacuum pumps. Two adequately sized fly ash piping streams as shown in the flow diagram will be provided. Both the streams will be in operation simultaneously for fly ash removal. Bag filter will be provided on intermediate surge hopper. The FA evacuation system from intermediate surge hopper to silo is designed such that, the ash collected in eight hours will be cleared in about five hours time at the rate of 660 TPH. The fly ash collected in the intermediate FA surge hoppers will be conveyed to FA silo by pressure type pneumatic system. The capacity of the intermediate surge hopper will be about eight hours storage. Two conveying pipelines will be provided below each intermediate surge hopper. A vent filter will be mounted on each silo to reduce the environmental pollution. The capacity of silo would be of 12 hours storage. The intermediate surge hoppers will be provided with two more openings below which rotary feeder, wetting unit, feed sump and jet pumps will be installed for pumping the fly ash in slurry form to ash slurry sump. The schematic diagram of the fly ash handling system is given in **Figure 2.5**.

Ash Disposal: The dry fly ash shall be collected in the storage silo. There will be four outlets from ash Silo. First outlet will be used for loading the closed ash container/Bulkers, Second for evacuation through ash conditioner in to the open trucks. Third will be kept for emergency evacuation in slurry mode. Fourth will be kept as standby. **Figure 2.6**

Bottom ash slurry and fly ash slurry will be pumped from ash slurry sump to ash disposal area. Three series (2W + 1S) of slurry pumps of capacity approx 800 m³/hr each and one pipe line associated with each series would be provided. The bottom ash overflow will be collected in a sump near the bottom ash hopper area and will be pumped to the ash slurry sump using horizontal centrifugal type drain pumps.

Ash Water Recovery System: The ash water from the ash pond will flow to the setting pond through the collecting wells where the ash particles will settle down. This ash water will be treated in the clarifier to reduce the suspended solids and clear water will be collected in the clear water sump. This water will be pumped for utilization in the ash handling plant.

2.9 TECHNOLOGY DESCRIPTION

2.9.1 Importance of Efficiency

Since the time thermal power stations have been engineered, there is a quest for efficiency improvement. The general supercritical parameters for 660 MW boilers are: 251kg/cm² of pressure and 571°C SH and 603°C RH of temperature.

2.9.2 Methods of Increasing Ranking Cycle Efficiency

The steam power cycle efficiency can be improved by the following methods:

- Raising supply temperature by super heating: Increasing the turbine inlet temperature of steam will raise the heat supply to the boiler more than the heat rejection.
- Raising inlet pressure of steam: Increasing the pressure will mean increase in saturation temperature at which steam evaporates thus increasing the average inlet temperature (T1).

- Efficiency can be improved by dropping the final pressure (or temperature) at which heat is rejected.
- Regenerative heating: Heating the feed water pumped to the boiler by bleeding steam from turbine.
- Reheat cycle: Reheating of steam in boiler after it has already expanded in high pressure (HP) turbine will avoid moisture formation in low pressure (LP) Turbine. Also more heat content of steam before LP turbine will improve efficiency.

2.9.3 Thermodynamic Cycle

The thermodynamic cycle for 660MW units will consider super-critical steam parameters. The unit comprises the boiler, the steam turbine generator, the condenser, the condensate extraction and boiler feed system along with all other necessary equipment for single/double reheat-regenerative cycle. For the purposed of the study, the steam parameters at the other end of the boiler have been considered to be 251 Kg/Cm² (abs.), 571°C with steaming capacity of about 2118 TPH as per the established practice of the units in 660MW range. Corresponding steam parameters at the turbine inlet would be 247Kg/Cm² (abs.) and 566°C and reheated steam parameters would be about 55 Kg/Cm² (abs.) and 600°C. The MP/IP cylinders may be of single/double casing design as per manufacturers' standard. The exhaust from HP-IP turbine will further expand in the double flow LP Turbine.

The exhaust steam from the LP turbine will be cooled in the main steam condenser by circulation of required quantity of cooling water and its vacuum will be maintained by two of the four (2)100% capacity vacuum pumps maintaining a backpressure of 76 mm Hg (abs.) The condenser would be twin flow, double pass, horizontal shell and tube cooled by circulation of cooling water (inlet water temperature will be 33°C max.) in re-circulating cooling water circuit using wet type cooling tower.

The regenerative feeds heating system will consist of four stages of low pressure heaters, one gland steam condenser, one separate drain cooler, one spray-cum-tray type deaerator, and three high pressure heaters. The condensate drawn from condenser hot well by 3x50% capacity motor driven condensate extraction pumps will be pumps to the deaerator through condensate polishing unit, gland steam condenser, drain cooler and the LP heaters. The boiler feed pumps and pumped to the respective boiler, through the three higher-pressure heaters, would draw the feed water. Three boiler feed pumps [two turbine driven of 50% capacity each and one motor driven of 35% capacity] have been envisaged for each unit.

2.9.4 Supercritical Boiler

A Boiler operating at a pressure above critical point is called Supercritical Boiler. Supercritical Boiler has no drum and heat-absorbing surface being, in effect, one continuous tube hence called 'once through Supercritical Pressure Boilers'. Boiler Feed Pump pressurizes the water in boiler, sensible heat is added in feed heaters, economizer and furnace tubes, until water attains saturation temperature and flashes instantaneously to dry saturated steam and super heating commences.

2.9.5 Steam Generator

The Steam Generator shall be super critical or once through type, tower or two pass type, water tube, pulverized coal fired. The configuration / arrangement of the steam generator will be as per the standard proven design of the manufacturer. Steam Generator design shall be suitable for variable pressure operation from 40% to 90% BMCR. Indicative main parameters for the Steam Generator at its maximum continuous rating will be as follows:

1	Main steam flow at super-heater outlet, T/hr	2118
2	Pressure at super heater outlet, kg/cm ² (a)	251
3	Pressure at HP turbine inlet, kg/cm ² (a)	247
4	Temperature at SH outlet, °C	571
5	Main steam temperature at HP turbine inlet °C	566
6	Steam temperature at re-heater outlet , °C	603
7	Reheat Steam temperature at IP turbine inlet °C	600
8	Feed water temperature at economizer inlet, °C	290

2.9.6 Turbine and its Auxiliaries

The scope of each TG unit of 660 MW shall broadly cover the Steam Turbine and generator along with its integral systems and auxiliaries like lube oil system, control-fluid system, condensers, condenser air evacuation system, HP & LP Bypass system, complete regenerative feed heating system, condensate pumps along-with their drives, boiler feed water pumps along-with their drives, automatic turbine run-up system, instrumentation and control devices, turbine supervisory instruments, turbine protection and interlock system, automatic turbine testing system and turbine hall EOT cranes.

2.10 WORKSHOP AND GENERAL STORES EQUIPMENTS

2.10.1 Workshop

The Power Plant will be equipped with a workshop capable of catering to the routine maintenance/ repair required for the plant. The equipment and facilities will include lathe machines, milling machines, boring machines, motor rewinding machines, welding equipment and flame cutting machine, etc. required for handling also will be installed in the workshop.

2.10.2 Permanent Stores

Permanent stores will be a combination of open storage areas and enclosed buildings required for the proper up-keep of spare parts. The stores will be equipped with suitable parts handling system. Air conditioned rooms will be provided for storage of electronic equipment. Hazardous chemicals will be stored in a separate confined area. Computerized spares management system also will be adopted in the stores for spares accounting and control.

2.10.3 Roads

All roads for the complete plant area (except those, which are already provided) shall be provided. All works related to maintain continuity of road system shall be constructed in addition to approach roads to different buildings / facilities related to storage, equipment areas where access is necessary from inspection and O & M point of view as well as functional point of view.

2.10.4 Drains

Drains shall be constructed on both sides of the roads which shall discharge in to the trunk drain. The trunk drain shall be connected to the nearby natural drainage system. Drains shall be of brick masonry/RCC construction.

2.10.5 Sewerage

R.C.C. concrete pipes / C.I. pipes shall be used for sewage disposal and / or to be extended to the existing system to match the future requirement. Extended aeration type permanent Sewage treatment plant shall be provided for treatments of sewage disposal

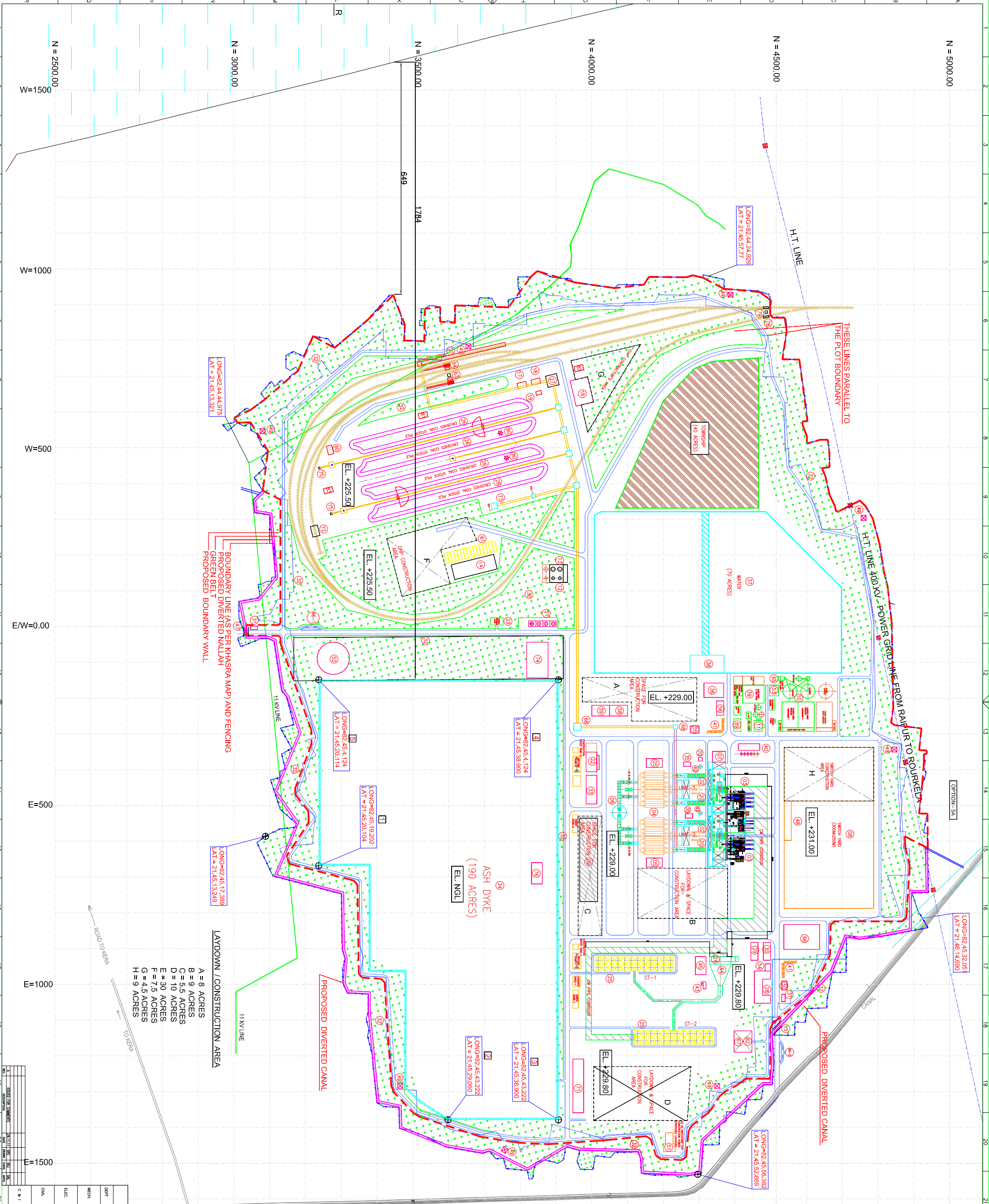
system including Central Monitoring Basin (CMB) as per applicable local bylaws / pollution standard / conditions of State and / or Central authorities

2.10.6 Railway Siding

Coal is proposed to be transported through Indian Railway's network from the mine end to nearest railway station near power plant site. Railway siding is to be constructed to connect Indian railway's network to plant and also for handling coal and other materials.

2.11 PROJECT SCHEDULE

The first 660 MW units will be commissioned in 42 months (as per client data) from the Zero Date i.e. Main Plant Award and the second unit at an interval of 6 months.



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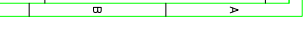
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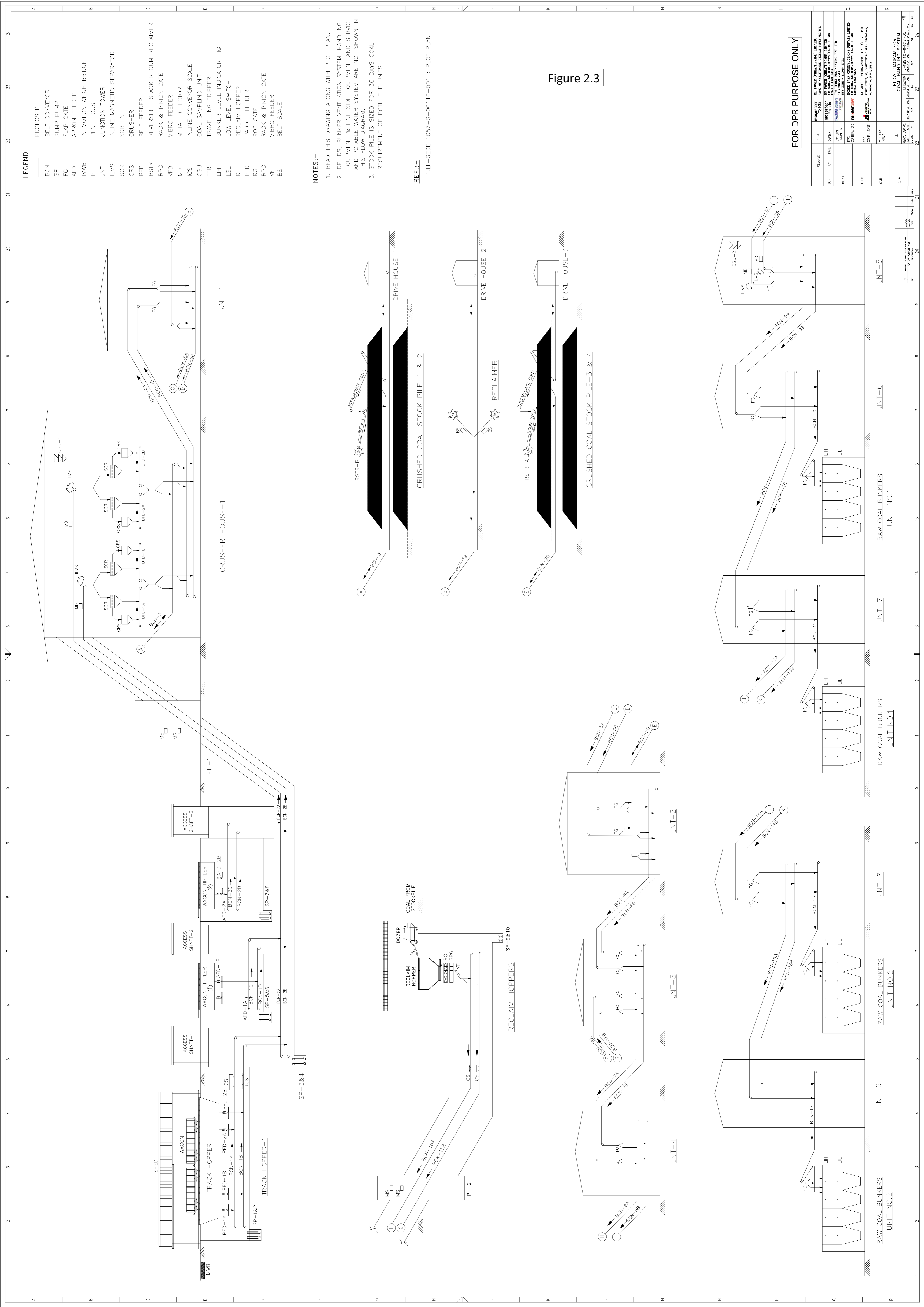
- ALL DIMENSIONS & CO-ORDINATES SHOWN ARE IN METERS, UNLESS SPECIFIED OTHERWISE.
- THIS IS A CONCEPTUAL DRAWING AND IS ISSUED ONLY FOR TENDER PURPOSES. IT IS SUBJECT TO CHANGE DURING BIDDING ENGINEERING & AS PER THROUGHOUT DRAWING OR SITE.
- DIMENSIONS SHOWN OF VARIOUS FACILITIES ARE TENTATIVE.
- DESIGNER SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS & APPROVALS.
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LEGEND:

BLOCK NO.	DESCRIPTION
1	TURBINE GENERATOR BUILDING
2	STEAM GENERATOR
3	TRANSFORMER YARD
4	ELECTROSTATIC PRECIPITATOR
5	E.S.P. CONTROL ROOM
6	CHIMNEY
7	TECHNICAL BUILDING
8	SWITCH YARD
9	SPACE FOR FOOD PLANT
10	PRE-TREATMENT PLANT
11	RAW WATER STORAGE TANK
12	DOO TANK
13	HFO/LDO UNLOADING PUMP HOUSE
14	MAIN PLANT GATE
15	CHP WORKSHOP/ O&M MAINTENANCE BUILDING
16	CHP STORES
17	CHP CONTROL ROOM
18	BULLDOZER SHED
19	COAL WELLS
20	FLY ASH SLO
21	FLY ASH SLURRY SWAMP & PUMP HOUSE
22	SEWAGE TREATMENT PLANT (ST)
23	SEWAGE TREATMENT PLANT (CW)
24	INDUCED DRAFT COOLING TOWER
25	CRUSHED COAL STOCK PILE
26	CRUISER HOUSE
27	ADMIN. BUILDING
28	CANTEN
29	FIRE STATION
30	SECURITY
31	SECURITY
32	GREEN BELT
33	ASH WATER PUMP HOUSE
34	ASH DYKE
35	BOTTOM ASH SYSTEM
36	WORKSHOP
37	RAW WATER RESERVOIR 1&2
38	RAW WATER PUMP HOUSE
39	GUARD ROAD/ O&M & PUMP HOUSE
40	CONTRACTOR HOUSE
41	O&M PARKING
42	CONDENSATE STORAGE TANK (CST)
43	ELECT./M&CC ROOM
44	C.W.P.H. FIRE BAY
45	C.W.P.H. CONTROL ROOM
46	WELCH BRIDGE-STORE & ASH
47	MATERIAL DATE
48	SWITCH YARD CONTROL ROOM
49	WITCH TOWER
50	TIME OFFICE
51	33 KV SWITCHGEAR FOR CONSTRUCTION POWER
52	HELIPAD
53	MEDICAL HOUSE
54	DOG SET
55	DOG SET
56	O&M CANTEN
57	CLOSE STORAGE YARD
58	BIG CONTRACTOR'S OFFICE
59	BIG CONTRACTOR'S OFFICE
60	COAL PILE RUN-OFF
61	HFO/LDO UNLOADING BAY
62	FIELD HOSTEL
63	WAGON TIPPLER
64	WAGON TIPPLER CONTROL ROOM
65	SLUDGE PIT
66	OPEN STORAGE AREA
67	GUEST HOUSE
68	TRANSFORMER TOWER
69	COPI REGISTRATION PLANT
70	FIRE WATER BOOSTER PUMP HOUSE
71	SITE OFFICE
72	LOCO SHED
73	EMERGENCY RECLAIM HOPPER
74	EMERGENCY RECLAIM HOPPER
75	SPACE FOR TAKEUP OF BELT CONVEYORS
76	SPACE FOR RECLAIMER WATER COMPLEX
77	TRACK HOPPER
78	IN-ACTION WELCH BRIDGE CONTROL ROOM
79	RECLAIMER
80	RECLAIMER
81	PNCC - 1
82	PNCC - 2
83	PNCC - 3



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LEGEND

BCN	PROPOSED BELT CONVEYOR
SP	SUMP PUMP
FG	FLAP GATE
AFD	APRON FEEDER
IMWB	IN MOTION WEIGH BRIDGE
PH	PENT HOUSE
JNT	JUNCTION TOWER
ILMS	INLINE MAGNETIC SEPARATOR
SCR	SCREEN
CRS	CRUSHER
BFD	BELT FEEDER
RSTR	REVERSIBLE STACKER CUM RECLAIMER RACK & PINION GATE
VFD	VIBRO FEEDER
MD	METAL DETECTOR
ICS	INLINE CONVEYOR SCALE
CSU	COAL SAMPLING UNIT
TTR	TRAVELLING TRIPPER
LH	BUNKER LEVEL INDICATOR HIGH
LSL	LOW LEVEL SWITCH
RH	RECLAIM HOPPER
PPD	PADDLE FEEDER
RG	ROD GATE
RPG	RACK & PINION GATE
VF	VIBRO FEEDER
BS	BELT SCALE

NOTES:-

1. READ THIS DRAWING ALONG WITH PLOT PLAN.
2. DE. DS. BUNKER VENTILATION SYSTEM, HANDLING EQUIPMENT & LINE SIDE EQUIPMENT AND SERVICE AND POTABLE WATER SYSTEM ARE NOT SHOWN IN THIS FLOW DIAGRAM.
3. STOCK PILE IS SIZED FOR 30 DAYS COAL REQUIREMENT OF BOTH THE UNITS.

REF.:-

1.LJI-GEDE11057-G-00110-001 : PLOT PLAN

FOR DPR PURPOSE ONLY

CLASS	PROJECT	NO. PAPER (CONTINUED) LIMITED
DATE	OWNER	NO. PAPER (CONTINUED) LIMITED
BY	DESIGNER	NO. PAPER (CONTINUED) LIMITED
MECH	ENGINEER	NO. PAPER (CONTINUED) LIMITED
ELEC	CONTRACTOR	NO. PAPER (CONTINUED) LIMITED
CIVIL	CONSULTANT	NO. PAPER (CONTINUED) LIMITED
E & I	CLIENT	NO. PAPER (CONTINUED) LIMITED
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PROJECT INFORMATION

PROJECT: NO. PAPER (CONTINUED) LIMITED

OWNER: NO. PAPER (CONTINUED) LIMITED

DESIGNER: NO. PAPER (CONTINUED) LIMITED

ENGINEER: NO. PAPER (CONTINUED) LIMITED

CONTRACTOR: NO. PAPER (CONTINUED) LIMITED

CONSULTANT: NO. PAPER (CONTINUED) LIMITED

CLIENT: NO. PAPER (CONTINUED) LIMITED

PROJECT TITLE

FLOW DIAGRAM FOR COAL HANDLING SYSTEM

PROJECT LOCATION

NO. PAPER (CONTINUED) LIMITED

REVISIONS

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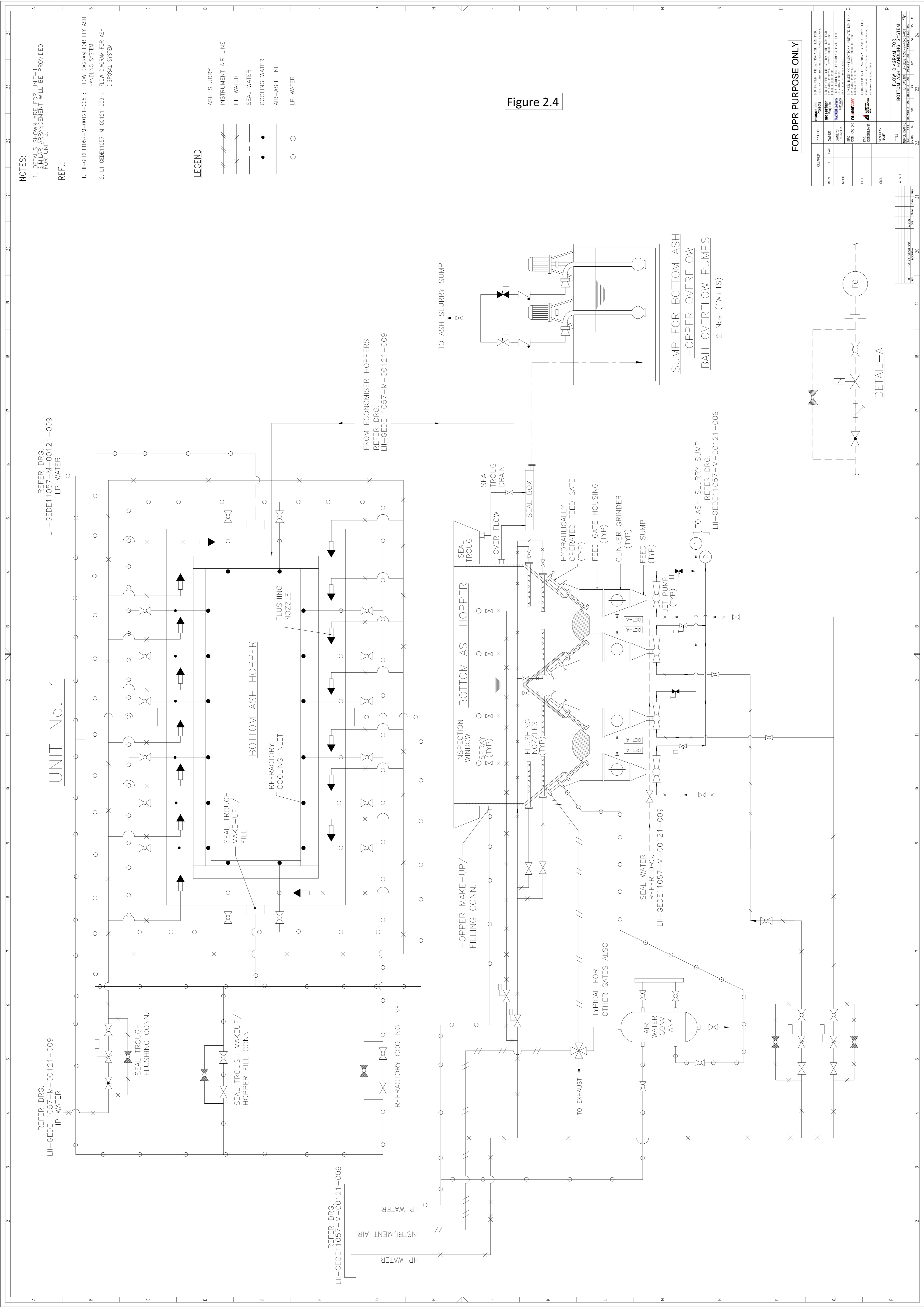
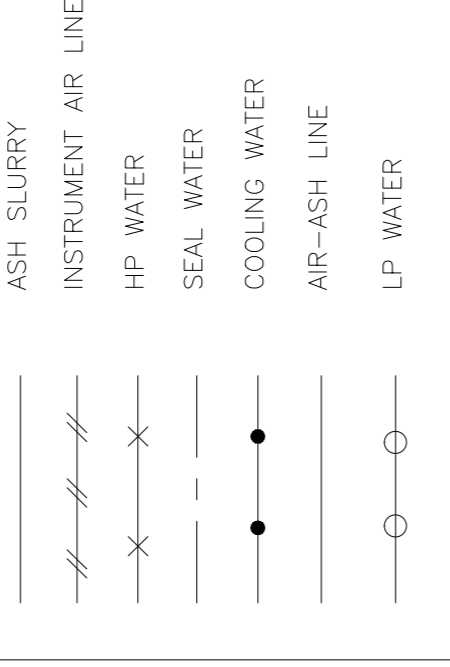


Figure 2.4

NOTES:
 1. DETAILS SHOWN ARE FOR UNIT-1. SIMILAR ARRANGEMENT WILL BE PROVIDED FOR UNIT-2.
 REF.:

- 1. LI-GEDE11057-M-00121-005 : FLOW DIAGRAM FOR FLY ASH HANDLING SYSTEM
- 2. LI-GEDE11057-M-00121-009 : FLOW DIAGRAM FOR ASH DISPOSAL SYSTEM

LEGEND

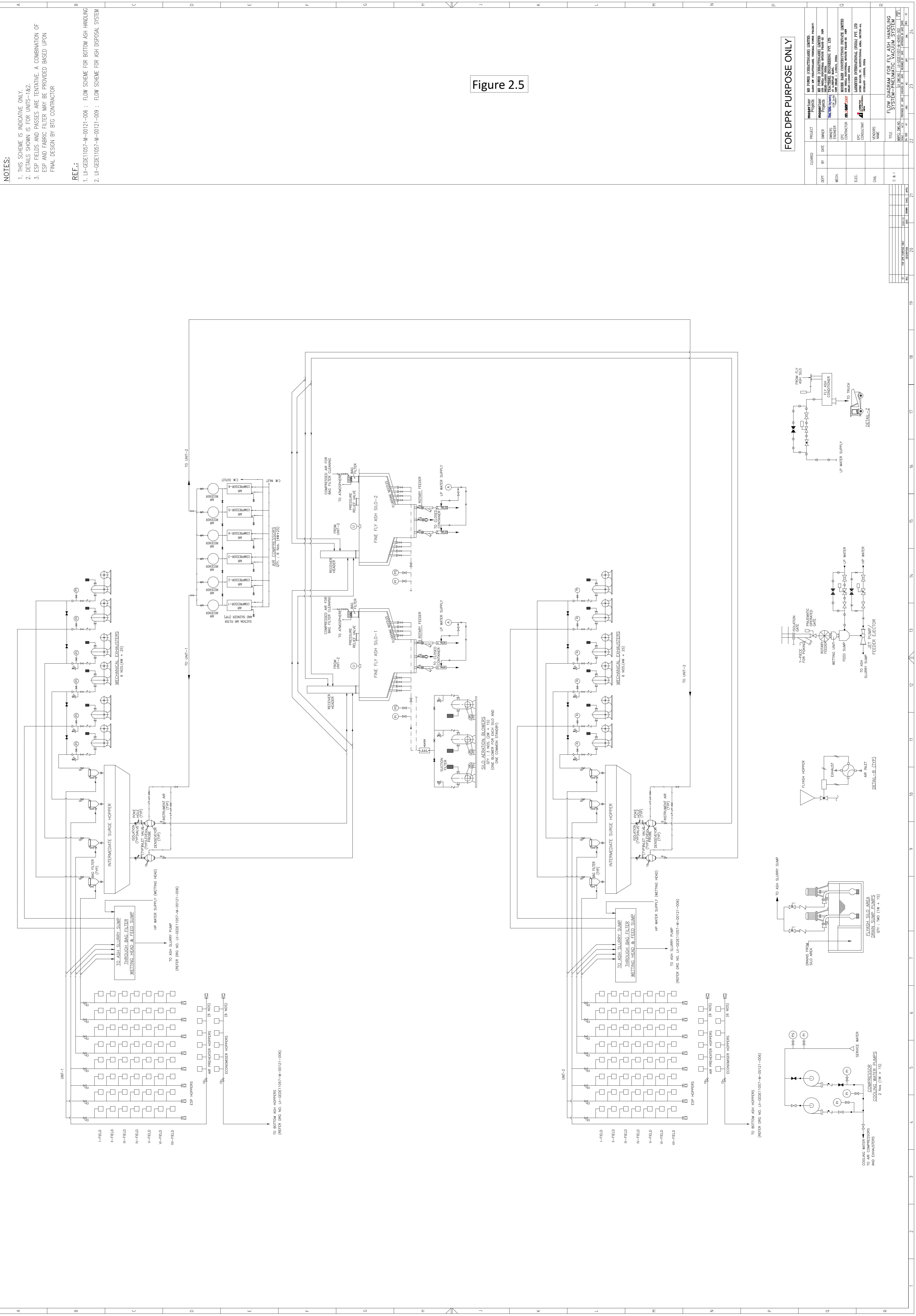


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PROJECT	LIJ POWER (BHAVANSHAH) LIMITED.
OWNER	LIJ POWER (BHAVANSHAH) LIMITED.
DESIGNER	LIJ POWER (BHAVANSHAH) LIMITED.
CONTRACTOR	LIJ POWER (BHAVANSHAH) LIMITED.
DATE	10/01/2017
SCALE	AS SHOWN
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DETAIL-A

TITLE	FLOW DIAGRAM FOR BOTTOM ASH HANDLING SYSTEM
DATE	10/01/2017
BY	AS
CHECKED	AS
APPROVED	AS



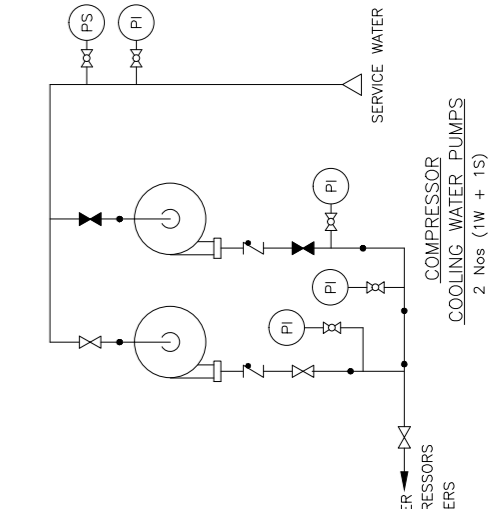
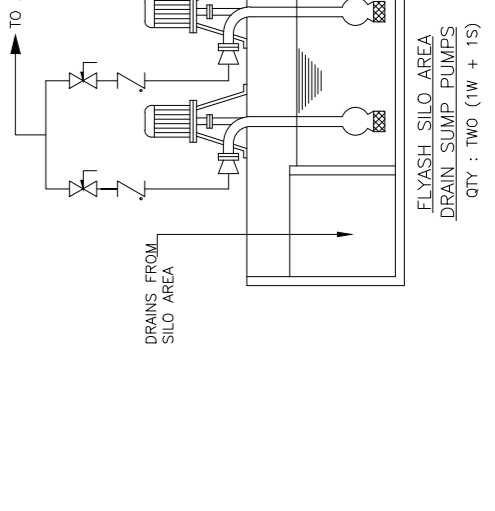
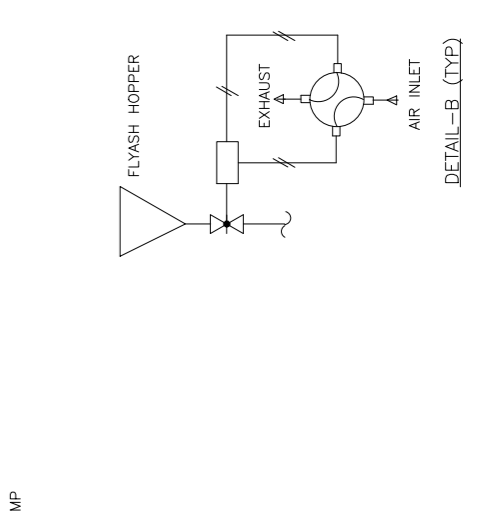
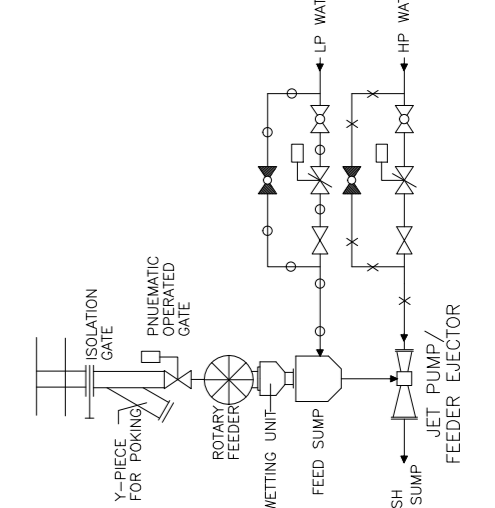
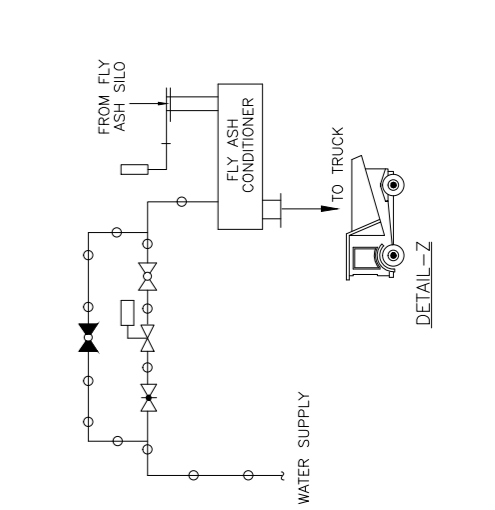
NOTES:
 1. THIS SCHEME IS INDICATIVE ONLY.
 2. DETAILS SHOWN IS FOR UNITS-1&2.
 3. ESP FIELDS AND PASSES ARE TENTATIVE. A COMBINATION OF ESP AND FABRIC FILTER MAY BE PROVIDED BASED UPON FINAL DESIGN BY BTG CONTRACTOR

REF.:
 1. UI-GEDE11057-M-00121-006 : FLOW SCHEME FOR BOTTOM ASH HANDLING
 2. UI-GEDE11057-M-00121-009 : FLOW SCHEME FOR ASH DISPOSAL SYSTEM

Figure 2.5

FOR DPR PURPOSE ONLY

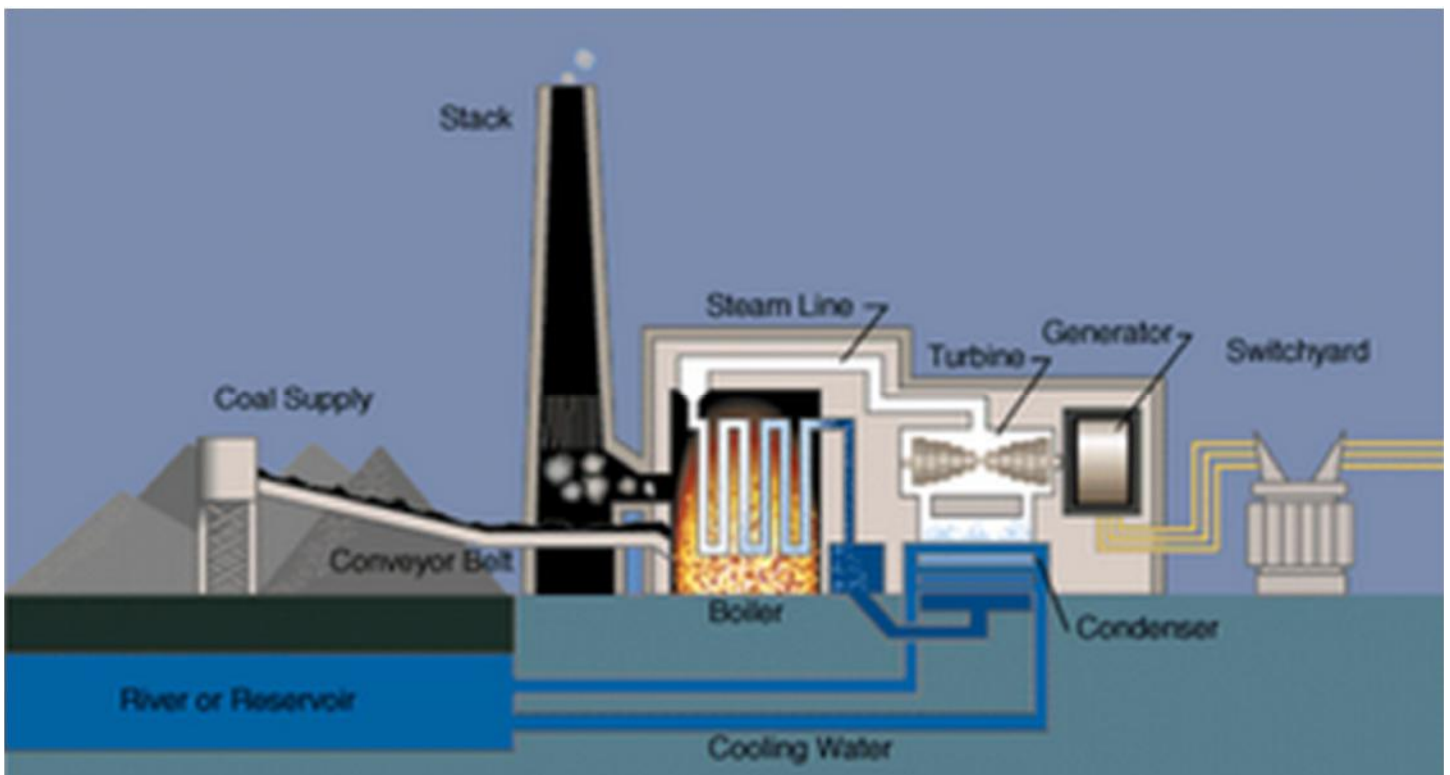
PROJECT		M/S PAPER (CHENNAI) LIMITED	
OWNER		M/S PAPER (CHENNAI) LIMITED	
DESIGNER		M/S PAPER (CHENNAI) LIMITED	
CONTRACTOR		M/S PAPER (CHENNAI) LIMITED	
CONSULTANT		M/S PAPER (CHENNAI) LIMITED	
DATE		15/05/2014	
PROJECT NO.		UI-GEDE11057-M-00121-006	
SHEET NO.		06 OF 06	
SCALE		AS SHOWN	
DRAWN BY		SRI RAGHAVA	
CHECKED BY		SRI RAGHAVA	
APPROVED BY		SRI RAGHAVA	
DATE		15/05/2014	
PROJECT		M/S PAPER (CHENNAI) LIMITED	
OWNER		M/S PAPER (CHENNAI) LIMITED	
DESIGNER		M/S PAPER (CHENNAI) LIMITED	
CONTRACTOR		M/S PAPER (CHENNAI) LIMITED	
CONSULTANT		M/S PAPER (CHENNAI) LIMITED	
DATE		15/05/2014	
PROJECT NO.		UI-GEDE11057-M-00121-006	
SHEET NO.		06 OF 06	
SCALE		AS SHOWN	
DRAWN BY		SRI RAGHAVA	
CHECKED BY		SRI RAGHAVA	
APPROVED BY		SRI RAGHAVA	
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Chapter 3

Baseline Environment Status



3. BASELINE ENVIRONMENT STATUS

3.1 INTRODUCTION

The technical details of the proposed 2x660 MW supercritical coal-based Thermal Power Project has been described in the Chapter 2. In order to assess environmental impacts due to the proposed project, it is essential to monitor the environmental quality prevailing at the project site and its surrounding areas prior to implementation of the project. This chapter outlines the present environmental setting of the project site and its influence area (10 km radius from site).

The parameters of environmental impact can be identified by elaborating the various aspects of environment which can be divided as: (i) Physical aspect which include topography, geological aspects, soil characteristics, etc; (ii) Meteorological aspects which includes the air environment and micro-climatic factors including air quality; (iii) Water and Drainage aspect which includes water environment i.e. surface water and groundwater condition and area drainage; (iv) biological aspect including the type of flora and fauna; and lastly (v) socio-economic aspects relating to demographic and socio-economic conditions of the population around the project site.

3.2 STUDY AREA AND PERIOD

For base-line data collection, an area covering 10 km radius from the proposed project site has been considered as per EIA guidelines published by the MoEF, Govt. of India. Baseline data of prominent environmental attributes like ambient air, water, soil, geology, water use, hydrology, noise, meteorology, socio-economic features, terrestrial ecology, aquatic ecology, land use etc. was collected. The baseline study for the project was conducted during the post-monsoon season from October to December, 2009.

3.3 METHODOLOGY ADOPTED

For collecting the baseline data (primary and secondary) during the study period, a temporary field office was established at Birra. The following methodology was adopted for data collection:

- Sampling of soil and water, monitoring of air quality and noise level and other field data collection were carried out by the team operating from the field station.
- A meteorological station was setup on the roof top of a house in Birra village. Wind speed, wind direction, dry and wet bulb temperature, relative humidity and general weather conditions were recorded throughout the study period.
- In order to assess the Ambient Air Quality (AAQ), samples of ambient air were collected by installation of Respirable Dust Sampler at different locations from the study area during study period and analyzed for primary air pollutants to work out the existing status of air quality.
- Ground water samples were collected during the study period from existing tube wells and surface water collected from rivers and available local surface water body like pond, lakes etc. The samples were analyzed for parameters necessary to determine water

- quality (based on IS: 10500 criteria) and those which are relevant from the point of view of environmental impact of the proposed thermal power plant.
- Grab samples of soil were collected and analyzed for relevant physical and chemical characteristics in order to assess the impact of the proposed project on soil.
 - The noise level measurements were made at various locations in one hour intervals of time with the help of sound level meter in the study area to establish the baseline noise levels in the impact zone.
 - Socio-economic data was collected from field studies and secondary sources like Census of India 2001.
 - Inventory of flora and fauna species was made by a team of ecologist during the site visit in December 2009 and collected data from DCF Champa.

3.4 REGIONAL AND LOCATIONAL SETTING

3.4.1 Location

As already mentioned the site falls within the revenue boundary of three villages, viz. Birra, Siladehi and Gatwa. The coordinates of the site is given in **Table 3.1**. The project boundary along with ash pond superimposed on a topo-sheet with coordinates is given in **Figure 3.1**.

Table 3.1: Coordinates of Project Site

S. No.	Latitude	Longitude
1.	21°45'57.77"N	82°44'24.92"E
2.	21°45'13.32"N	82°44'44.97"E
3.	21°45'13.25"N	82°45'17.39"E
4.	21°45'31.25"N	82°45'50.23"E
5.	21°45'52.67"N	82°45'56.38"E
6.	21°46'14.69"N	82°45'32.05"E

Source: GPS Reading by MBP(C)L

3.4.2 Seismology

The seismic hazard map of India was updated in 2004 by the Bureau of Indian Standards (BIS). The study area viz the Raigarh region of Chhattisgarh fall in Seismic Zone III. However, incidences of minor tremors have been reported just a few years back. During the designing and construction stage of the project, this fact will be considered to make an earthquake free building.

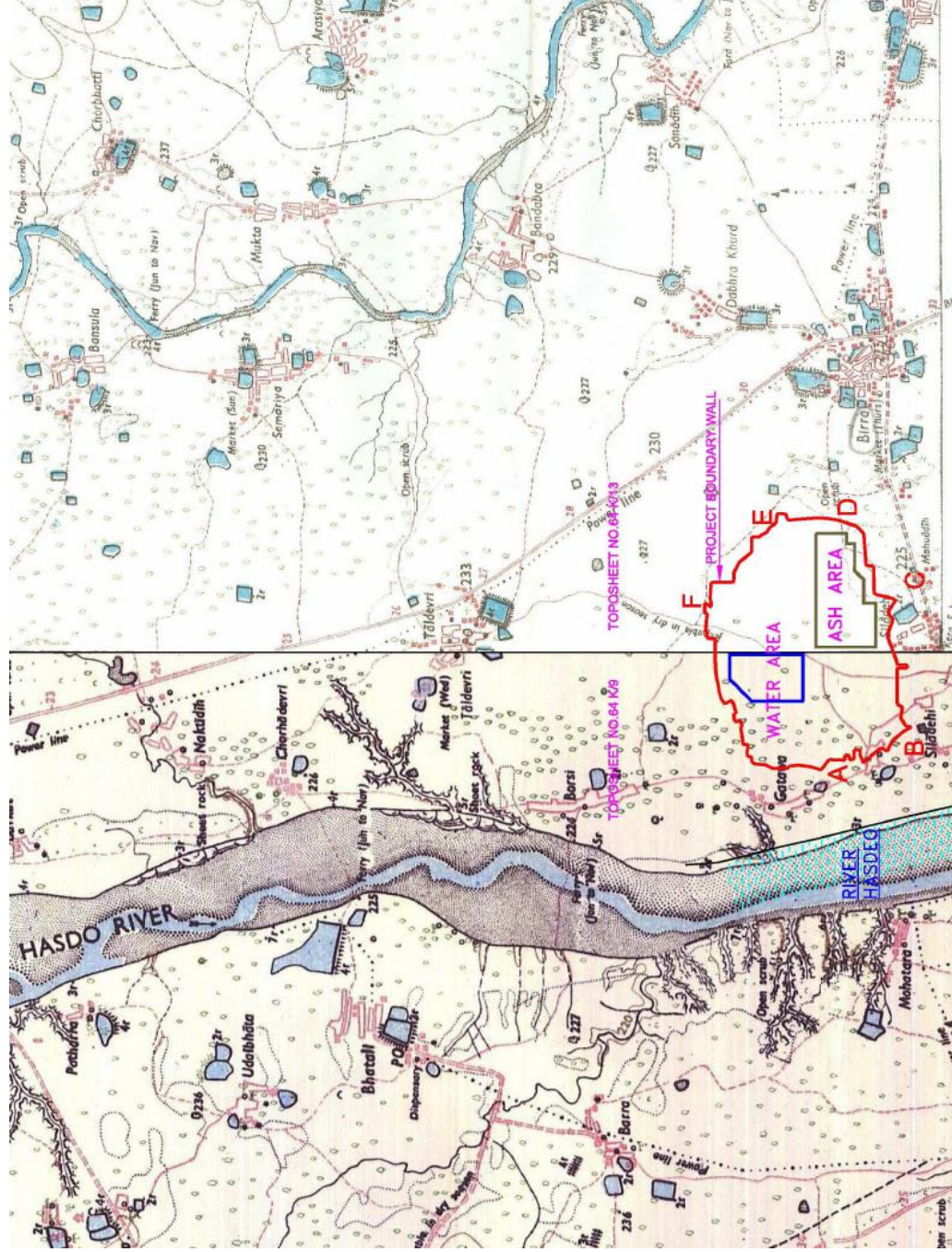
3.4.3 Sensitivity

There is no wildlife sanctuary, national parks and archeological monuments within 15 km radius of the project site. There is no forest-land within the study area. The nearest famous temple is Lakshmaneshvar Mahadev Temple at Kharaud, which is located 21 km from the proposed site.

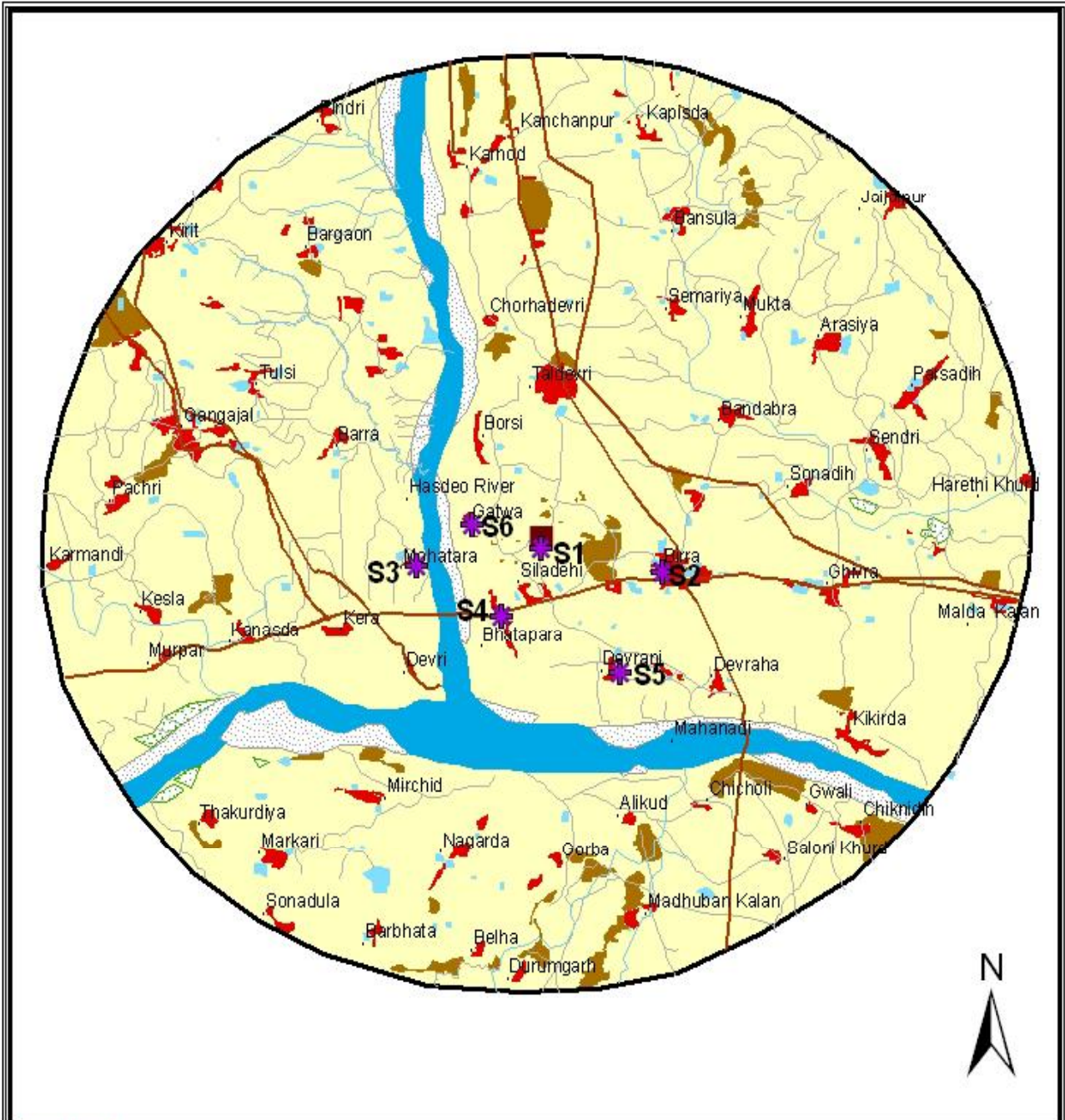
3.4.4 Connectivity

The site is well accessible by Major District Road from NH-200 which is 35 km away from the project site. Champa is the nearest railway station located north of the project site at a distance of 32 km.

Fig 3.1 Site on Toposheet



Point	Latitude DDMMSS	Longitude DDMMSS
A	21°45'57.77"N	82°44'24.92"E
B	21°45'13.32"N	82°44'44.97"E
C	21°45'13.25"N	82°45'17.39"E
D	21°45'31.25"N	82°45'50.23"E
E	21°45'52.67"N	82°45'56.38"E
F	21°46'14.69"N	82°45'32.05"E



Legend

-  Soil Sample Locations
-  Proposed Site
-  Streams
-  Minor Streams
-  Roads
-  Study Area
-  River
-  Sandy Area
-  Vegetation
-  Settlement
-  Pond
-  Barren Land
-  Agricultural Land

**Soil Sampling Locations Map
(within 10 Km radius)**

Project Proponent:

MB Power (Chhattisgarh) Ltd.

Scale:

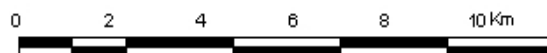


Figure : 3.2

3.5 PHYSICAL ENVIRONMENT

3.5.1 Topography

Topographic features of the study area are depicted in Survey of India's topographical sheet No. 64 K/9. The land is slightly undulating with the average altitude of about 226 m above MSL. Overall there will be no requirements for cutting and filling. Leveling of land in some parts of the site will be required before construction.

3.5.2 Soil Quality

Assessment of soil quality is an important aspect with reference to tree plantations, percolation of water, groundwater impact, etc. The soil quality of the study area has been assessed by collecting samples from 6 (six) different locations. Details of soil sampling locations are presented in **Table 3.2** and depicted in **Figure 3.2**.

Table 3.2: Details of Soil Sampling Locations

S. No.	Location	Code	Distance w.r.t. Site	Direction w.r.t. Site	Criteria for Selection
1.	Siladehi	S1	-	-	Ash disposal area
2.	Birra	S2	1.0	E	Nearest major settlement
3.	Mohatara	S3	2.0	W	Near Hasdeo River
4.	Bhatapara	S4	1.0	SW	Near Plant Site
5.	Devrani	S5	2.5	SSE	Near Mahanadi
6.	Gatwa	S6	-	-	Plant area

Source: GreenC Survey 2009

Random soil samples were collected by 'Auger' up to depth of 15cm and homogenized. The homogenized samples were then packed in polythene bags and sealed with proper remarks. The sealed samples were then sent to the laboratory for analysis.

The physical and chemical characteristics of the soil of the study area have been assessed by analyzing various parameters as per the methods described in "Soil Chemical Analysis" (M.L Jackson). The soil quality as analyzed from the collected samples of the study area is given in **Table 3.3**.

Table 3.3: Soil Quality of the Study Area

S. No.	Parameters	Unit	S1	S2	S3	S4	S5	S6
1.	pH	pH unit	7.1	7.2	7.6	7.7	7.5	6.7
2.	Bulk density	gm/cm ³	1.04	1.10	1.02	1.14	1.17	1.37
3.	Water holding Capacity	%	31.3	30.6	35.8	29.5	27.7	25.5
4.	Soil texture	----	Silt	Silt	Silt	Silt	Silt	Sandy
5.	Soil Colour	----	Brown	Brown	Earth Brown	Brown	Brown	Brown
6.	Nitrogen as N	%	0.72	0.64	0.95	0.73	0.62	0.52
7.	Phosphorus	g/Kg	0.37	0.27	0.51	0.47	0.81	0.081
8.	Potassium as K	g/Kg	0.46	0.38	0.52	0.37	0.38	0.32
9.	Calcium as Ca	g/Kg	0.167	0.143	0.182	0.158	0.160	0.130
10.	Nitrate as NO ₃	g/Kg	0.068	0.056	0.087	0.061	0.070	0.050
11.	Sulphate as SO ₄	g/Kg	0.169	0.150	0.271	0.157	0.188	0.098
12.	Electrical Conductivity	µmho/cm	335	230	440	330	220	180

13.	Organic matter	%	2.40	1.48	4.14	1.85	1.67	0.85
14.	Chloride	g/Kg	0.143	0.137	0.125	0.128	0.138	0.129
15.	Moisture	%	8.3	8.9	9.3	7.4	7.7	10.6

Source: Field Monitoring, Laboratory Analysis by GreenC

The summary of the findings on soil quality is given below:

- The soil cover of the study was found brownish in colour
- The pH of the soil samples was mostly found to be neutral to alkaline in nature and ranges 6.7 to 7.7.
- Moisture content of the soil samples were found to be in the range of 8.3% to 10.6% which indicates that the soil is having moderate moisture contents for agriculture purpose.
- The texture of the soil in the study area was found predominantly silty in nature. However, texture of the four soil samples were observed as silty and silty sand respectively.
- Organic matter content of the soil samples was found in the range of 0.85 to 4.14 % indicating moderate fertility status of the soil.
- Nitrogen content was found between 0.52 to 0.95 %, whereas Potash & Phosphorous content in the range 0.32 to 0.52 g/kg as K and 0.081 to 0.81 kg/ha as P respectively.

3.5.3 Geology

The area owns the oldest archaean rocks. E-W trending Central India Shear has divided the area into two parts, Satpura province in north and Bastar province in south. Bastar province comprises Archaean Gneissic Complex where as Satpura province comprises granite gneisses, metamorphics, Deccan traps and Gondwana group. The study area belongs to Satpura province comprises the rocks of metamorphic, Deccan traps and Gondwana group.

3.5.4 Land-use Pattern

The terms 'land use' used in this report means land use and land cover both. The land use of the study area was determined by utilizing three principal resources, namely

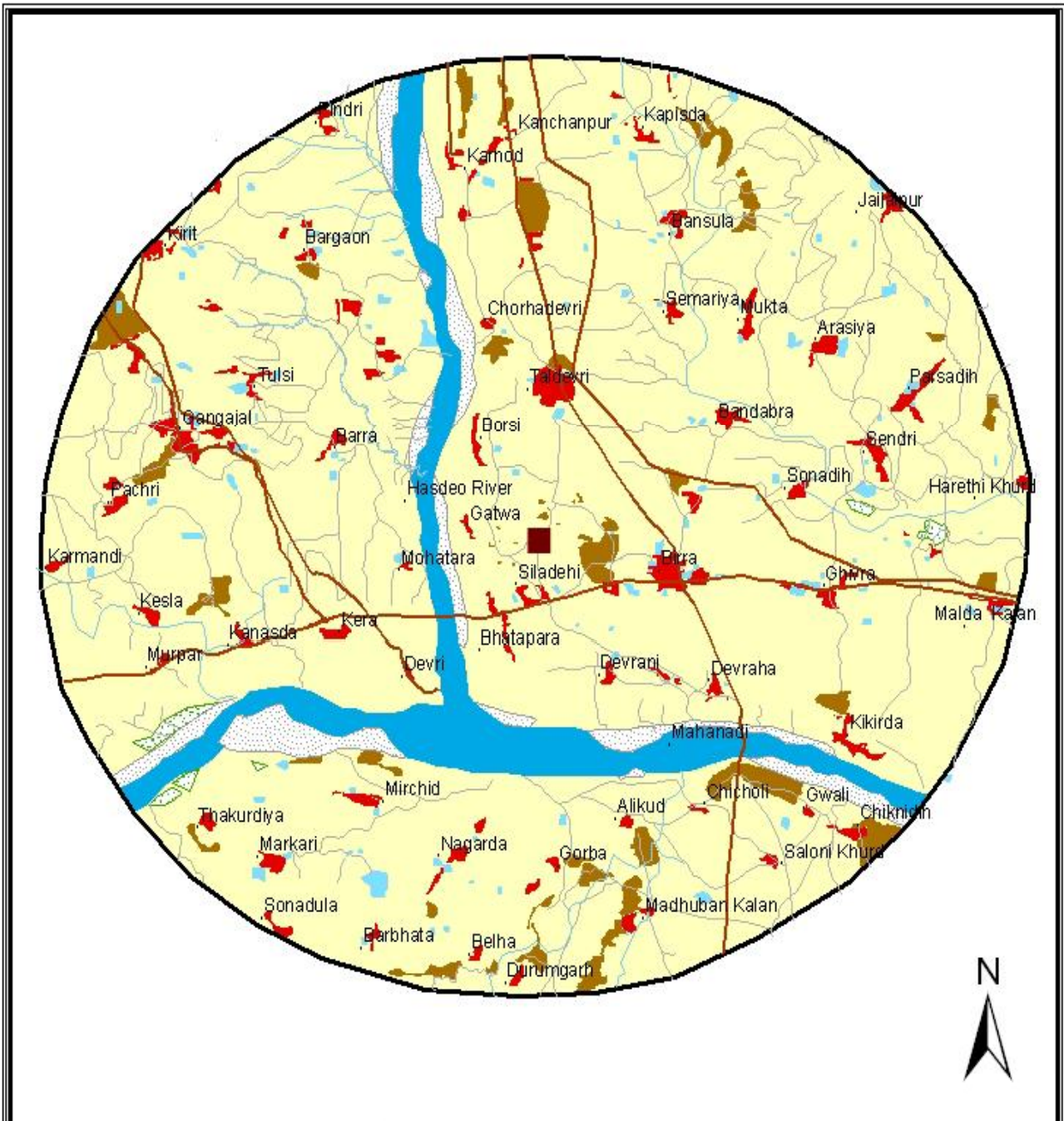
- Survey of India Topographical sheet No. 64K/9, 10, 13 & 14
- Satellites imageries without cloud cover supplied by National Remote Sensing Agency, Hyderabad (NRSA); and
- Ground validation for interpretation of the FCC imagery

3.5.4.1 Land-use of Study Area

The land use pattern of the study area is given in **Table 3.4** and shown in the pie diagram given below (**Figure 3.3**). The land use/land cover map (**Figure 3.4**) shows the land use pattern of the area within 10 km radius.

In the study area within 10 km radius covering about 314 sq. km of land, the major share of the land is under agriculture which is about 263.91 sq km covering 84% of the total land cover. Sandy and barren lands are also present in the study area which consists of 11.24sq.km and 7.65sq.km respectively and accounts for only 3.6% and 2.4% of the total area respectively.

There are 68 villages in the study area, which cover about 9.12 sq km (2.9% of the total land) within 10 km radius. The water bodies covering 6.7% of the total study area include Mahanadi and Hasdeo River.



Legend

- Proposed Site
- Streams
- Minor Streams
- Roads
- Study Area
- River
- Sandy Area
- Vegetation
- Settlement
- Pond
- Barren Land
- Agricultural Land

Landuse/Landcover map of Study Area

Project Proponent:

MB Power (Chhattisgarh) Ltd.

Scale:



Figure : 3.4

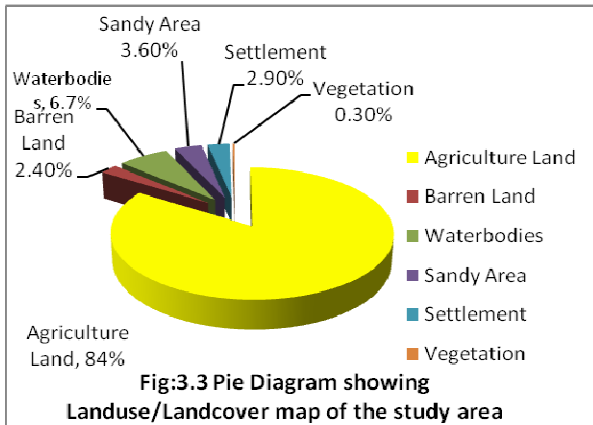


Table 3.4: Land-use Pattern of Study Area

Land Type	Area (Sq.km)	Area (%)
Agriculture Land	263.91	84.0
Barren Land	7.65	2.4
Water-bodies	21.06	6.7
Sandy Area	11.24	3.6
Settlement	9.12	2.9
Vegetation	1.01	0.3
Total	314	100

Source: Satellite Imagery

3.5.4.2 Land use of Site

The land-use of the Project site is mainly covered by agricultural land (80%), water bodies (5%) and barren land (15%). No forest land and settlement is present within the site. There are two canals within the site which will be suitably diverted.

3.6 CLIMATOLOGY & METEOROLOGY

3.6.1 IMD Meteorological Data

The region has warm and humid climate due to positioning near Tropic of Cancer. The area experiences warm and humid summers but cool winters. Winter season ranges from mid-November to February and summer season ranges from March to mid-June. During a typically hot summer day, the mercury can shoot up to 45°C. The winter can be chilly with the mercury plummeting to hit the 10°C mark. The period from mid-June to September is the monsoon season. The summary of the 30 years meteorological data of Champa IMD Station located north of the study area is given in **Table 3.5**.

Table 3.5: Climatology and Meteorology of Study Region

		Total Annual average rainfall is 1359.8 mm		
		Months	Total rainfall	
1	Rainfall in mm	Winter (Dec to Feb)	Dec	5.6
			Jan	14.9
			Feb	13.9
			Total	34.4
		Summer (Mar to May)	Mar	21.3
			Apr	9.2
			May	15
			Total	45.5
		Monsoon (June to Sept)	June	173.1
			Jul	390.1
			Aug	434.8
			Sep	222.7
			Total	1220.7
Post-Monsoon (Oct to Dec)	Oct	49.1		

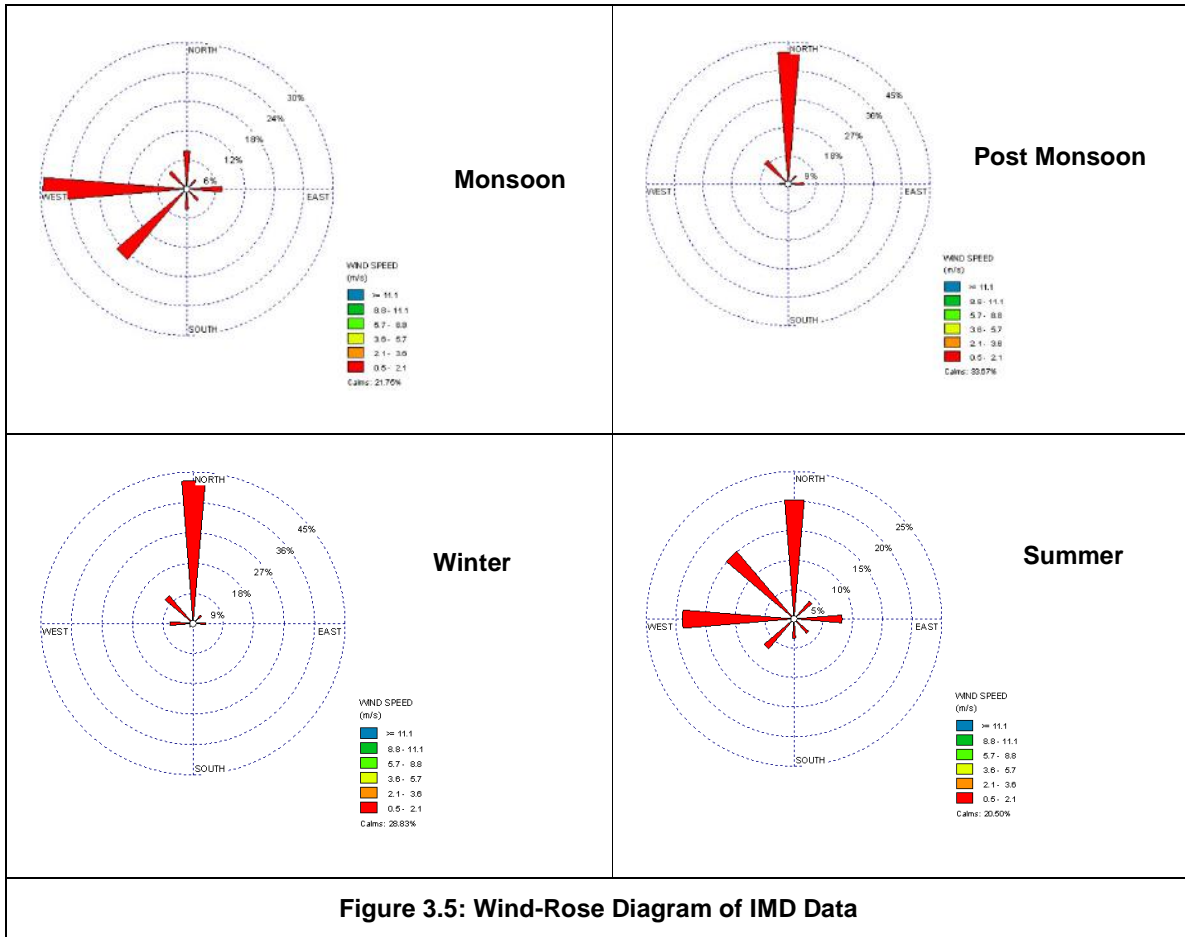
Table 3.5: Climatology and Meteorology of Study Region

		Nov	4.5			
		Dec	5.6			
		Total	59.2			
2	Temperature (Mean Daily Temperature in °C)		Months	Max	Min	Avg.
		Winter (Dec to Feb)	Dec	24.5	16.0	20.3
			Jan	25.3	15.8	20.6
			Feb	29.2	19.0	24.1
			Average	26.3	16.9	21.6
		Summer (Mar to May)	Mar	33.8	24.2	29.0
			Apr	38.3	29.8	34.1
			May	40.7	33.0	36.9
			Average	37.6	22.2	29.9
		Monsoon (June to Sept)	June	34.9	30.1	32.5
			Jul	29.1	26.5	27.8
			Aug	28.6	26.3	27.5
			Sep	29.1	26.7	17.9
			Average	34.0	22.4	28.2
		Post-Monsoon (Oct to Dec)	Oct	29.0	24.4	26.7
			Nov	26.8	19.7	23.3
			Dec	24.5	16.0	20.3
	Average	26.8	20.0	23.4		
3	Relative Humidity in per cent	Winter (Dec to Feb)	Month	8.30hrs		17.30hrs
			Dec	70	44	
			Jan	67	39	
			Feb	57	29	
			Average	64.6	37.3	
		Summer (Mar to May)	Mar	44	23	
			Apr	38	19	
			May	38	20	
			Average	40	20.6	
		Monsoon (June to Sept)	Jun	64	48	
			July	87	76	
			Aug	88	79	
			Sep	85	74	
			Average	81	69.2	
		Post-Monsoon (Oct to Dec)	Oct	79	61	
			Nov	71	46	
			Dec	70	44	
	Average	73.3	50.3			

Source: Climatological Tables (1951-1980)

The average annual rainfall experienced in the region from the 30 years meteorological data was found to be 1359.8 m. The average maximum temperature was recorded in the month of May at 40.7°C and the average minimum temperature was 15.8°C in January. The Relative Humidity was reported maximum during the month of August at 88%. The predominant wind direction recorded at the IMD station was found to be North during all the seasons except

monsoon when the predominant was West. The wind-rose diagrams of all the four seasons are given in **Figure 3.5**.



3.6.2 Micrometeorology of the Project Site

As already mentioned, the meteorological data for the site was monitored during the period October to December 2009. **Table 3.6** gives the details of the rainfall, humidity, rainfall and wind characteristics of the area.

Table 3.6: Climatology and Meteorology of Project Site (October – December 2009)

Parameter	Unit	October	November	December	Post Monsoon
Total Rainfall in mm	mm	8.0	0.0	0.0	8.0
Humidity in %	Max.	78	76	79	77.7
	Min.	46	48	43	45.7
	Avg.	66.1	66.2	66.3	66.2
Temperature in °C	Max.	32.9	27.3	25.8	28.7
	Min.	19.3	16.0	14.2	16.5
	Avg.	26.1	21.6	20.0	22.6
Wind Speed in m/s	Avg.	3.7	4.4	4.2	4.1
Predominant Wind Direction		N,NW	N,NW	NW,N	N, NW

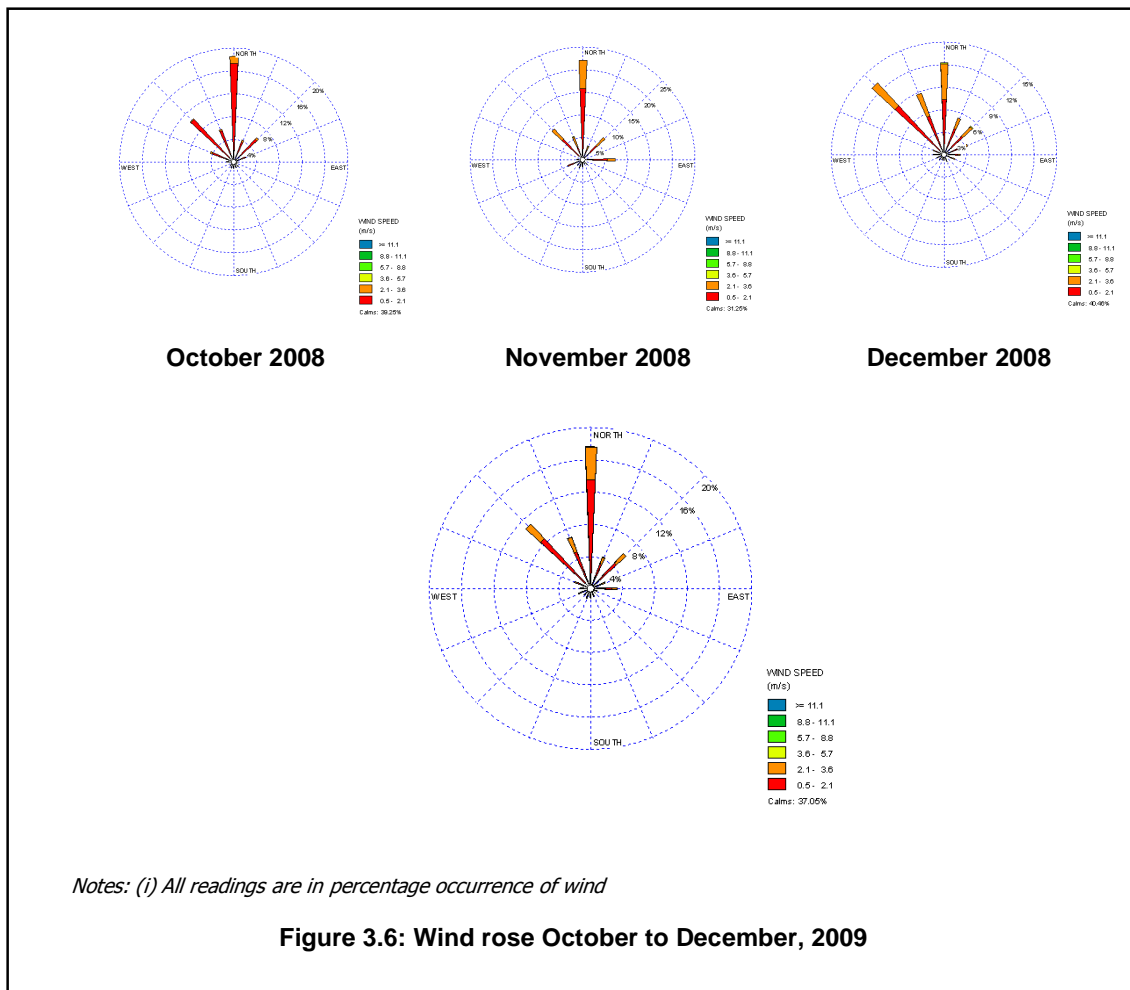
Source: GreenC On-Site Monitoring (Oct – Dec, 2009)

3.6.2.1 Temperature: The maximum and minimum dry bulb temperatures recorded during the study period were 32.9°C in October and 14.2°C in December respectively. The average temperature was calculated at 22.6°C.

3.6.2.2 Relative Humidity: During the study period, mean humidity was recorded at 66.2% while maximum and minimum humidity were observed as 78% and 43% respectively.

3.6.2.3 Rainfall: During the field monitoring survey the maximum rainfall i.e. 8 mm was experienced in October. No rainfall was observed during the months of November and December.

3.6.2.4 Wind Characteristics: During the study period, the average wind velocity was observed to be 4.1 m/s. The 24 hour wind rose was prepared using the data on wind direction and speed collected for study period. The predominant wind direction recorded was N followed by NW as the second predominant. The wind rose diagram of the study period is shown in Figure 3.6.



The detailed hourly meteorological data as collected during the primary survey is presented in Annexure IV.

3.6.3 Comparison of Site Meteorological Data with Climatological Data

The frequency and time of collection of data at the site differs from that of IMD Champa. A comparison of site data generated during the three months with that of IMD, Champa reveals the following:

- ❖ The temperatures show the similar trend in both the cases.
- ❖ The rainfall recorded at site was found to be less than that recorded by IMD, Champa.
- ❖ The relative humidity levels at site follow the similar trend as IMD, Champa.
- ❖ The wind speed at site is found one higher side compare to IMD, Champa.
- ❖ The predominant wind direction is same for both the data.

3.7 AIR ENVIRONMENT

The study area represents a rural environment. The sources of air pollution in the region are vehicular traffic, dusts arising from unpaved village roads, and domestic fuel burning and fugitive emissions. The prime objective of the baseline air quality study was to establish the existing ambient air quality of the area. This will also be useful for assessing the conformity to standards of the ambient air quality during the operation of the proposed power plant. This section describes the identification of sampling locations, methodology adopted for monitoring, and frequency of sampling and results of monitoring during the study period.

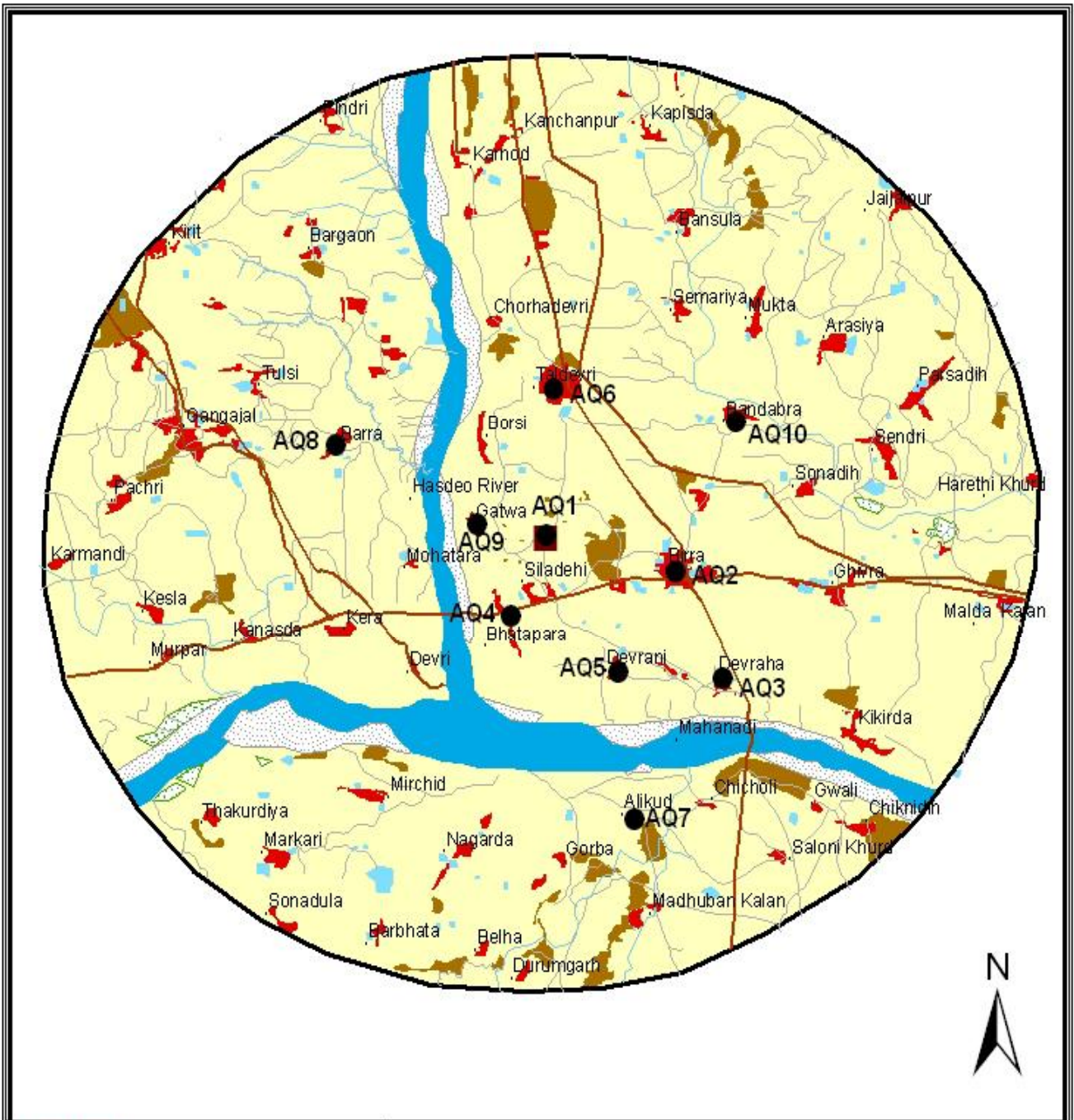
3.7.1 Air Monitoring Location

The air quality monitoring has been carried out at ten different locations. The details of the monitoring are depicted in **Table 3.7** and **Figure 3.7**. The selection of AAQ monitoring locations was principally governed by the wind rose pattern for the Post-monsoon season and also the accessibility of the selected sites. Major environmental receptors such as settlements etc. were also considered for selection of monitoring locations in the 10 km radius study area.

Table 3.7: Details of AAQ Monitoring Locations

S. No.	Location	Code	Distance in km w.r.t. site	Direction w.r.t site	Criteria for Selection
1.	Siladehi	AQ1	0	-	On-site
2.	Birra	AQ2	1.0	ESE	Nearest major settlement
3.	Devraha	AQ3	4.5	SE	Predominant downwind quadrant
4.	Bhatpara	AQ4	2	S	Predominant downwind
5.	Devrani	AQ5	3.5	SSE	Predominant downwind
6.	Taldevri	AQ6	2.5	N	Upwind
7.	Alikud	AQ7	6.5	S	Predominant downwind
8.	Barra	AQ8	4.5	WNW	2 nd Predominant Upwind
9.	Gatwa	AQ9	1.0	NNW	Nearest settlement to site
10.	Bandabra	AQ10	4.5	NE	Near main road

Source: Field Monitoring, GreenC (Oct-Dec) 2009



Legend

- Air Monitoring Locations
- Proposed Site
- Streams
- Minor Streams
- Roads
- Study Area
- River
- ▨ Sandy Area
- ▨ Vegetation
- Settlement
- Pond
- Barren Land
- Agricultural Land

**AAQ Monitoring Locations Map
(within 10 Km radius)**

Project Proponent:

MB Power (Chhattisgarh) Ltd.

Scale:



Figure 3.7

3.7.2 Sampling Method

3.7.2.1 Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two samples per week at three or four locations at a time. The baseline data of ambient air has been generated for the following parameters as mentioned below:

- Suspended Particulate Matter (SPM);
- Respirable Suspended Particulate Matter (RSPM);
- PM 2.5
- Sulphur Dioxide (SO₂);
- Oxides of Nitrogen (NO_x);
- Mercury (Hg).

3.7.2.2 Instruments used for Sampling

Respirable Dust Samplers APM-451 of Envirotech Instrument Pvt. Ltd. make were installed for monitoring Suspended Particulate Matter (SPM), Respirable fraction (<10 microns) and gaseous pollutants like SO₂ and NO_x. Whereas the concentration Particulate matter 2.5 was monitored by installing Envirotech made APM 50MFC particulate matter sampler.

Mercury in ambient air was monitored electro-thermal atomic absorption spectro-photometric method. The dust samples for mercury analysis are collected on EPM 2000 filter papers using respirable dust high volume samplers.

3.7.2.3 Sampling and Analytical Techniques

SPM and RSPM present in ambient air are sucked through the cyclone. Coarse and non-respirable dust is separated from the air stream by centrifugal forces SPM and RPM have been Suspended Particulate Matter and RSPM present in ambient air is sucked through the cyclone acting on the solid particles.

These separated particulates fall through the cyclone's conical hopper and collected in the sampling cap placed at the bottom. The fine dust (<10 microns) forming the respirable fraction of the TSPM passes the cyclone and is retained by the filter paper. A tapping is provided on the suction side of the blower to provide suction for sampling air through a set of impingers. The techniques used for ambient air quality monitoring are as under:

Table 3.8: Techniques Used For Ambient Air Quality Monitoring

Parameter	Technique	Technical Protocol
Suspended Particulate Matter	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)
Respirable Particulate Matter	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)
PM 2.5	APM 550 Fine Particle Sampler	
Sulphur Dioxide	West and Gaeke	IS-5182 (Part-II)
Oxides of Nitrogen	Jacob and Hochheiser	IS-5182 (Part-IV)

3.7.3 Analysis of Baseline Concentrations

Specific station-wise Ambient Air Quality (AAQ) data for SPM, PM₁₀, PM_{2.5}, SO₂, NO_x and Ozone as recorded during the period from October to December, 2009 are summarized in **Tables 3.9 to 3.14**.

Table 3.9: Ambient Air Quality (SPM) in $\mu\text{g}/\text{m}^3$

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	130.0	139.3	2.4	135.3	138.9
AQ2	24	136.4	152.6	4.0	146.6	152.5
AQ3	24	140.3	165.2	4.5	149.4	159.3
AQ4	24	131.9	153.8	6.8	142.0	152.6
AQ5	24	131.2	147.9	4.7	139.5	147.0
AQ6	24	128.2	146.2	4.2	134.5	143.4
AQ7	24	121.1	140.2	5.2	129.7	139.2
AQ8	24	121.3	141.8	5.1	128.3	139.2
AQ9	24	132.4	147.9	4.9	139.8	147.0
AQ10	24	135.6	153.7	5.2	144.3	153.5

Table 3.10: Ambient Air Quality (PM10) in $\mu\text{g}/\text{m}^3$

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	40.4	46.3	1.5	43.5	46.0
AQ2	24	42.7	47.8	1.4	44.8	47.4
AQ3	24	44.6	53.7	2.2	50.2	53.2
AQ4	24	41.3	56.0	4.3	47.4	55.7
AQ5	24	33.2	53.7	5.2	44.6	52.9
AQ6	24	38.3	52.1	3.8	44.2	51.4
AQ7	24	36.8	49.2	3.4	43.1	49.1
AQ8	24	29.3	41.5	3.3	36.0	41.1
AQ9	24	35.7	50.4	4.5	44.3	50.3
AQ10	24	39.5	51.3	3.3	44.0	51.0

Table 3.11: Ambient Air Quality (PM2.5) in $\mu\text{g}/\text{m}^3$

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	15.6	23.8	2.2	20.2	23.6
AQ2	24	19.1	25.8	1.9	22.1	25.3
AQ3	24	18.2	28.6	2.4	23.2	27.7
AQ4	24	18.5	27.8	2.4	22.3	26.8
AQ5	24	15.7	26.2	3.1	21.1	25.7
AQ6	24	14.5	25.4	2.6	20.0	24.5
AQ7	24	16.5	24.7	2.2	20.1	24.1
AQ8	24	13.5	21.5	2.1	16.8	21.3
AQ9	24	17.8	25.7	2.3	22.7	25.4
AQ10	24	19.7	25.7	1.7	22.7	25.2

Table 3.12: Ambient Air Quality (SO₂) in $\mu\text{g}/\text{m}^3$

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	6.2	12.3	1.7	9.2	11.7
AQ2	24	7.0	14.2	1.8	9.7	13.5
AQ3	24	6.3	12.0	1.7	9.0	11.9
AQ4	24	6.5	11.5	1.4	8.5	11.4
AQ5	24	6.4	11.5	1.6	8.7	11.4
AQ6	24	6.0	11.8	1.5	8.2	11.3
AQ7	24	6.1	10.7	1.2	8.0	10.4
AQ8	24	5.1	9.2	1.2	7.0	9.2
AQ9	24	6.2	10.9	1.4	8.5	10.8

AQ10	24	6.1	10.0	0.9	7.9	9.7
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Table 3.13: Ambient Air Quality (NO_x) in µg/m³

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	6.4	12.8	1.8	9.3	12.6
AQ2	24	7.1	11.3	1.3	9.2	11.2
AQ3	24	7.2	12.3	1.5	9.5	12.1
AQ4	24	6.2	14.6	2.0	9.0	13.6
AQ5	24	6.3	12.1	1.6	8.9	11.6
AQ6	24	6.0	12.4	1.8	8.2	12.3
AQ7	24	5.7	12.3	1.6	8.1	11.6
AQ8	24	5.3	11.3	1.5	7.6	11.3
AQ9	24	6.7	11.9	1.5	8.8	11.5
AQ10	24	6.2	10.7	1.2	8.1	10.5

Table 3.14: Ambient Air Quality (Ozone) in µg/m³

Stn. Code	No. of Sample	Minimum	Maximum	Std dev	Average	98 Percentile
AQ1	24	7.0	8.7	0.4	7.4	8.4
AQ2	24	7.0	7.9	0.3	7.4	7.9
AQ3	24	7.0	8.0	0.3	7.4	8.0
AQ4	24	7.0	8.0	0.4	7.5	8.0
AQ5	24	7.0	8.2	0.4	7.6	8.2
AQ6	24	7.0	8.3	0.4	7.4	8.1
AQ7	24	7.0	8.2	0.4	7.4	8.1
AQ8	24	7.0	8.4	0.4	7.4	8.3
AQ9	24	7.0	8.5	0.5	7.6	8.5
AQ10	24	7.0	8.4	0.4	7.5	8.4

Source: Field monitoring by GreenC (Oct-Dec) 2009

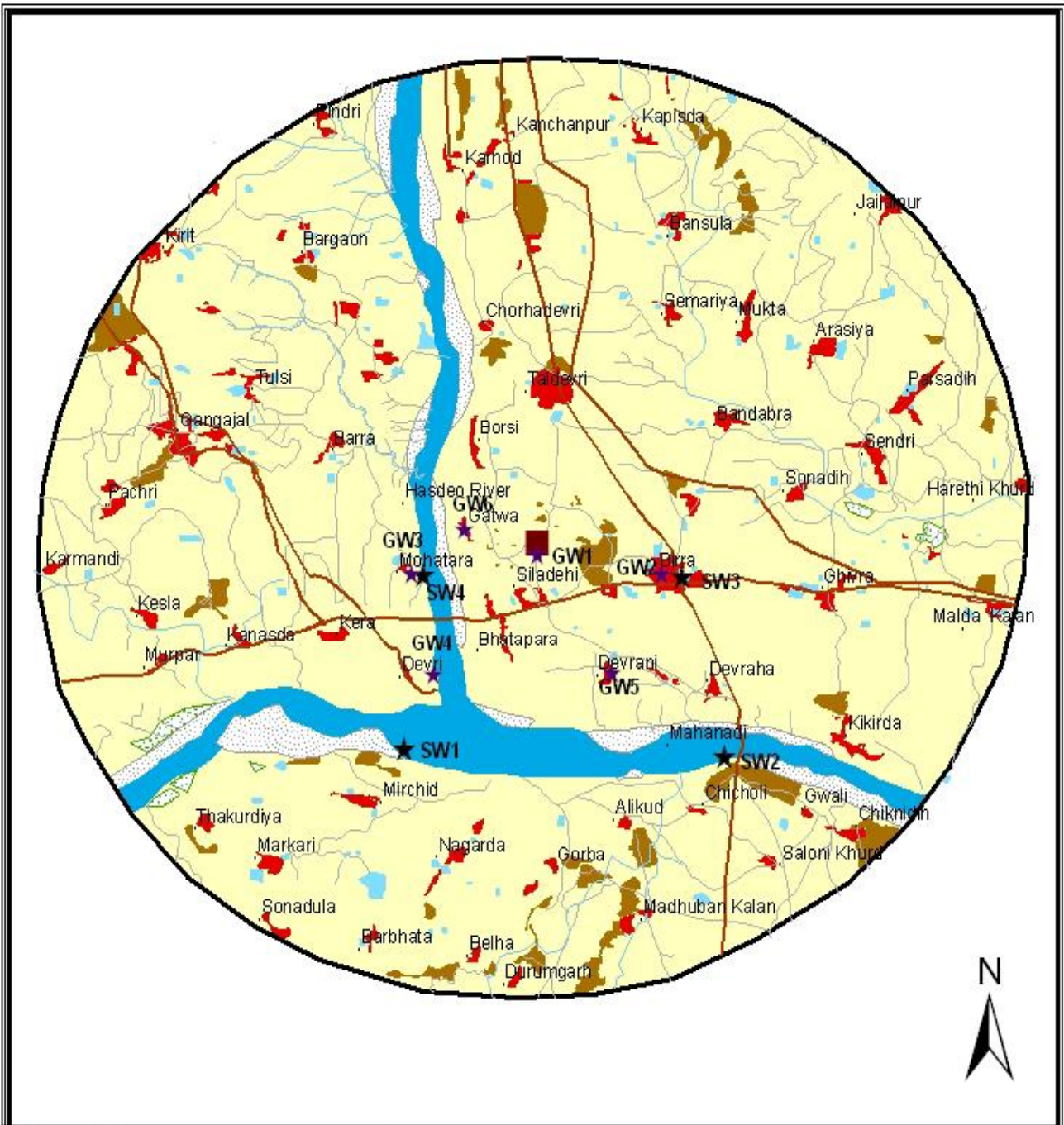
Overall Baseline Ambient Air Quality

Table 3.15: Consolidated Values of AAQ (98th Percentile Values (µg/m³))

Village	Station Code	SPM	PM10	PM 2.5	SO ₂	NO _x	Ozone
On-Site	AQ1	138.9	46.0	23.6	11.7	12.6	8.4
Birra	AQ2	152.5	47.4	25.3	13.5	11.2	7.9
Devraha	AQ3	159.3	53.2	27.7	11.9	12.1	8.0
Bhatpara	AQ4	152.6	55.7	26.8	11.4	13.6	8.0
Devrani	AQ5	147.0	52.9	25.7	11.4	11.6	8.2
Taldevri	AQ6	143.4	51.4	24.5	11.3	12.3	8.4
Alikud	AQ7	139.2	49.1	24.1	10.4	11.6	8.1
Barra	AQ8	139.2	41.1	21.3	9.2	11.3	8.3
Gatwa	AQ9	147.0	50.3	25.4	10.8	11.5	8.5
Bandabra	AQ10	153.5	51.0	25.2	9.7	10.5	8.4
Standards (Concentration in µg/m³) 24 hours*		SPM	RSPM	PM 2.5	SO₂	NO_x	Ozone**
Industrial, Residential, Rural & other Areas		200	100	60	80	80	180
Sensitive Areas		100	100	60	80	80	180

* 24 hourly 8 hourly values should be met 98% of the time of the year. However 2% of the time it may exceed but not on two consecutive days

** Standards (Concentration in µg/mg³) 8 hours



Legend

- ★ Groundwater Sample Locations
- ★ Surface water Sample Locations
- Proposed Site
- Streams
- Minor Streams
- Roads
- Study Area
- River
- Sandy Area
- Vegetation
- Settlement
- Pond
- Barren Land
- Agricultural Land

**Water Sampling Locations Map
(within 10 Km radius)**

Project Proponent:

MB Power (Chhattisgarh) Ltd.

Scale:



Figure 3.8

It may be seen from above that P_{98} value of SPM varied between 138.9 and 159.3 $\mu\text{g}/\text{m}^3$. The 24-hrs PM10 level of ambient air during monitoring period was recorded between 41.1 and 55.7 $\mu\text{g}/\text{m}^3$ as against allowable value of 100 $\mu\text{g}/\text{m}^3$ stipulated in National Ambient Air Quality Standards (NAAQS) for industrial, residential and rural area. The PM2.5 value (P_{98}) was found between 21.3 to 27.7 $\mu\text{g}/\text{m}^3$. Similarly values of SO_2 and NO_x were found to be ranging from 9.2 to 13.5 $\mu\text{g}/\text{m}^3$ and 10.5 to 13.6 $\mu\text{g}/\text{m}^3$ respectively.

The range of ozone varied from 7.9 to 8.5 $\mu\text{g}/\text{m}^3$. However, concentration of Mercury (Hg) was found below detectable limit i.e. 5 ppb (detectable limit of the method) during study period. On the whole, the prevailing ambient air quality within the study area is well within the NAAQS standard.

3.8 WATER ENVIRONMENT

3.8.1 Description on Area Drainage

The plant area is located near the confluence of Hasdeo River with the Mahanadi River. There are two minor canals (for irrigation) at the southern boundary of the project site and flows in north-south direction. It was found that the water supply in this canal is very erratic and at times there is no supply for the whole year. One of the branches ends in the site and was meant to supply water to the lands acquired under the plant. The other branch will be suitably diverted so that there is no impact on downstream water users. Other than the canals, there are some seasonal first order nalas starting within the site and flowing towards Mahanadi.

Mahanadi River: The Mahanadi rises near Nagri town in Raipur district of Chhattisgarh. About 13km above Sheorinarayan, near Khargahni in Bilaspur district, the Seonath joins Mahanadi from the left. Beyond this confluence, the Mahanadi takes an easterly course for a length of about 138km. It receives the tributary Jonk from south near Sheorinarayan. The Hasdeo joins from the north about 17 km further lower down near Mahuadih. It forms a braided course about 21km long while receiving Barai River from north.

Hasdeo River: It rises at an elevation of about 915 m at a place nearly 10 km north of Sonhat in the Sarguja district of Chhattisgarh. Hasdeo flows through Korba and Champa townships. The Hasdeo River flows for about 333 km to join the Mahanadi on its left near village Mahuadih. It has a catchment area of about 10457 sq km.

3.8.2 Water Quality

3.8.2.1 Water Monitoring Locations

Water samples have been collected from six locations for ground water and four locations for surface water. This water sample analysis has been carried out in the laboratory as per the methods described in APHA, 2005. The details of the sampling locations are mentioned in **Table 3.16** and shown in **Figure 3.8**.

Table 3.16: Details of Water Sample Collection Locations

Code	Location	Distance & Direction	Selection Criteria
Ground Water			
GW 1	Siladehi	Site	To assess the water quality near Ash Pond area
GW 2	Birra	1km, E	To assess present quality of ground water used for drinking
GW3	Mohatara	2km, W	To assess water quality in the settlement near Hasdeo River

GW4	Devri	3km, SW	To assess the water quality near Mahanadi River
GW5	Devrani	3km, SE	To assess drinking water quality of major settlement.
GW6	Gatwa	1km, W	To assess the water quality of project affected village
Surface Water			
SW1	Mahanadi upstream (at Mirchid)	4km, SW	To assess the quality of main water body in the region
SW2	Mahanadi downstream (at Chicholi)	4km, SE	To assess the future impact of the proposed project on downstream of water source
SW3	Pond at Birra Village	1km, E	To assess local surface water quality of the region
SW4	Hasdeo at Mohatara	2km, W	To assess surface water quality of nearby major river

Source: Field monitoring by GreenC (Oct-Dec) 2009

3.8.2.2 Methodology of Sampling and Analysis

The surface and ground water quality characteristics of the study area have been established through monthly monitoring of the following parameters:

- **Physical Parameters** - pH, temperature, conductivity, total suspended solids and dissolved oxygen.
- **Chemical parameters** - Total dissolved solids, alkalinity, hardness, NO₃, Cl, SO₄, Na, K, Ca, Mg, Phenolic compounds, BOD and COD etc.
- **Heavy metals** - Cd, Cr⁺⁶, Cu, Fe, Pb, Zn, Hg, As etc.

Water samples were collected once during the study period and analyzed for selected physico-chemical and biological parameters. The parameters such as pH, temperature and DO were analyzed at the site itself at the time of collection of sample (with the help of water testing kit developed by CPCB) while for other parameter, samples were preserved and analyzed in laboratory. Samples were collected, preserved and analyzed as per methods given in Standard Methods for the Examination of Water and Waste Water (APHA, AWWA and WPCF).

3.8.2.3 Ground Water Quality

The physico- chemical characteristics of groundwater quality are depicted in **Table 3.17**

Table 3.17: Ground Water Quality

Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6	IS-2296-1982 Class-C
Colour	Hazan	C/L	C/L	C/L	C/L	C/L	C/L	300
Odour	-	U/O	U/O	U/O	U/O	U/O	U/O	U/O
Turbidity	NTU	1	1	1	1	1	1	\$
pH	--	7.38	7.42	7.18	7.93	7.63	7.74	6.5-8.5
Conductivity	µS/cm	420	460	580	330	440	120	300
Total Dissolve Solids	mg/l	252	276	348	198	264	72	1500
Alkalinity as CaCO ₃	mg/l	127	312	640	484	241	108	200
Total Hardness as CaCO ₃	mg/l	133.0	240.5	237.5	352.0	243.8	52.6	600
Calcium as Ca	mg/l	42	85	67	80	72	12	\$
Magnesium as Mg	mg/l	6.8	6.8	17	37	15.5	5.5	\$

Table 3.17: Ground Water Quality

Parameters	Unit	GW1	GW2	GW3	GW4	GW5	GW6	IS-2296-1982 Class-C
Sodium	mg/l	24	26	23	22	26	21	\$
Potassium	mg/l	0.7	1.2	1.8	1	1.3	1.6	\$
Bicarbonate	mg/l	154.9	380.6	780.8	590.5	294.0	131.8	\$
Chloride as Cl	mg/l	22	62	42	39	12	20	600
Sulphate as SO ₄	mg/l	2.3	3.4	4.2	2.7	2.9	3.0	400
Nitrate as NO ₃	mg/l	3.6	2.2	2.7	3.1	3.3	3.5	50
Fluoride as F	mg/l	0.45	0.62	0.34	0.54	0.48	0.42	1.5
Phenolic compound as C ₆ H ₅ OH	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	50
Cyanide	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	
Aluminum	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	1.5
Arsenic	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	\$
Cadmium	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.01
Chromium as Cr ⁺⁶	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05
Iron	mg/l	0.12	0.21	0.15	0.1	0.1	0.1	0.2
Copper	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05
Lead	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.1
Manganese	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	15
Mercury	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	0.05
Zinc	mg/l	0.12	0.35	0.45	0.53	0.30	0.25	

Source: Field monitoring by GreenC (Oct-Dec) 2009

From the sample analysis, it was found that the pH of the ground water was found ranging from 7.18 to 7.93. The TDS values were found in the range of 72 to 348 mg/l. The hardness values were in the range of 52.6 to 352.0 mg/l and the calcium and magnesium were in the range of 12 to 85 mg/l and 5.5 to 37.0 mg/l respectively.

The heavy metals such as Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, and Zinc are all found within drinking water standards. In general, the groundwater quality indicates that the groundwater bodies are not polluted and can be used for drinking purpose after necessary disinfection.

3.8.2.4 Surface Water Quality

The physico- chemical characteristics of surface water quality are depicted in **Table 3.18**.

Table 3.18: Surface Water Quality

Parameters	Unit	SW1	SW2	SW3	SW4	IS-2296-1982 Class-C
Colour	Hazan	C/L	C/L	C/L	C/L	300
Odour	-	U/O	U/O	U/O	U/O	U/O
Turbidity	NTU	2	2	2	2	\$
pH	--	7.3	7.1	7.4	7.2	6.5-8.5
Conductivity	µS/cm	330	230	190	210	300
Total Dissolve Solids	mg/l	198	138	114	126	1500
Alkalinity as CaCO ₃	mg/l	55	58	60	68	200
Total Hardness as CaCO ₃	mg/l	70.0	75.0	68.0	62.0	600

Table 3.18: Surface Water Quality

Parameters	Unit	SW1	SW2	SW3	SW4	IS-2296-1982 Class-C
Calcium as Ca	mg/l	16	19.2	14.4	13.6	\$
Magnesium as Mg	mg/l	7.3	6.5	7.7	6.8	\$
Sodium	mg/l	32	46	35	37	\$
Potassium	mg/l	0.7	1.2	1.8	1	\$
Bicarbonate	mg/l	67.1	70.8	73.2	83.0	\$
Chloride as Cl	mg/l	22	62	42	39	600
Sulphate as SO ₄	mg/l	2.3	3.4	4.2	2.7	400
Nitrate as NO ₃	mg/l	3.6	2.2	2.7	3.1	50
Fluoride as F	mg/l	0.46	0.38	0.32	0.43	1.5
Phenolic compound as C ₆ H ₅ OH	mg/l	BDL	BDL	BDL	BDL	50
Cyanide	mg/l	BDL	BDL	BDL	BDL	
Aluminum	mg/l	BDL	BDL	BDL	BDL	1.5
Arsenic	mg/l	BDL	BDL	BDL	BDL	\$
Cadmium	mg/l	BDL	BDL	BDL	BDL	0.01
Chromium as Cr ⁺⁶	mg/l	BDL	BDL	BDL	BDL	0.05
Iron	mg/l	0.28	0.31	0.23	0.3	0.2
Copper	mg/l	BDL	BDL	BDL	BDL	0.05
Lead	mg/l	BDL	BDL	BDL	BDL	0.1
Manganese	mg/l	BDL	BDL	BDL	BDL	15
Mercury	mg/l	BDL	BDL	BDL	BDL	0.05
Zinc	mg/l	0.18	0.22	0.35	0.32	
Dissolved Oxygen (D.O)	mg/l	5.9	6.2	6.4	5.2	
BOD	mg/l	3.4	3.7	4.1	3.2	
Total Coliform	MPN/100ml	620	590	470	530	

Source: Field monitoring by GreenC (Oct-Dec) 2009

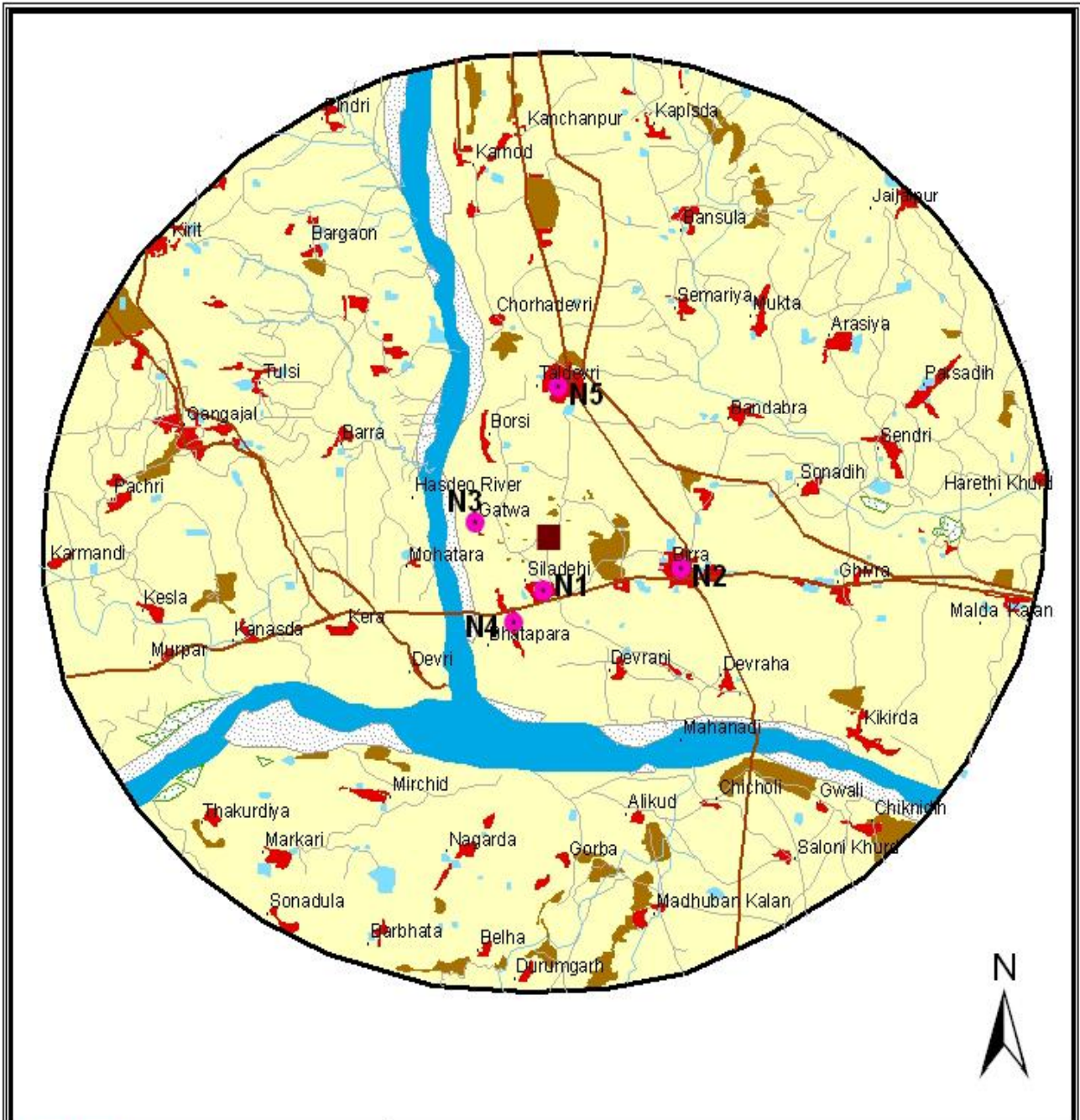
The pH and TDS of the surface water samples are found normal with pH range of 7.1 to 7.4 and TDS between 114 and 198. The values of hardness, calcium and magnesium, chloride, sulphate, nitrate values are also found well within the limits of drinking water standard prescribed by BIS (IS 10,500: 1991).

The heavy metals such as Arsenic, Cadmium, Chromium, Copper, Lead and Mercury are all found below detection limits. Although low concentrations of iron and zinc are found, they are within drinking water standards. The BOD values observed as 3.2 mg/l to 4.1 mg/l are well within the prescribed limits.

3.9 NOISE LEVEL MEASUREMENT

The baseline assessment of prevailing noise levels in and around the study area is an important parameter in preparation of impact assessment report. Impact of noise sources on environment depend upon the sources which are generating noise and their respective characteristics. Noise levels are more annoying in the night time particularly in the residential area. The environmental impact of noise can have several effects varying from hearing loss to annoyance depending on loudness of noise levels.

In the present study, Sound Pressure Level (SPL) was measured by a sophisticated sound level meter (Integrating Sound Level Meter Cygnet, Model 2031A). Since loudness of sound is important by its effects on people, the dependence of loudness upon frequency must be



Legend

- Noise Monitoring Locations
- Proposed Site
- Streams
- Minor Streams
- Roads
- Study Area
- River
- Sandy Area
- Vegetation
- Settlement
- Pond
- Barren Land
- Agricultural Land

**Noise Monitoring Locations Map
(within 10 Km radius)**

Project Proponent:

MB Power (Chhattisgarh) Ltd.

Scale:



Figure 3.9

taken into account in environmental noise assessment. This has been achieved by the use of A-weighting filters in the noise measuring instrument which gives a direct reading of approximate loudness.

The ambient noise levels equivalent for 1 hr duration at 5 different locations were recorded keeping in view the traffic movement and other activities in the region. The details of the monitoring stations are given in **Table 3.19** and are portrayed in **Figure 3.9**.

Table 3.19: Details of Noise Monitoring Locations

Code	Location	Distance w.r.t Centre	Direction w.r.t Centre	Environmental Setting
N1	Siladehi	0.5	S	Southern boundary of plant site near road leading to Seorinarayan
N2	Birra	1.0	E	Residential cum commercial area as well as a road junction.
N3	Gatwa	1.0	W	Residential area surrounded by houses and agricultural fields
N4	Bhatapara	2.0	S	Residential areas on main road leading to Seorinarayan
N5	Taldevrahi	3.0	NE	Residential areas on main road leading to Champa

3.9.1 Parameters Measured

The important parameters to be measured are L_{eq} , L_{day} , and L_{night} .

L_{eq} : Noise monitoring equipments have the facility for measurement of L_{eq} directly. However, L_{eq} can also be calculated using the following equation:

$$L_{eq} (hrly) = L_{50} + (L_{10} - L_{90})^2 / 60$$

where,

L_{10} (Ten Percentile Exceeding Level) is the level of sound, which exceeds 10% of the total time of measurement.

L_{50} (Fifty Percentile Exceeding Level) is the level of sound, which exceeds 50% of the total time of measurement.

L_{90} (Ninety Percentile Exceeding Level) is the level of sound, which exceeds 90% of the total time of measurement.

L_{day} : This represents L_{eq} of day-time. L_{day} is calculated as logarithmic average using the hourly L_{eq} 's for day time hours from 6.00 A.M to 10.00 P.M

L_{night} : This represents L_{eq} of night-time. L_{night} is calculated as logarithmic average using the hourly L_{eq} 's for night time hours from 10.00 PM to 6.00 A.M.

3.9.2 Noise Standards

The Ambient Air Quality Standards with respect to noise have been stipulated by Govt. of India vide Gazette Notification dt. 14.02.2000. **Table 3.20** describes the Ambient Noise Standards.

Table 3.20: Ambient Noise Standards (CPCB)

Area Code	Category of Area	Limits in dB(A), L_{eq}	
		Day time	Night time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45



D	Silence Zone*	50	40
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* Silence zone is defined as an area up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the competent authority;

3.9.3 Noise Levels

From **Table 3.21**, it is observed that the present noise levels of the study area are well within the prescribed standards of CPCB norms.

Table 3.21: Noise Levels

Location	Day			Night		
	L Max	L Min	L eq	L Max	L Min	L eq
Siladehi	44.0	40.3	41.6	35.8	28.6	33.5
Birra	46.0	36.0	42.3	39.0	32.0	36.0
Gatwa	47.3	40.0	45.0	40.2	32.1	36.1
Bhatapara	48.2	36.2	43.9	39.0	36.0	37.8
Taldevrahi	43.4	33.2	38.5	36.2	28.3	32.6

Source: Field monitoring by GreenC (Oct-Dec) 2009

3.10 ECOLOGICAL ENVIRONMENT

3.10.1 Forest Land in the Region

The district of Janjgir Champa has 156 Sq.km¹ of forest cover (4.5% of total land area). The total forest cover of the state is about 41 percent. As already mentioned in the land-use, there is no forest within the 10-km study area. In terms of forest land in the district the total area occupied is 250.1 km².

3.10.2 Flora in the Study Area

The flora of the region can be divided into natural vegetation / forest vegetation, shrubs, herbs / grasses and plantation vegetation raised by forest department in the degraded forest areas. In the study area, the number of species was limited and it was found that there was a lack of impressive vegetation cover in the whole study area. The list of flora in the region is mentioned below in the **Table 3.22**.

Table 3.22: Flora of the Study Area

No	Botanical Name	Local Name	S No	Botanical Name	Local Name
A. Trees					
1.	<i>Acacia arabica</i>	Babul	37.	<i>Gardenia latifolia</i>	Papra
2.	<i>Acacia catechu</i>	Khair	38.	<i>Gmelina arborea</i>	Gamhar
3.	<i>Adina cordifolia</i>	Karam	39.	<i>Grewia hirsuta</i>	Gursukhi
4.	<i>Ailanthus excelsa</i>	Ghorkaranj	40.	<i>Holarrhena antidysentrica</i>	Koreya
5.	<i>Alangium Lamarckii</i>	Dhela	41.	<i>Holoptelea integrifolia</i>	Chilbil
6.	<i>Albizia lebbek</i>	Siris	42.	<i>Hymenodictyon excelsum</i>	Bhurkur
7.	<i>Alstonia scholaris</i>	Chatni	43.	<i>Lagerstroemia parviflora</i>	Sidha
8.	<i>Anogeissus latifolia</i>	Dhautha	44.	<i>Lannea grandis</i>	Genjan
9.	<i>Artocarpus lakoocha</i>	Barhar	45.	<i>Madhuca latifolia</i>	Mahua
10.	<i>Azadirachta indica</i>	Neem	46.	<i>Mangifera indica</i>	Mango

¹ Source: Forest Survey of India Report 2005

Table 3.22: Flora of the Study Area

No	Botanical Name	Local Name	S No	Botanical Name	Local Name
11.	<i>Bauhinia racemosa</i>	Katmauli	47.	<i>Melia azedarach</i>	Bakain
12.	<i>Bauhinia retusa</i>	Kathul	48.	<i>Michelia champaca</i>	Champa
13.	<i>Bauhinia variegata</i>	Kachnar	49.	<i>Morinda tinctoria</i>	Ach
14.	<i>Bombax ceiba</i>	Semal	50.	<i>Murraya exotica</i>	Kamini/Otel
15.	<i>Boswellia serrata</i>	Salia	51.	<i>Oroxylum indicum</i>	Sonapatta
16.	<i>Bridelia retusa</i>	Kajhi	52.	<i>Ougeinia oojenensis</i>	Sandam
17.	<i>Buchanania lanzan</i>	Piar	53.	<i>Polyalthia cerasioides</i>	Kudmi
18.	<i>Butea frondosa</i>	Palas	54.	<i>Pongamia glabra</i>	Karanj
19.	<i>Casearia tomentosa</i>	Beri	55.	<i>Pterocarpus marsupium</i>	Bia/Paisar
20.	<i>Cassia fistula</i>	Dhanraj	56.	<i>Rubia cordifolia</i>	Jotsingh
21.	<i>Cordia Macleodii</i>	Belwanjan	57.	<i>Sapindus Mukorossi</i>	Ritha
22.	<i>Cordia myxa</i>	Bahuar	58.	<i>Schleichera oleosa</i>	Kusum
23.	<i>Dalbergia lanceolaria</i>	Hardi	59.	<i>Semecarpus anacardium</i>	Bhelwa
24.	<i>Dalbergia latifolia</i>	Kala Shisham	60.	<i>Shorea robusta</i>	Sal/Sakhua
25.	<i>Dalbergia sissoo</i>	Shisham	61.	<i>Soymida febrifuga</i>	Rohena
26.	<i>Diospyros embryopteris</i>	Madartendu	62.	<i>Sterculia urens</i>	Keonjhi
27.	<i>Diospyros melanoxylon</i>	Tend/Kend	63.	<i>Stereospermum suaveolens</i>	Pader
28.	<i>Ehretia laevis</i>	Bhaire	64.	<i>Tamarindus indica</i>	Imli
29.	<i>Elaeodendron Mukorossi</i>	Ratangur	65.	<i>Tectona grandis</i>	Teak
30.	<i>Emblica officinalis</i>	Amla	66.	<i>Terminalia arjuna</i>	Arjun
31.	<i>Eugenia heyneana</i>	Katjamun	67.	<i>Terminalia chebula</i>	Harra
32.	<i>Eugenia jamb</i>	Jamun	68.	<i>Terminalia tomentosa</i>	Asan
33.	<i>Ficus benghalensis</i>	Ber	69.	<i>Toona ciliata</i>	Toon
34.	<i>Ficus histida</i>	Dimar	70.	<i>Wendlandia exerta</i>	Tilia/Tiril
35.	<i>Ficus religiosa</i>	Pipal	71.	<i>Zizyphus mauritiana</i>	Ber
36.	<i>Ficus tomentosa</i>	Barun	72.	<i>Zizyphus xylopyra</i>	Katber

B. Shrubs And Herbs

S No	Botanical Name	Local Name	S No	Botanical Name	Local Name
1.	<i>Achyranthus aspara</i>	Chirchiri	19.	<i>Hypericum gaitii</i>	Gaiti
2.	<i>Andrographis paniculata</i>	Kalmegh	20.	<i>Indigofera pulchella</i>	Jirhul
3.	<i>Asparagus racemosa</i>	Satawar	21.	<i>Lantana camara</i>	Putus
4.	<i>Calotropis gigantea</i>	Akaon	22.	<i>Nyctanthes arobortristis</i>	Samshihar
5.	<i>Carisa carandas</i>	Kanwar	23.	<i>Phoenix acaulis</i>	Khejur
6.	<i>Carisa spinarum</i>	Jangli Karonda	24.	<i>Rauwolfia spp.</i>	Chandra
7.	<i>Cleistanthus collinus</i>	Kargali	25.	<i>Solanum nigrum</i>	Makoi
8.	<i>Clerodendron infortunatum</i>	Bhant	26.	<i>Solanum xanthocarpum</i>	Rengni
9.	<i>Colebrookia oppositifolia</i>	Binda/Bindhu	27.	<i>Storobilanthus auriculatus</i>	Marmaridara
10.	<i>Croton oblongifolius</i>	Putri	28.	<i>Swertia pulchella</i>	Chiretta
11.	<i>Emblica robusta</i>	Baborang	29.	<i>Symplocas racemosa</i>	Lodh

Table 3.22: Flora of the Study Area

No	Botanical Name	Local Name	S No	Botanical Name	Local Name
12.	<i>Euphorbia hirta</i>	Dudhi	30.	<i>Tephrosia purpurea</i>	Sarpuka
13.	<i>Flacourtia Ramontchi</i>	Katai	31.	<i>Urginea indica</i>	Jangli Piaj
14.	<i>Flemingia stricta</i>	Salpani	32.	<i>Ventilago maderaspatana</i>	Keonti
15.	<i>Flueggia obovata</i>	Sika	33.	<i>Vitex negundo</i>	Sindwar
16.	<i>Gardenia gummifera</i>	Dekamali	34.	<i>Woodfordia fruticosa</i>	Dhawai
17.	<i>Gardenia turgida</i>	Karhar/Dhanu k	35.	<i>Wrightia tinctoria</i>	Adhkapar
18.	<i>Helicteres isora</i>	Aitha/Atham	36.	<i>Zizyphus oenoplia</i>	Dhathora

C. Climbers, Parasites, Orchids

S No	Botanical Name	Local Name	S No	Botanical Name	Local Name
1.	<i>Abrus precatorius</i>	Karjani	9.	<i>Milletia auriculata</i>	Gurnar
2.	<i>Acacia pennata</i>	Arar	10.	<i>Momordica dioica</i>	Keksa
3.	<i>Bauhinia vahlii</i>	Maholan	11.	<i>Mucuna prurita</i>	Alkosi
4.	<i>Butea superba</i>	Dorang	12.	<i>Pogonia spp.</i>	Orchid
5.	<i>Cryptolepsis Buchanani</i>	Dudhia lar	13.	<i>Porana paniculata</i>	Bhidia lar
6.	<i>Cuscuta reflexa</i>	Alaj-jor	14.	<i>Smilax macrophylla</i>	Ram datwan
7.	<i>Ichnocarpus frutescens</i>	Saon lar	15.	<i>Smilax prolifera</i>	Ram datwan
8.	<i>Loranthus spp.</i>	Banda	16.	<i>Viscum spp.</i>	Banda

D. Grasses, Bamboo, Agave

S No	Botanical Name	Local Name	S No	Botanical Name	Local Name
1.	<i>Agave spp.</i>	Moraba	7.	<i>Eulaliopsis binata</i>	Sabai
2.	<i>Apluda varia</i>	Dudhia sauri	8.	<i>Heteropogon contortus</i>	Sauri grass
3.	<i>Bambusa arundinacea</i>	Bara bans	9.	<i>Imperata cylindrica</i>	Ulu
4.	<i>Chrysopogon aciculatus</i>	Chor kanta	10.	<i>Saccharum munja</i>	Munj
5.	<i>Cynodon dactylon</i>	Doob	11.	<i>Thysanolaena agrostis</i>	Jharu grass
6.	<i>Dendro calamus strictus</i>	Bans	12.	<i>Vetiveria zizanioides</i>	Khus-khus

Source: Working Plan, Forest Division

3.10.3 Fauna in the Study Area

The list of fauna and avi-fauna in the region is mentioned below in Table 3.23 and 3.24 respectively.

Table 3.23: Fauna of the Study Area

S No	Local Name	Zoological Name	Schedule
1.	Indian Jackal	<i>Canis orius</i>	Schedule II
2.	Indian Fox	<i>Vulpes bengalensis</i>	Schedule II
3.	Jungle Cat	<i>Felis quas</i>	Schedule II
4.	Common Palm Civet	<i>Paradoxurus hermphoditus</i>	Schedule II
5.	Indian Chameleon	<i>Chameleon zilenicous</i>	Schedule II
6.	Rat Snake	<i>Ptiyas mucosus</i>	Schedule II
7.	Common Langur	<i>Prebitish antelus</i>	Schedule II

Table 3.23: Fauna of the Study Area

S No	Local Name	Zoological Name	Schedule
8.	Rhesus Macaque	<i>Macaca mulata</i>	Schedule II
9.	Small Indian Civet	<i>Viveriquila indica</i>	Schedule II
10.	Grey Musk Shrew	<i>Sunscus meurinus</i>	Schedule III
11.	Nilgai	<i>Boselaphus tragocamelus</i>	Schedule III
12.	Chital, Spotted Deer	<i>Axis axis</i>	Schedule III
13.	Sambhar	<i>Cervus unicolor</i>	Schedule III
14.	Common Skink	<i>Mabua carinata</i>	Schedule III
15.	Barking Deer	<i>Muntiacus muntjak</i>	Schedule III
16.	Wild Boar	<i>Sus scrofa</i>	Schedule III
17.	Striped Hyeana	<i>Hyeana hyeana</i>	Schedule III
18.	Common Stripped Squirrel	<i>Funambulus pennati</i>	Schedule IV
19.	Cobra	<i>Naja naja</i>	Schedule IV
20.	Indian Hare	<i>Lipus nigricolis</i>	Schedule IV
21.	Common Krait	<i>Bengerus corulious</i>	Schedule IV
22.	Garden Lizard	<i>Celotus versicolor</i>	Schedule IV
23.	Short nosed Fruit Bat	<i>Cyneopterus sphinx</i>	Schedule V
24.	Indian Mole Rat	<i>Bondicota bengalensis</i>	Schedule V
25.	Indian Bush Rat	<i>Golanda iliati</i>	Schedule V
26.	White Tailed Wood Rat	<i>Ratatus blanfordy</i>	Schedule V
27.	Indian Field Mouse	<i>Mouse buduga</i>	Schedule V
28.	Long-tailed Mouse	<i>Vendeleuria oleresia</i>	Schedule V

Source: Working Plan, Forest Division

As a result, the faunal diversity of the area was also found to be low. It was found that there are no endangered faunal species in the study area. As already mentioned there is lack of vegetation and forests in the study area and its vicinity.

Table 3.24: Avi-Fauna of the Study Area

Sl.	Zoological Name	English Name	Sl.	Zoological Name	English Name
1	<i>Acridotheres tristis</i>	Myna, Indian	26	<i>Oriolus xanthornus</i>	Oriole, Black-headed
2	<i>Amaurornis phoenicurus</i>	White-breasted water hen	27	<i>Orthotomus sutorius</i>	Bird, Tailor
3	<i>Anas acuta</i>	Duck, Pintail	28	<i>Picoides mahrattensis</i>	Woodpecker
4	<i>Anas crecca</i>	Teal, Common	29	<i>Ploceus benghalensis</i>	Weaver Bird Black-breasted
5	<i>Ardeola grayii</i>	Paddy Bird	30	<i>Ploceus manyar</i>	Weaver Bird, Streaked
6	<i>Bubo zeylonensis</i>	Owl, Brown Fish	31	<i>Pomatorhinus schisticeps</i>	Babbler, Slaty-headed Scimitar
7	<i>Burhinus oediconemus</i>	Curlew, Stone	32	<i>Psittacula eupatria</i>	Parakeet
8	<i>Ceryle rudis</i>	Kingfisher, Pied	33	<i>Psittacula krameri</i>	Parakeet, Rose-ringed
9	<i>Charadrius dubius</i>	Plover, Little Ringed	34	<i>Pterocles exustus</i>	Sandgrouse, Common
10	<i>Circaetus gallicus</i>	Eagle, Short-toed	35	<i>Pycnonotus cafer</i>	Bulbul, Red-vented
11	<i>Cisticola juncidis</i>	Warbler, Streaked Fantail	36	<i>Saxicola caprata</i>	Bushchat, Pied
12	<i>Corvus splendens</i>	Crow, House	37	<i>Streptopelia decaocto</i>	Dove, Ring
13	<i>Cuculus varius</i>	Cuckoo	38	<i>Streptopelia senegalensis</i>	Dove, Little Brown

Table 3.24: Avi-Fauna of the Study Area

SI.	Zoological Name	English Name	SI.	Zoological Name	English Name
14	<i>Dicrurus adsimilis</i>	Drongo, Black	39	<i>Sturnus contra</i>	Myna, Pied
15	<i>Dicrurus caeruleus</i>	Drongo, White-bellied	40	<i>Taccocua leschenaultii</i>	Cuckoo, Sirkeet
16	<i>Dinopium benghalense</i>	Woodpecker, Golden-backed	41	<i>Tephrodornis pondicerianus</i>	Shrike, Common Wood
17	<i>Hirundo rustica</i>	Swallow, Common	42	<i>Treron phoenicoptera</i>	Pigeon, Common Green
18	<i>Hirundo smithii</i>	Swallow, Wire-tailed	43	<i>Tringa glareola</i>	Sandpiper, Wood
19	<i>Lonchura malacca</i>	Munia, Black-headed	44	<i>Tringa hypoleucos</i>	Sandpiper, Common
20	<i>Lonchura punctulata</i>	Munia, Spotted	45	<i>Turdoides caudatus</i>	Babbler, Common
21	<i>Merops leschenaulti</i>	Bee-eater, Chestnut-headed	46	<i>Turdoides striatus</i>	Babbler, Jungle
22	<i>Merops philippinus</i>	Bee-eater, Blue-tailed	47	<i>Turdus merula</i>	Bird, Black
23	<i>Milvus migrans</i>	Kite, Common Pariah	48	<i>Turnix tanki</i>	Yellow-legged Button
24	<i>Mirafra erythroptera</i>	Lark, Red-winged Bush	49	<i>Tyto alba</i>	Owl, Barn or Screech
25	<i>Nectarinia zeylonica</i>	Sunbird, Purple rumped			

Source: Working Plan, Forest Division

3.11 SOCIO – ECONOMIC ENVIRONMENT

3.11.1 Socio-Economic Parameters

The prevailing status of socio-economic aspect comprises of demographic profile, infrastructure, socio-economic condition, literacy level and lifestyle, etc. The proposed project will definitely have some positive impact on the socio-economic environment of the people of surrounding villages experiencing development in the study area. The demographic profile and socio-economic status of the people in the project plant site area and study area is given in **Table 3.25**. The name of the villages located in the Project Influence Area is given in **Annexure V**.

From the table it can be observed that in the project site area, there are 1,723 households covering a population of 10,041 persons as per secondary data. In the 10km study area, there is a population of 87,540 persons in 15,922 households. The literacy rate of the area is average although the female literacy rate was found to be low.

In terms of caste composition, the Scheduled Caste population in the study area is 23.41% while it is 11.19% in plant area. The Scheduled Tribe population in study area comprises of 2.16% of the total population while it is 2.10% in the plant site.

Table 3.25: Socio-economic Status

Parameters	Project Site	Study Area
Population and Household		
Population	10041	87540
Households	1723	15922
Household Size	5.81	5.50
Population Density	249.0	278.8
Caste		
Scheduled Caste	1121(11.19%)	20489(23.41%)
Scheduled Tribe	210(2.10%)	1890(2.16%)
General	8710(86.61%)	65161(74.43%)
Literacy Rate		
Literacy rate	53.3	49.9
Female Literacy Rate	20.53%	18.34%
Occupational Structure		
Cultivator	1953	24772
Agricultural Labours	1357	11027
Household Industries	117	638
Others	1458	2847
Total Workers	4885	39284

Source: Census of India, 2001

Note: The figures given for Project site area are for the whole villages and taken from census data

The occupational structure in both the project site area and study region had predominance of the primary sector with majority of the population depending on agriculture for their livelihood.

3.11.2 Infrastructure Status

The notable feature of the villages is that most of the houses are *kutchha* houses or semi-*pucca* houses. The *pucca* houses are absent in most of the villages. The houses are made of mud with thatched roof. The details of the infrastructure facilities available are given in **Table 3.26**.

The socio-economic analysis of the Project Impact and Project Influence Area shows that in terms of educational and other developments the area is moderately developed. The overall socio-economic status of the target population is low in terms of literacy, Work Participation Rate, access to facilities, etc. More attention and care should be taken so that the affected population can get more exposure to modern facilities of education and development.

Table 3.26: Amenities Available in the Project Influence Area (2001)

S. No	Facilities	Description	No. of Facility in impact area (3 villages)	No. of Facility in influence Area (68 villages)
1	Education facilities	Primary school	7	80
		Middle school	3	20
		Secondary school	2	12
		Senior secondary school	2	8
2	Medical Facilities	Ayurvedic dispensary	0	2
		Maternity & Child Welfare Centre	0	3
		Primary Health Sub Centre	2	12
		Registered Medical Practitioners	2	3
		Community Health workers	1	15
3	Drinking Facilities	Tap	1	2
		Well	4	68
		Tank	6	87
		Tube well	6	92
		Hand pump	3	70
4	Transport Facilities	Bus	1	14
5	Post office facilities	Post office	2	17
6	Bank & credit societies facilities	Commercial bank	1	3
		Cooperative bank	0	1
7	Power supply	Domestic	0	28
		Agriculture	0	1
		Others	0	5

Source: Census of India, 2001

Educational Facilities: Most of the villages in the study area have Primary Schools. Although Middle Schools and Secondary Schools are not available in all villages, still 14 villages have Secondary Schools. The college and high schools are situated about 32 km away in Champa town. For higher education people need to go to Raigarh or Champa.

Health Facilities: The region is moderately developed in terms of health facilities. Basic primary health care facilities are available only in 2 villages and have a catchments area of around 80-90

villages. Primary Health sub-centers are available in 14 villages and Registered Private Medical Practitioners are available in 5 villages. For serious illness people usually go to Champa.

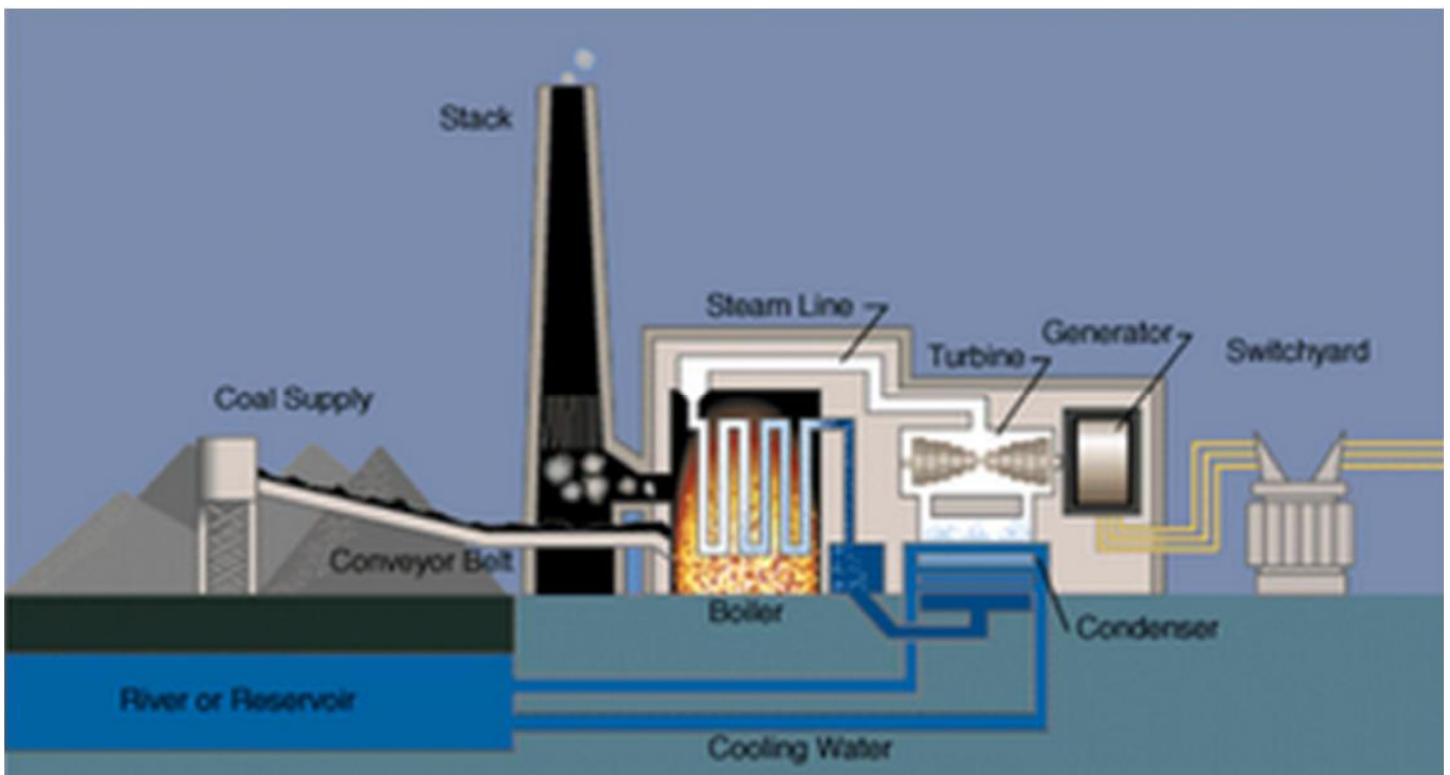
Drinking Water: People generally depend on wells and hand pumps for drinking water. Drinking water is available in all villages and people do not have to spend much time to get drinking water.

Banking: Banking facilities are accessible to people of the area. There are 4 Commercial Banks and 1 Co-operative Banks in the study area.

Credit Societies: There is only 1 Non-agricultural Credit Society in the area.

Chapter 4

Environment Impact Assessment



4. IMPACT ASSESSMENT AND MITIGATION MEASURES

4.1. INTRODUCTION

Prediction of environmental impacts is an important part of impact assessment study as it provides quantitative information related to projection of possible environmental consequences from the proposed project well in advance. Several mathematical / statistical techniques and methodologies are available for predicting impact from any proposed developmental projects on the surrounding physico-chemical, ecological and socio-economic components of environment. The results obtained from the predictions are superimposed over the baseline (pre-project) status of environmental quality to derive the ultimate (post-project) scenario of environmental quality within the impact zone (10km radius) around site. The quantitative impact derived through prediction are also essential to delineate pragmatic environment management plan, especially pollution control measures required to be implemented at different stages of proposed project for minimizing the possible adverse effects on the surrounding environment. This chapter makes an assessment of the environment impacts of the project during the construction and operation phase, considering no mitigation measures.

The construction and operational phase of the proposed project comprises various activities each of which may have an impact on environmental parameters. Various impacts during the construction and operation phase on the environment have been studied to estimate the impact on the environmental attributes and are discussed in the subsequent section. The probable impacts of each of these activities on various sectors of environment have been described under two phases, viz construction phase and operation phase.

4.1.1 Impact during Construction Phase

The impact during construction will be localized and short term with permanent changes in use of surrounding land as compared to the current conditions. Impact will be primarily related to the civil works and less intensive impact is expected during erection of the equipment and trial operation. The details of the activities and probable impact are discussed below in **Table 4.1**.

Table 4.1: Identification of Activities & Probable Impacts (Construction)

Construction Activities	Environment Attribute	Probable Impacts
Land Acquisition	Land	❖ Change in Land Use Pattern ❖ Change in land use pattern in the vicinity
	Socio-economics	❖ Rehabilitation & Resettlement issues
Site clearing and Leveling (cutting, stripping, excavation, earth movement, compaction)	Air	❖ Fugitive Dust Emissions ❖ Noise/ Air Emissions from construction equipment and machinery
	Water	❖ Run-off from area
	Land	❖ Loss of top soil ❖ Change in Drainage Pattern
	Ecology	❖ Loss of vegetation/ habitat

Table 4.1: Identification of Activities & Probable Impacts (Construction)

Construction Activities	Environment Attribute	Probable Impacts
Transportation and Storage of Construction Material / Equipment	Air	❖ Noise and Air Emissions from Vehicles ❖ Fugitive Dust Emissions due to Traffic Movement
	Water	❖ Run-off from Storage Areas of Construction Material
	Public Utilities	❖ Increased flow of traffic
Civil Construction Activities	Air	❖ Noise and Air Emissions from Construction Machinery ❖ Fugitive Dust Emissions
	Water	❖ Run-off from Construction Areas
Mechanical and Electrical Erection Activities	Air	❖ Noise and Air Emissions from Machines/ activities
	Water	❖ Run-off from Erection Areas containing Oil wastes, Paints
Influx of Labour and Construction of Temp. Houses	Socio-economics	❖ Stress on infrastructure ❖ Stress on social relations
	Land	❖ Change in land use pattern of the area
	Water	❖ Sanitary effluents from labour colonies
Transportation and Disposal of Construction Debris	Air	❖ Noise and Air Emissions from Transport Vehicles ❖ Fugitive Dust Emissions due to Movement of Traffic ❖ Spillage and fugitive emissions of debris materials
	Water	❖ Run-off from Disposal Areas
	Soil	❖ Conversion of land into waste land

4.1.2 Impact During Operation Phase

Table 4.2 lists various activities of operation and maintenance phase and their probable impacts on various sectors of environment. The significance of most of these impacts is envisaged to be low, as discussed in the subsequent sections.

Table 4.2: Identification of Activities and Probable Impacts (O&M)

O&M Activities	Sector	Probable Impacts
Transportation of Coal / Oil	Air	❖ Noise and Air Emissions from Vehicles ❖ Fugitive Dust Emissions due to Traffic Movement ❖ Spillage and fugitive emissions of coal
	Water	❖ Spillage of coal and flow into streams
	Public Utilities	❖ Increased flow of traffic
Unloading, Crushing and Storage of Coal/ Unloading and Storage of Oil	Air	❖ Fugitive Dust Emissions from Coal Handling Areas
	Water	❖ Effluents for CHP/ Oil Storage Areas ❖ Run-off from Coal Stock Yard
Burning of Fuel	Air	❖ Stack emissions (TSPM, RSPM, SO ₂ , NOx)
Water Treatment for various uses	Water	❖ Generation of Effluents and sludge from Water Treatment Plant
Power Cycle	Water	❖ Discharge of Blow-down
Equipment Cooling	Water/ Ecology	❖ Discharge of Hot Water containing chemicals/ biocide
Transportation, Storage and Use of Chemicals/ Cl ₂	Air/ Water	❖ Risks of Accidental spillage of chemicals
Transportation and Disposal of Ash	Water	❖ Overflow/ Leachate from Ash Disposal Area
	Land	❖ Land requirement for ash disposal

Table 4.2: Identification of Activities and Probable Impacts (O&M)

O&M Activities	Sector	Probable Impacts
	Air	❖ Fugitive Emissions
Operation of transformers and switchyard	Water	❖ Generation of effluents containing oil
Maintenance (cleaning, over-haul, oil change, lubrication etc.)	Water	❖ Generation of effluents containing oil/ chemicals
Domestic Use of Water in Plant and Township	Water	❖ Generation of sanitary effluents

4.2. IMPACT AND MITIGATION DURING CONSTRUCTION PHASE

4.2.1 Land-use and Topography

Impact

Present land use of the selected site is mainly agricultural land and barren land. The site selected for the project and its surroundings study area are not much developed in terms of built-up properties. The land-use of the area will be industrial after setting up of the plant.

The construction activities usually attract a sizeable influx of population which leads to construction of temporary hutments, having an effect on land-use pattern of the areas surrounding the project. However, this impact is envisaged to be insignificant due to the following reasons:

- Most of the labour will be locally sourced, therefore less negative impact on resources.
- Temporary labour colonies shall be situated inside the project site.
- It will be only a temporary change (restricted to construction period). After construction phase, the areas used for labour colonies shall be reverted back as per the requirement of the plant / green belt / afforestation.

The land is slightly undulating with the average altitude about 226 m above MSL. The slope of the site varies from 220-230 m. Although there will be no requirements for cutting and filling, leveling of land will be required in some areas. Attempt will be made to design the plant according to the gradient of the land.

Mitigation

- Land requirement for the project be optimized.
- Labour colonies should be set up in the designated places.
- The area will be reverted back as per the requirement of the project.

4.2.2 Soil Quality

Impact

Site preparation activities (like site clearing and leveling, excavation, earth movement) and construction activities would result into permanent loss of fertile topsoil of the construction area. The eroded soil may also get carried away by winds and get deposited on the surrounding area, thereby interfering in the free gaseous exchange of the plants. These impacts are envisaged to be insignificant because of the following reasons:

- It shall be confined to the construction areas only *i.e.* main plant area, township area

and proposed ash pond area.

- Removed topsoil may be utilized for landscaping and land improvement in other areas, which are not under construction.
- Afforestation and green belt development will be undertaken during which would help in confining these impacts to construction areas by creating a physical barrier.

Mitigation Measures

- All construction materials will be procured from authorized suppliers.
- Proper arrangements will be made to prevent soil erosion due to deposition of spilled construction materials and flow into water streams.

4.2.3 Air Quality

Impact

The main source of emission during the construction phase is the movement of equipment and vehicles at site. Equipment deployed during the construction phase is also likely to result in marginal increase in the levels of SO₂, NO_x, and particulate matter. However, the impact will be reversible, marginal and temporary in nature. Proper upkeep and maintenance of vehicles, sprinkling of water on roads and construction site, providing sufficient vegetation wherever possible would significantly reduce the dust emission during the construction phase.

The impact will be for short duration and confined within the project boundary and is expected to be negligible outside the plant boundaries. Also as the plant site will be cordoned off by a high boundary wall and planned green belt, particulate impacts will be mostly confined within the plant site.

Mitigation Measures

- Only "PUC" certified vehicles of contractor should be deployed at site.
- Diesel powered vehicles are properly maintained to minimize the exhaust emission as well as noise generation.
- Extensive tree plantation will be carried out along the plant boundary to control spread of fugitive emission.
- Water Sprinkling should be adhered to minimize the dust emission arising out from the excavation, leveling, and transportation and stockpiling activities.
- Continuous monitoring of air quality will be carried out in and around the construction sites

4.2.4 Water Environment

Impact

The generation of domestic sewage discharge from labour colonies and washing of construction materials stockpiled and concrete batching plant may have some impact on surface water and to a smaller degree on groundwater. The main pollutants are organic components and micro-organisms with the potential to cause contamination of surface water and groundwater.

Construction process would include fabrication of steel structures, concrete and related water usage. The potential impact is considered minor as it will be mostly occurring during

construction period and will have no long-term impact with view to persistent pollution. The overall impact on water environment during construction phase due to the proposed project would be short term duration and insignificant.

Mitigation Measures

- Alkaline wash water containing excessive amounts of cement will be settled and neutralized before discharge.
- Domestic waste water to be reused to the extent possible.
- Storage of fuels and chemicals in secure and lined bounded and shall have drainage valves to allow storm water drainage.
- Proper drainage for in plant areas.

4.2.5 Solid Waste

Impact

Solid waste during the construction phase will consist primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, Styrofoam, plastics etc.) and human waste. However, it is expected that there will be generation of sizeable amount of garbage, for which suitable disposal methods have to be devised. Otherwise, it may lead to health hazard for the workers.

Mitigation Measures

- Designate practices of solid waste disposal are to be followed
- The methods for disposal and /or recycle of the waste materials are given in the Environment Management Plan.

4.2.6 Noise Impact

Impact

The major noise generating source during the construction phase is vehicular traffic, construction equipments like dozer, scrapers, concrete mixer, crane, generators pumps, and compressor, rock drills, pneumatic tools, vibrators, etc. During construction, these equipments will generate noise ranging between 75-85 dB(A). The areas close to the site are likely to be affected. To minimize the impact on nearby communities, construction schedules would be optimized to daytime working and scale down activities in night. Extensive earth-moving and movement of heavy equipment would be conducted only during regular working hours (day time).

Overall, the impact of generated noise on the environment is likely to be insignificant, localized in nature and mainly confined to the day hours. The noise level will drop down to the acceptable level, once construction period will be over.

Mitigation Measures

- Regularly maintaining equipments, erection noise enclosures, walls and imposing vehicle speed restrictions.
- Noise and vibration impacts at construction sites will be minimized by:
 - Locating generators as far as possible away from nearby workforce camps.
 - Fitting mufflers to road vehicles and construction equipment

- Adequate personal protective equipment like ear plugs and ear muffs shall be provided to the plant workers to reduce the effect of noise

4.2.7 Ecological Impact

Impact

The effect on biological environment can be divided into two parts, viz. the effect on flora and the effect on fauna. The site for the proposed project is reasonably level ground and would require very little cutting and grading. The initial construction work at the project site involves land clearance. The removal of vegetation from the soil and loosening of the topsoil generally causes soil erosion. However, as there are very few trees in the site area, the impact will be negligible. Impact will be minimized through adoption of imitative measures like paving and surface treatment, water sprinkling etc. The project site will be extensively landscaped with the development of green belts consisting of a variety of plants, which would enrich the ecology of the area and add to aesthetics.

Mitigation Measures

- The transplantation of existing matured trees in the area earmarked for green belt development will be taken up;
- Development of green belt all around the project will be started along with the construction activities to contain the dust and noise due to construction activities. Green belt having density of 2500 trees/hectare will be developed.

4.2.8 Socio-economic Impact

Impact

The non-workers in the study area constitute more than 55%. This indicates the availability of sizeable manpower required for the construction activity in the locality. The project will provide either direct or indirect job opportunities to the local population as far as possible. There will be some migration of labour force from outside during construction phase, which may put some pressure on the local settlements and resources.

However, the flow of men, money and material will affect the socio-economic status of the people in the area. The positive impact may be the increase of employment opportunities for un-skilled and semi-skilled workers. Growth of shops, hotels and other allied services will also open up avenues for employment. The subsequent improvement in the status of the people will also help in increasing the health and education status of the people.

Most of the construction labour will be on contractual basis. As most of the labours during construction phase will be recruited locally, the workers camp will not be large. Therefore, conflict of the migrating labour with local community will not take place during the construction phase.

The positive impacts of may lead to the following:

- Increase in employment opportunity to non-workers in the study area as non-skilled and semi-skilled workers to the contractors/sub-contractors.
- Growth of services (like retail shops, automobile workshops, etc.) and increase in employment and trade opportunities in service sector.
- Influx of persons with higher spending power and different socio-cultural background will improve the socio-cultural environment of the area. Since the area witnessed

industrialization, there may not be socio-cultural conflicts due to the proposed expansion of the project.

- Increase in per capita income and overall economic uplift of the area and improvement in transport, communication, health and educational services.

The negative impacts could be summarized as follows:

- Strain on civic amenities (like road, transport, communication, water supply and sanitation, health care and recreational utilities etc.) due to increase in floating population.
- Increase in consumer prices of indigenous services and produces like egg, fish, vegetables, milk, etc.

Mitigation Measures

- It will be only a temporary change (restricted to construction period). After construction phase, the subsequent improvement in the status of the people will also help in increasing the health, education and civic amenities of the people.

4.2.9 Displacement and R&R Issues

As already mentioned, most of the lands being acquired for the project is private revenue land followed by government lands. It is estimated that around 882 acres is private land while the remaining around 43 acres is government land. The maximum private land as well as government is being acquired at Siladehi. The village-wise distribution of land being acquired is given in **Table 4.3**.

Table 4.3: Village wise & Type wise Land to be acquired (acres)

S. No	Village	Government Land	Private Land	Total
1	Birra	7.20	212.03	219.00
2	Gatwa	3.60	132.27	135.87
3	Siladehi	32.45	537.69	570.14
4	Total	43.25	881.99	925.26

Source: R&R Report, GreenC 2010

The total estimated Project Affected Households will be 831 all of whom are losing land only. Village wise extent of displacement is given in **Table 4.4**.

Table 4.4: Project Affected Households

Name of Village	Number of Project Affected Households			
	Home Oustees	Land Oustees	Home & Land Oustees	Total
Birra	0	212	0	212
Gatwa	0	142	0	142
Siladehi	0	477	0	477
Total	0	831	0	831

Source: R&R Report, GreenC 2010

All the affected households will be provided compensation as per the provisions of Chhattisgarh State R&R Policy as well. These people will also get all the benefits of the CSR activities of this project.

4.2.10 Traffic Congestion

Impact

Traffic volume on nearby roads will increase due to movement of heavy earth moving vehicles (HEMMs) during the construction phase, which may cause public inconvenience. It was observed that the road leading to the proposed plant has medium traffic and has a mix of fast moving and slow moving traffic. Thus addition of the anticipated vehicles during construction phase will not have much impact on the traffic scenario. However, a traffic management plan for the area will be developed to ease the situation.

Mitigation Measures

- Where sections of existing roads are used for transport of construction materials and machinery, subsidiary roads shall be constructed as appropriate, so that the existing roads are not significantly congested. Existing roads will also be strengthened, if required, for transportation of material, goods etc. Also, widening of the roads will be done if it constricted and narrow in vital segments.
- Drivers of trucks / dumpers engaged in construction work will be instructed to give way to passenger buses, cars etc to avoid inconvenience to public transport system.
- Transport of construction materials and machineries shall be carried out during lean traffic period of the day or during night.

4.3. IMPACT AND MITIGATION DURING OPERATION PHASE

4.3.1 Air Impact

4.3.1.1 Operation of Plant

Plant operation could affect the air quality in many ways, such as, gaseous emissions from the stacks, fugitive emissions from raw material (coal) handling and transportation activities. The impact of fugitive emissions from all sources is likely to be restricted over a limited area (up to a maximum distance of 500 m from the source), but the gaseous emissions from the stacks will have an impact over a very wide area. Methodology and results for predicting impact due to stack emissions are presented in the following sections.

4.3.1.2 Air Pollution Modeling

Model Used

In the present case, Industrial Source Complex [ISC3] 1993 dispersion model based on steady state Gaussian plume dispersion, designed for multiple point sources for short term and developed by United States Environmental Protection Agency [USEPA] has been used for prediction of impact on air quality due to operation of the project.

The options used for short-term computations are:

- The plume rise is estimated by Briggs formulae, but the final rise is always limited to that of the mixing layer;
- Stack tip down-wash is not considered;
- Buoyancy Induced Dispersion is used to describe the increase in plume dispersion during the ascension phase;
- Calms processing routine is used by default;
- Flat terrain is used for computations;

- It is assumed that the pollutants do not undergo any physico-chemical transformation and that there is no pollutant removal by dry deposition;
- Washout by rain is not considered;
- Cartesian co-ordinate system has been used for computations; and

The model computations have been done for 10 km with 1000-m interval.

Stack Emission Data

The details of stack emissions for coal consumption are given in **Table 4.5** below and the emission rate calculations are elaborated below.

Table 4.5- Details of Stack Emissions

Parameters	Units	Domestic Coal	Imported Coal
Stack Height	m	275	275
Number of stacks	no.	1	1
Number of Flues in each stack	-	2	2
Internal Exit Diameter of flue	m	7.45	7.45
Flue gas velocity/flue	m/sec	25	25
Flue gas temperature	°C	130	130
Sulphur Content	%	0.37	0.4
Gas flow	Nm ³ /sec/flue	806.2	806.2
Coal consumption (each boiler)	TPH	365.2	336.4
Emission Rates (Per flue)			
Sulphur dioxide	gm/sec	750.7	747.5
Oxides of Nitrogen	gm/sec	604.6	604.6
Particulate Matter	gm/sec	40.3	40.3
Particulate Matter 10	gm/sec	20.1	20.1
Particulate Matter 2.5	gm/sec	8.1	8.1

It is evident from the above table; the total coal consumption is being reduced with the use of imported coal having higher GCV. Except for SO₂ emission rest of emissions like Particulate Matter and NO_x emission will have no change. The emission rate of SO₂ depends on fuel consumption and in this case as the coal consumption is reduced with the use of Higher GCV coal, SO₂ emission is coming down to 747.5 g/sec.

Meteorological Data

Data recorded at the weather monitoring station on at one-hour interval for three months was used as meteorological input. Model simulations have been carried for winter season i.e. Study Period.

Model Output

In the present case model simulations have been carried using the hourly Triple Joint Frequency data. Short-term simulations were carried to estimate concentrations at the receptors to obtain an optimum description of variations in concentrations over 10-km radius covering 16 directions.

Resultant Concentrations after Implementation of the Project

The maximum incremental GLCs due to operation of the proposed project for PM, SO₂ and NO_x due to use of both Indigenous as well as Imported Coal are superimposed on the Percentile 98 baseline concentrations recorded at the monitoring locations during the field monitoring. The cumulative ground level concentrations (baseline + incremental) are tabulated in **Tables 4.6 & 4.7** and **4.8 & 4.9** and shown in **Figure 4.1 to 4.10**.

Table 4.6: Cumulative Resultant Concentrations due to Plant Operation on 24 Hourly basis in µg/m³ (Domestic Coal)

S. No.	Location	Dist. (in km)	Dir.	Baseline GLCs			Incremental GLCs			Cumulative GLCs		
				SPM	SO ₂	NO _x	SPM	SO ₂	NO _x	SPM	SO ₂	NO _x
1	Siladehi	0	-	138.9	11.7	12.6	0.0	0.0	0.0	138.9	11.7	12.6
2	Birra	1	ESE	152.5	13.5	11.2	0.2	4.4	3.5	152.7	17.9	14.7
3	Devraha	4.5	SE	159.3	11.9	12.1	1.1	21.2	17.1	160.4	33.1	29.2
4	Bhatpara	2	S	152.6	11.4	13.6	0.8	15.7	12.7	153.4	27.1	26.3
5	Devrani	3.5	SSE	147.0	11.4	11.6	0.7	13.7	11.0	147.7	25.1	22.6
6	Taldevri	2.5	N	143.4	11.3	12.3	0.0	0.0	0.0	143.4	11.3	12.3
7	Alikud	6.5	S	139.2	10.4	11.6	1.1	20.2	16.2	140.3	30.6	27.8
8	Barra	4.5	NW	139.2	9.2	11.3	0.3	4.8	3.8	139.5	14.0	15.1
9	Gatwa	1	NNW	147.0	10.8	11.5	0.0	0.0	0.0	147.0	10.8	11.5
10	Bandabra	4.5	S	153.5	9.7	10.5	0.0	0.0	0.0	153.5	9.7	10.5

Table 4.7: Cumulative Resultant Concentrations of PM 10 & 2.5 due to Plant Operation on 24 Hourly basis in µg/m³ (Domestic Coal)

S. No.	Location	Dist. (in km)	Dir.	Baseline GLCs		Incremental GLCs		Cumulative GLCs	
				PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
1	Siladehi	0	-	46.0	23.6	0.0	0.0	46.0	23.6
2	Birra	1	ESE	47.4	25.3	0.1	0.1	47.5	25.4
3	Devraha	4.5	SE	53.2	27.7	0.6	0.2	53.8	27.9
4	Bhatpara	2	S	55.7	26.8	0.5	0.2	56.2	27.0
5	Devrani	3.5	SSE	52.9	25.7	0.4	0.2	53.3	25.9
6	Taldevri	2.5	N	51.4	24.5	0.0	0.0	51.4	24.5
7	Alikud	6.5	S	49.1	24.1	0.6	0.2	49.7	24.3
8	Barra	4.5	WNW	41.1	21.3	0.1	0.1	41.2	21.4
9	Gatwa	1	NNW	50.3	25.4	0.0	0.0	50.3	25.4
10	Bandabra	4.5	NE	51.0	25.2	0.0	0.0	51.0	25.2

Table 4.8: Cumulative Resultant Concentrations due to Plant Operation on 24 Hourly basis in µg/m³ (Imported Coal)

S. No.	Location	Dist. (in km)	Dir.	Baseline GLCs			Incremental GLCs			Cumulative GLCs		
				SPM	SO ₂	NO _x	SPM	SO ₂	NO _x	SPM	SO ₂	NO _x
1	Siladehi	0	-	138.9	11.7	12.6	0.0	0.0	0.0	138.9	11.7	12.6
2	Birra	1	ESE	152.5	13.5	11.2	0.2	4.4	3.5	152.7	17.9	14.7
3	Devraha	4.5	SE	159.3	11.9	12.1	1.1	21.1	17.1	160.4	33.0	29.2

Table 4.8: Cumulative Resultant Concentrations due to Plant Operation on 24 Hourly basis in $\mu\text{g}/\text{m}^3$ (Imported Coal)

S. No.	Location	Dist. (in km)	Dir.	Baseline GLCs			Incremental GLCs			Cumulative GLCs		
				SPM	SO ₂	NO _x	SPM	SO ₂	NO _x	SPM	SO ₂	NO _x
4	Bhatpara	2	S	152.6	11.4	13.6	0.8	15.6	12.7	153.4	27.0	26.3
5	Devrani	3.5	SSE	147.0	11.4	11.6	0.7	13.6	11.0	147.7	25.0	22.6
6	Taldevri	2.5	N	143.4	11.3	12.3	0.0	0.0	0.0	143.4	11.3	12.3
7	Alikud	6.5	S	139.2	10.4	11.6	1.1	20.1	16.2	140.3	30.5	27.8
8	Barra	4.5	NW	139.2	9.2	11.3	0.3	4.8	3.8	139.5	14.0	15.1
9	Gatwa	1	NNW	147.0	10.8	11.5	0.0	0.0	0.0	147.0	10.8	11.5
10	Bandabra	4.5	S	153.5	9.7	10.5	0.0	0.0	0.0	153.5	9.7	10.5

Table 4.9: Cumulative Resultant Concentrations of PM 10 & 2.5 due to Plant Operation on 24 Hourly basis in $\mu\text{g}/\text{m}^3$ (Imported Coal)

S. No.	Location	Dist. (in km)	Dir.	Baseline GLCs		Incremental GLCs		Cumulative GLCs	
				PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
1	Siladehi	0	-	46.0	23.6	0.0	0.0	46.0	23.6
2	Birra	1	ESE	47.4	25.3	0.1	0.1	47.5	25.4
3	Devraha	4.5	SE	53.2	27.7	0.6	0.2	53.8	27.9
4	Bhatpara	2	S	55.7	26.8	0.5	0.2	56.2	27.0
5	Devrani	3.5	SSE	52.9	25.7	0.4	0.2	53.3	25.9
6	Taldevri	2.5	N	51.4	24.5	0.0	0.0	51.4	24.5
7	Alikud	6.5	S	49.1	24.1	0.6	0.2	49.7	24.3
8	Barra	4.5	WNW	41.1	21.3	0.1	0.1	41.2	21.4
9	Gatwa	1	NNW	50.3	25.4	0.0	0.0	50.3	25.4
10	Bandabra	4.5	NE	51.0	25.2	0.0	0.0	51.0	25.2

The resultant GLCs of SO₂ due to use of imported coal will be less than the resultant GLCs due to use of Indigenous coal. After implementation of both of the units of project, the maximum GLCs are likely to be within the prescribed standards for rural and residential areas.

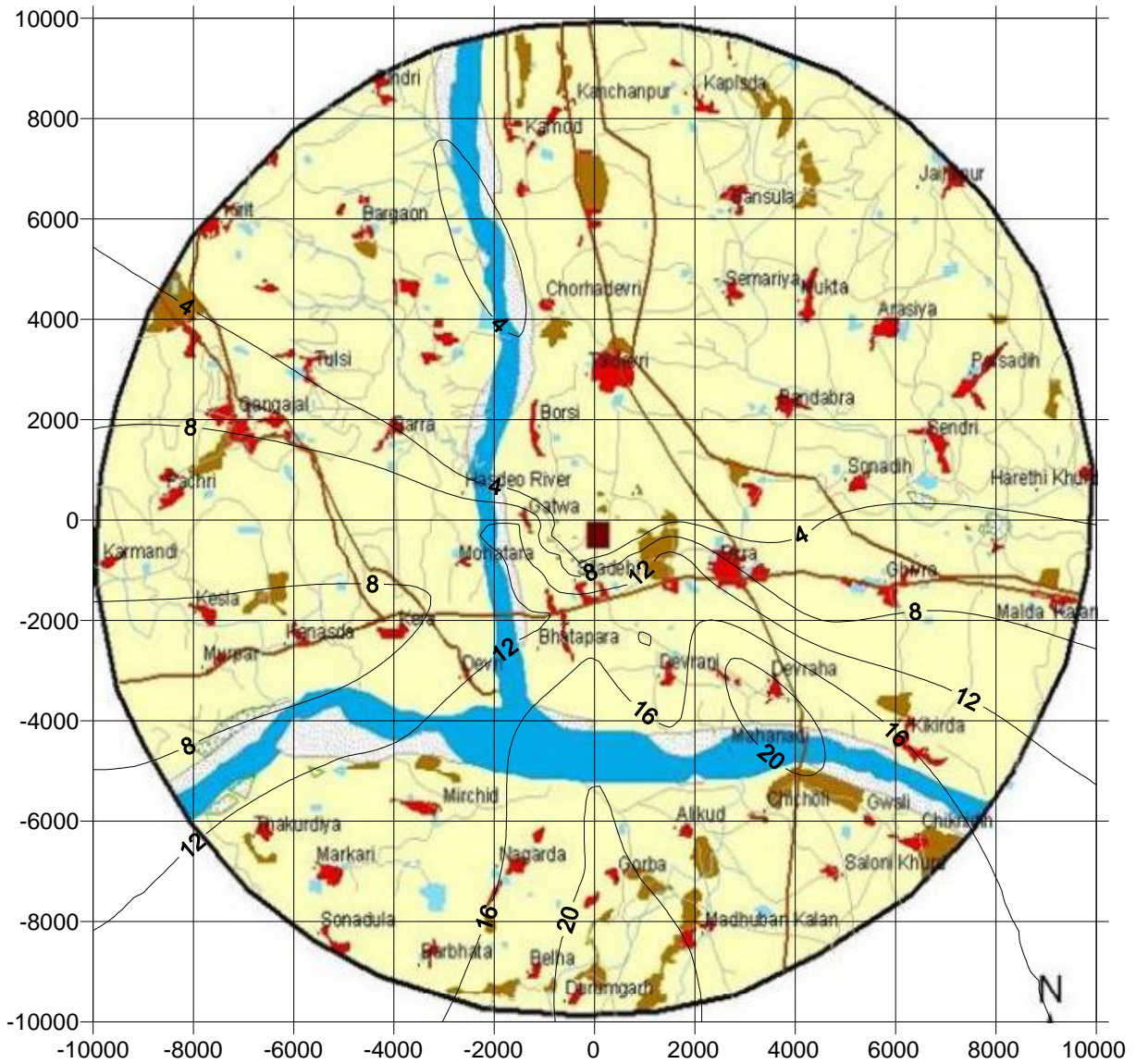
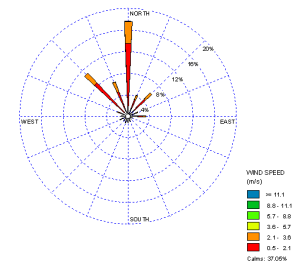


Figure 4.2: Impact Isopleths for SO₂ due to use of Domestic Coal



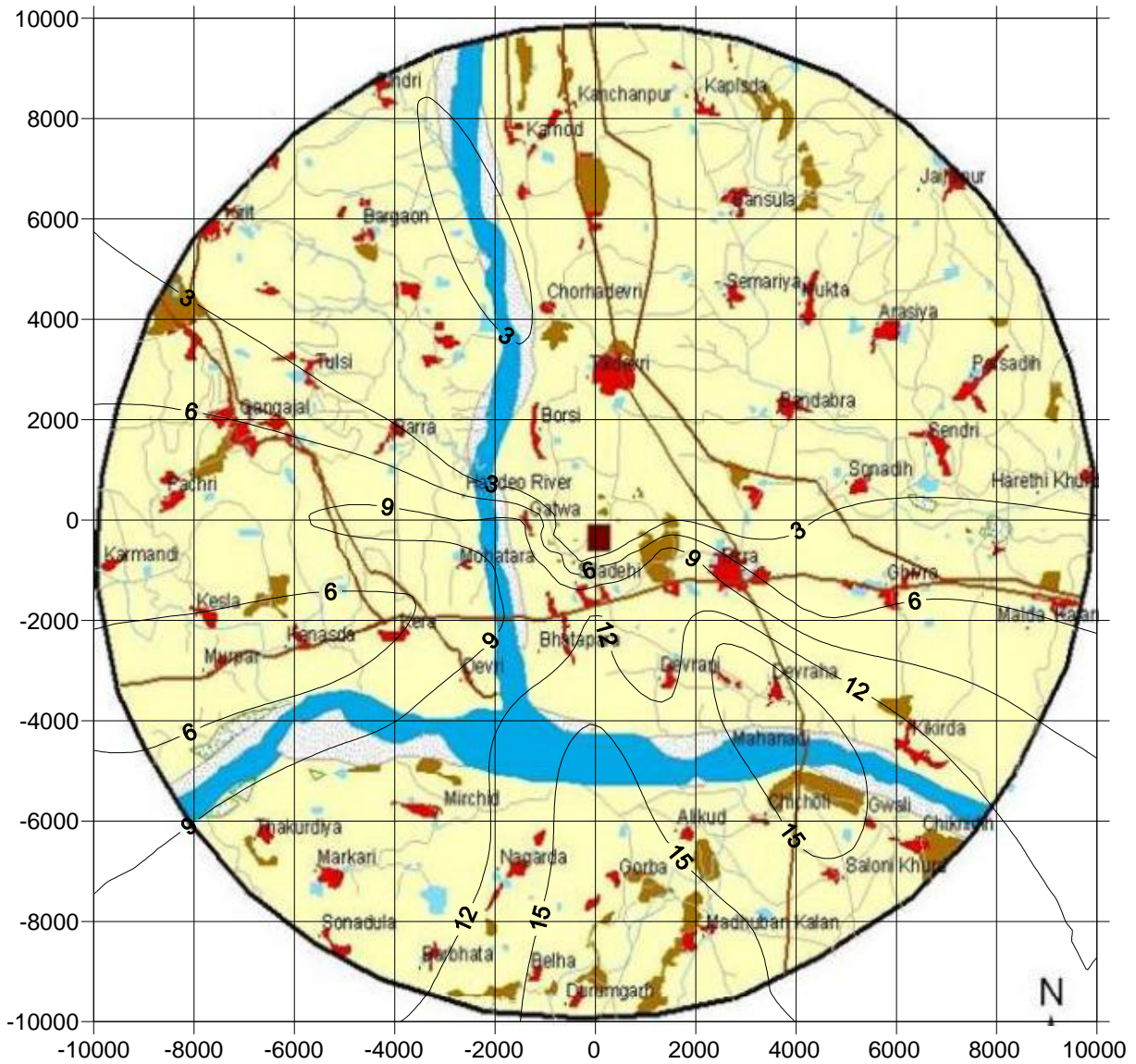
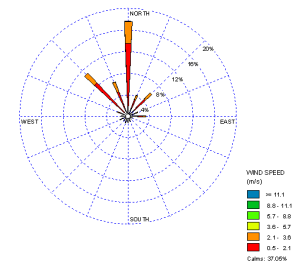


Figure 4.3: Impact Isopleths for NO_x due to use of Domestic Coal



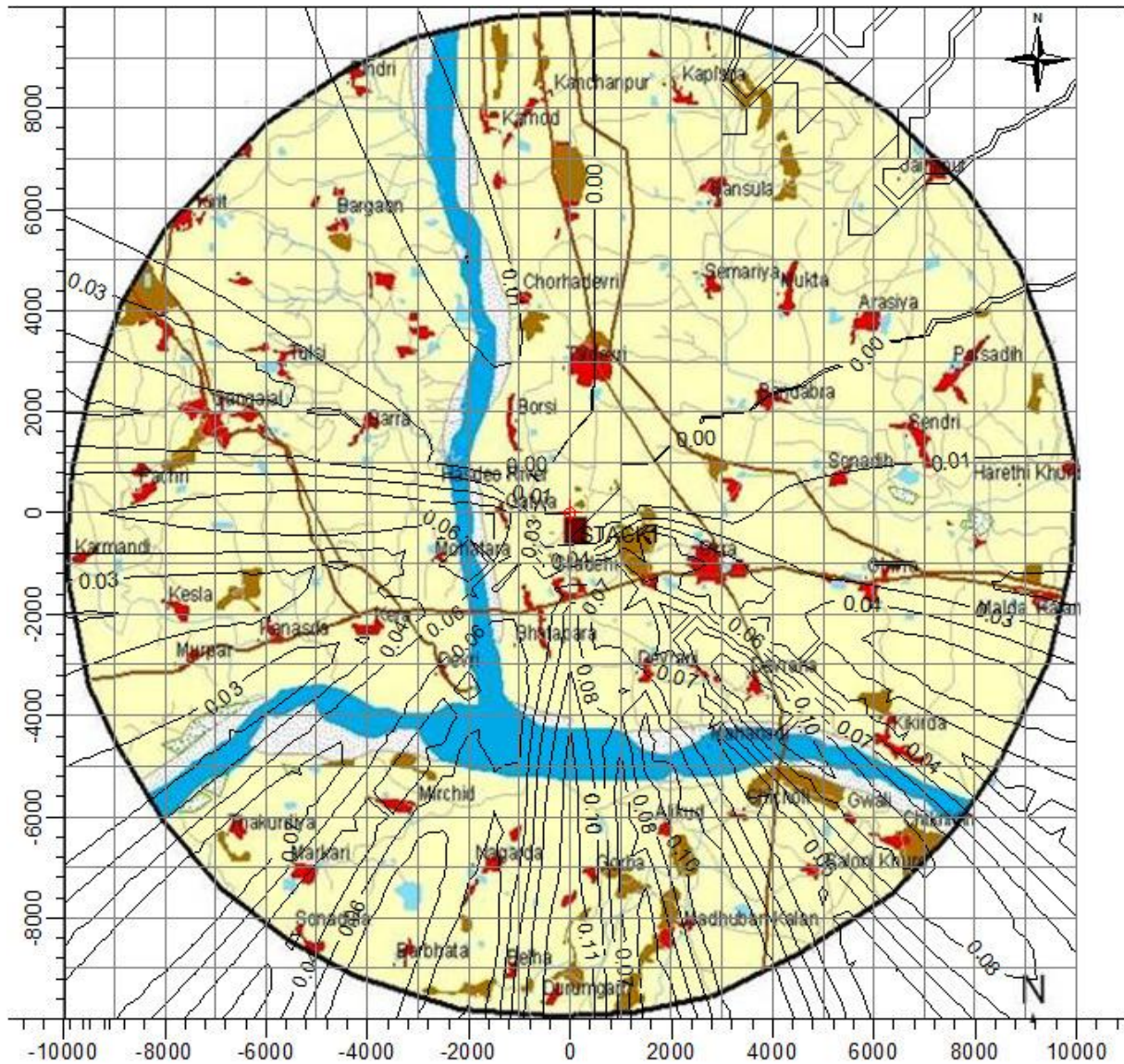
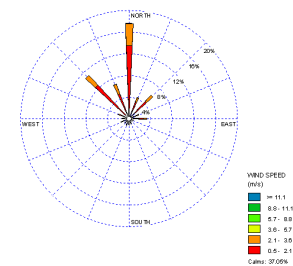


Figure 4.4: Impact Isopleths for PM10 due to use of Domestic Coal



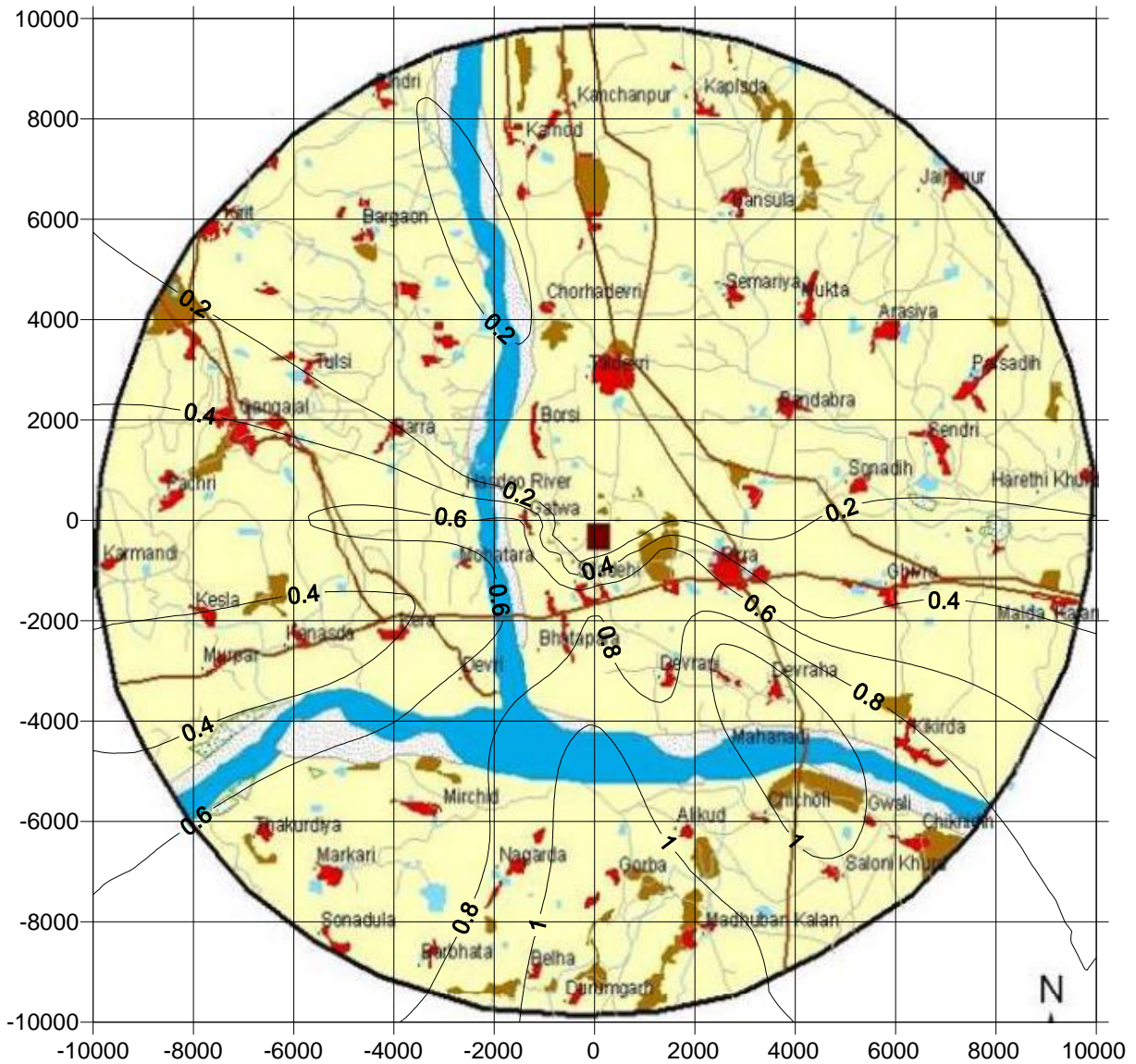
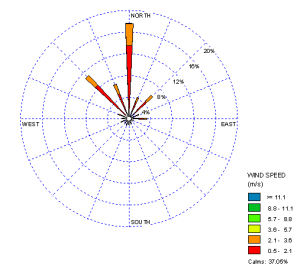


Figure 4.6: Impact Isopleths for SPM due to use of Imported Coal



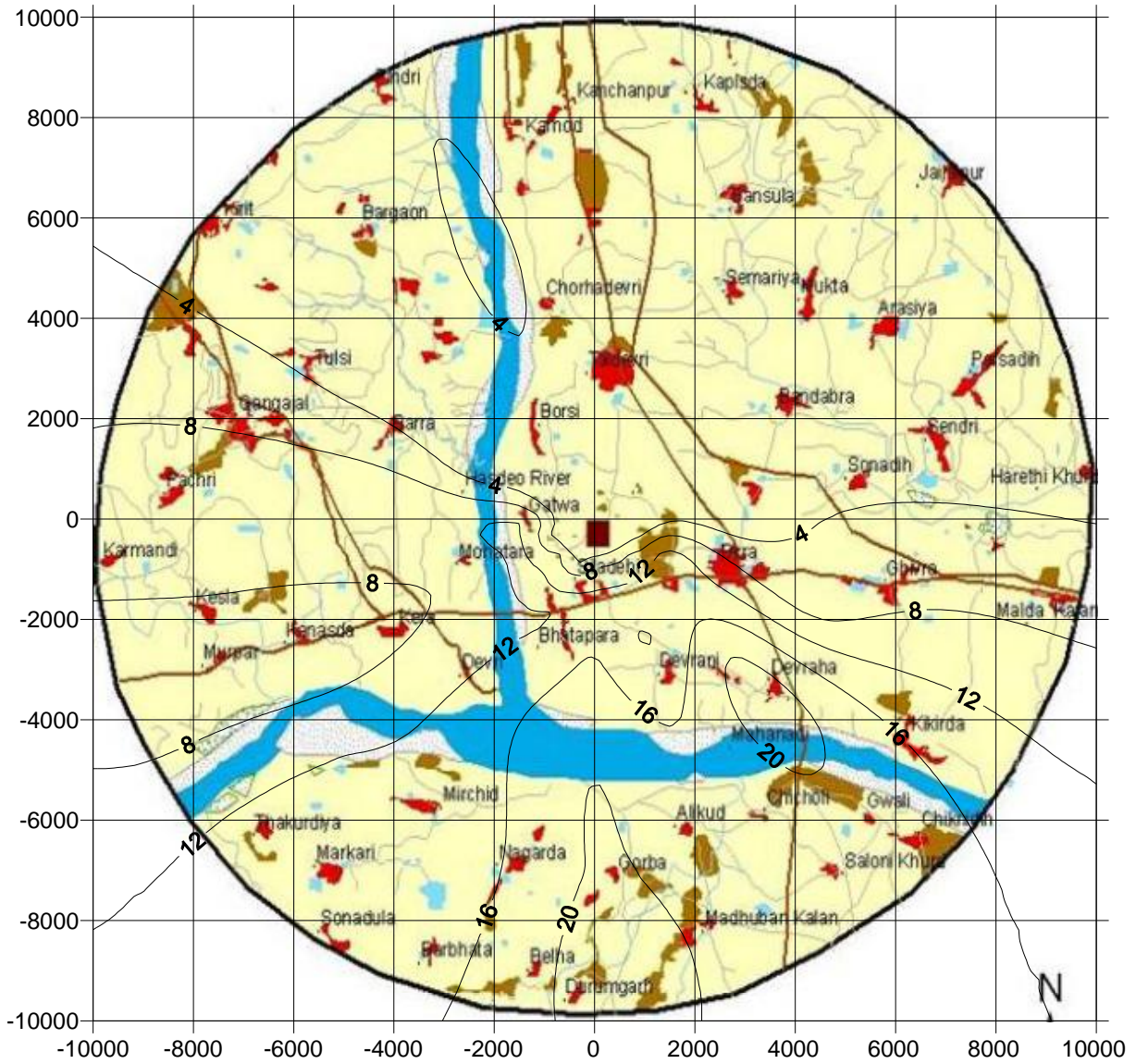
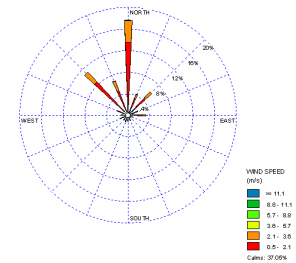


Figure 4.7: Impact Isopleths for SO₂ due to use of Imported Coal



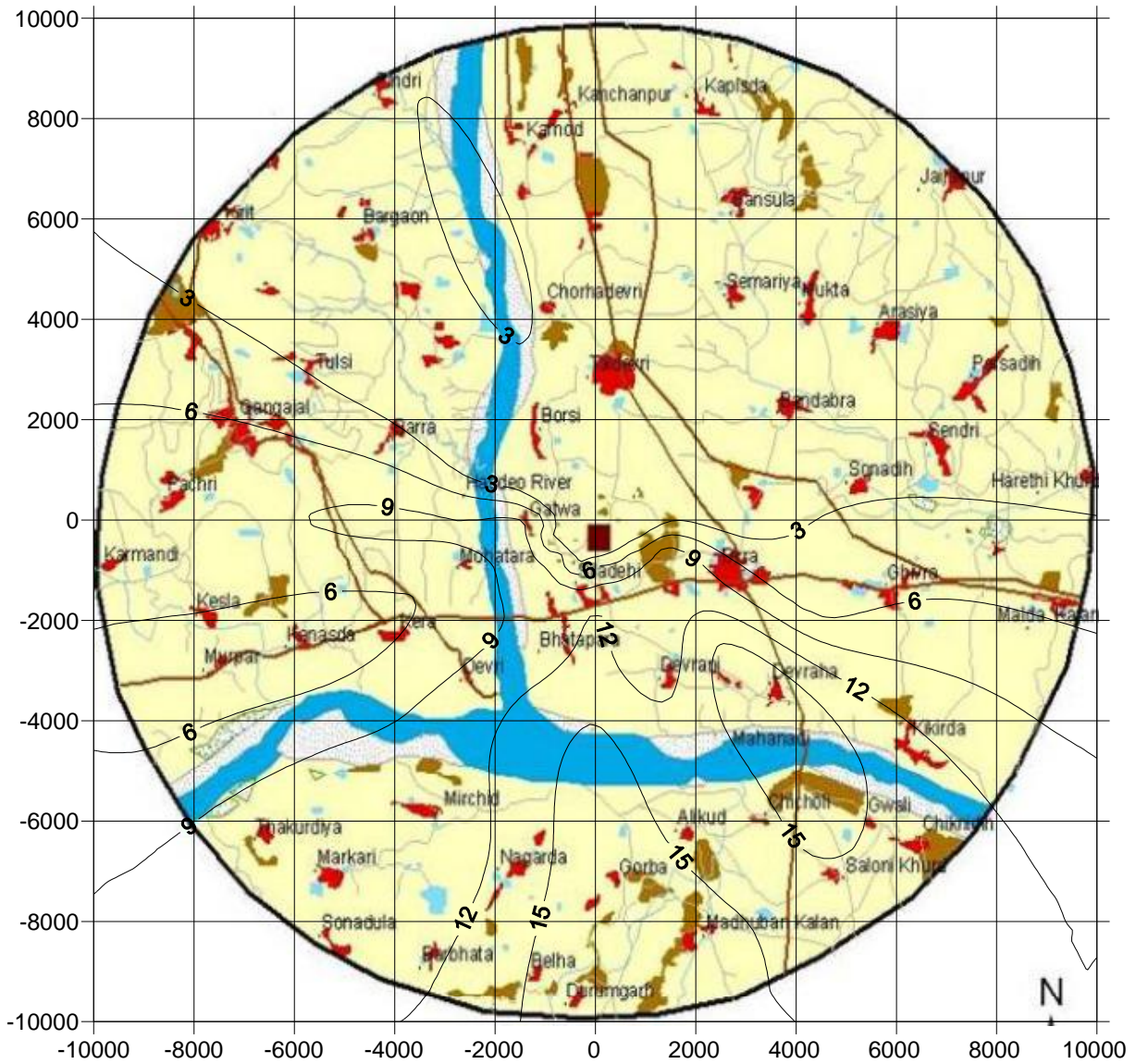
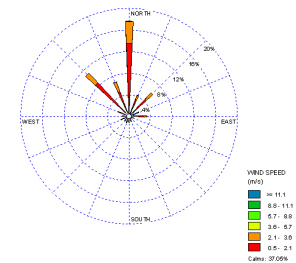


Figure 4.8: Impact Isopleths for NO_x due to use of Imported Coal



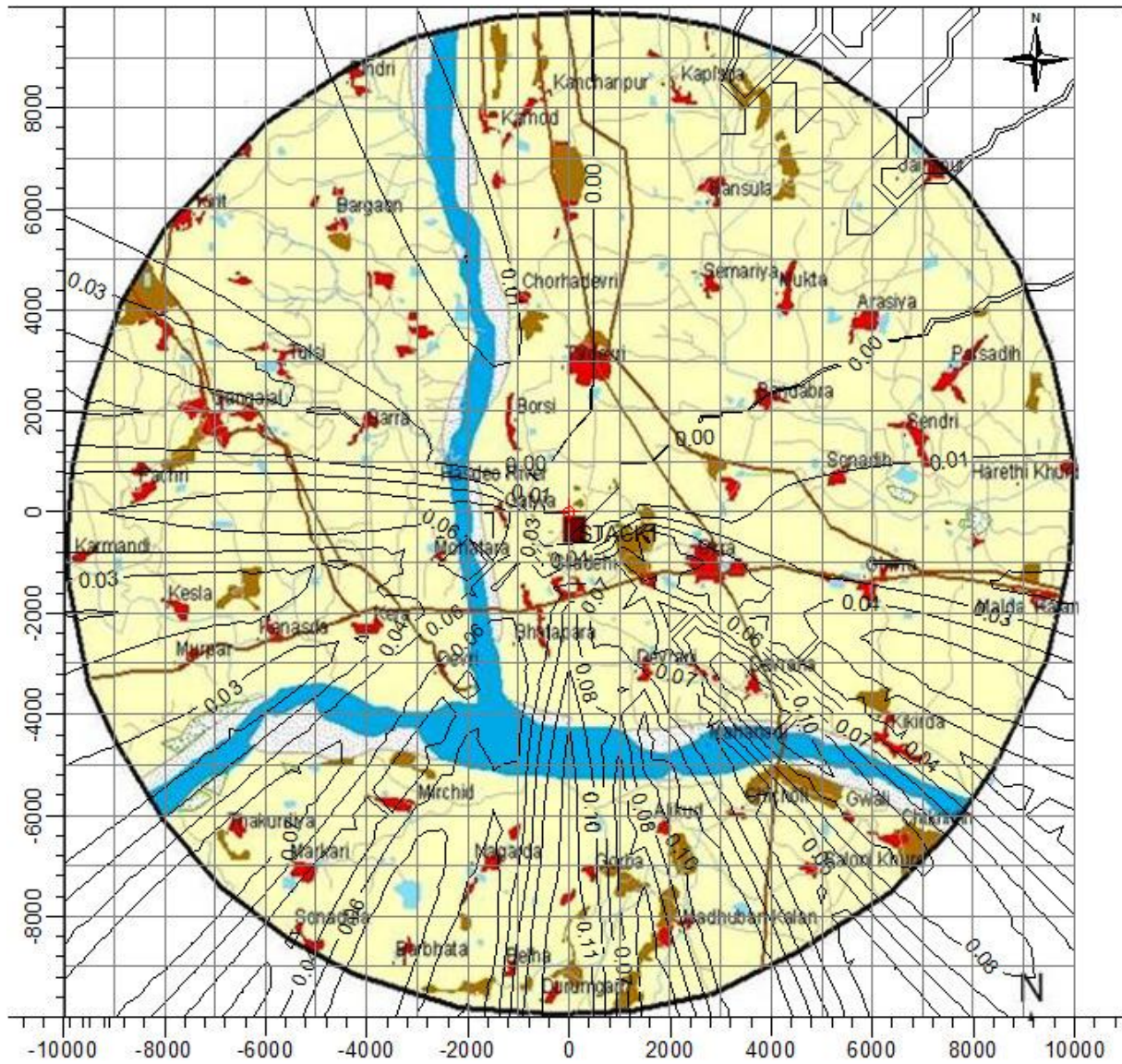
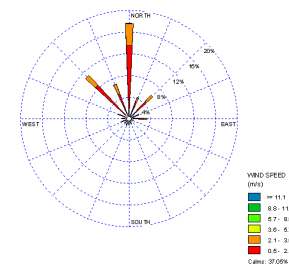


Figure 4.9: Impact Isopleths for PM10 due to use of Imported Coal



4.3.2 Impact on Water Quality

Operation of the plant will not have any long-term impact on water quality as it is proposed to follow the 'Zero Discharge' concept. The water system of the proposed project has been developed with maximum recycle and reuse of water, so as to minimize the water requirement for the project as well as to minimize the quantity of effluents generated from the plant.

Groundwater issues during the operation phase are typically limited to consumptive use of groundwater and percolation or leaching. As no ground water will be drawn during operation for any purpose, there is no scope of groundwater depletion. In addition, rainwater harvesting will be implemented at proposed plant to conserve storm water.

The impact on ground water due to the power plant operations primarily results due to likely leaching of toxic metals from the ash pond area. However, provision of appropriate lining of the ash pond will further ascertain that there is no leaching from the ash pond.

Area occupied by ash dyke area (190 acres) shall be lined and dyked to create a pond in which ash will be deposited. Runoff from the ash dyke area shall not be allowed to join Mahanadi River.

Thus this area will also not contribute to the storm runoff.

Impervious dykes may be constructed along periphery of ash pond to prevent entry of ash into the drain. Water stored in ash dyked area during rainfall may be used for making fly ash slurry.

Water Quality Management

In order to mitigate any adverse impact from water pollution, the following processes will be adopted.

- Settling ponds for settlement of suspended solids
- Re-circulating cooling water system, with blow-down from the cold side of the stream.
- Neutralization pit for pH adjustment of the DM plant regeneration waste.
- Central Monitoring Basin for equalization of various effluents.
- Sewage treatment plant to treat the domestic sewage generated from the township and plant area.
- Oil removal.
- Ash water recirculation.

The effluent treatment plant is proposed to treat all liquid effluent so as to meet the standards as per the MoEF/ MPPCB standards.

The effluent treatment plant, which receives discharges from neutralization pit of DM Plant, clarified effluent form Oil Water Separator, sludge from sludge pit of ETP Clarifier etc., will be designed to enable reuse/ recycle to the maximum extent. The treated water will be utilized for green belt development.

4.3.3 Noise Impact

The main sources of noise and vibration during operations will be:

- Delivery of equipment and raw materials by trucks
- Transfer of coal through railway line and unloading
- Operation of generators and turbine inside the power house
- Operation of various pumps, fans and motors

Scheduling deliveries to daytime as much as possible would minimize noise generation by truck movement. Turbines, cooling towers, transformers, compressors, pumps, vehicles and miscellaneous equipments during plant operation, will generate noise. However, proper acoustic enclosures would be provided to control the noise level within 80 dB, as per the requirement of Operational and Safety and Health Administration Standard (OSHA).

Also the adoption of modern building design and the use of sound-absorbing materials will minimize noise and vibration from the powerhouse.

4.3.3.1 Noise Modeling for Plant Machinery

The impact from a continuous stationary noise source at observer’s place, considering the hemispherical propagation of sound waves is represented by the following equation:

$$L_R = L_S + DI - 20 \text{ Log}(r) - A_e - 8$$

Where,

- L_R: Sound pressure level at a receptor located at radial ‘r’, dB (A)
- L_S: Sound pressure level at the source, dB (A)
- DI: Directivity index of the source (for hemispherical radiation DI = 3dB (A)
- R: Radial distance of the receptor from the source, m
- A_e: represents excess attenuation of sound caused by the environmental conditions such as:
 - o Absorption in Air
 - o Effect of rain, snow and fog
 - o Reflections and refractions at barriers and buildings
 - o Effect of the terrain, grass, shrubs, trees etc.
 - o Effect of wind and temperature gradient

The absorption of the sound is generally a complex phenomenon. In general, for homogeneous loss free atmosphere A_e = 0

The cumulative impact of multiple stationary noise sources (through hemispherical wave propagation) at a particular place can be calculated by

$$L_p \text{ (Total)} = 10 \text{ Log} \left[\sum_1^N 10^{(L_{pi}/10)} \right]$$

L_p (Total) is the resultant cumulative sound pressure level due to N separate sources. The cumulative impact from different stationary noise sources at proposed project site has been predicted at 1m distance using the above model. The results are shown in **Table 4.10**.

Table 4.10: Estimated Noise Levels in TPP

Source Name	Noise Levels Leq in dB(A) 1m from source
ID Fan	90.0
FD Fan	90.0
PA Fan	90.0
Boiler feed Pump	90.0
Turbine	90.0
Unit Control Room	65.0
Cooling Water Pump	90.0
Coal Handling Plant	90.0

Table 4.10: Estimated Noise Levels in TPP

Source Name	Noise Levels Leq in dB(A) 1m from source
Coal Mill	85.0
Cooling Tower	90.0
Transformer	75.0
Air Compressor	90.0

Noise modeling indicates the noise during daytime will be 67.5 dBA and during nights it is 55 dBA about 0.5 km from the plant site. At the boundary of the plant, it will be less than this value due to green belt proposed all around the plant site as well as the distance.

In applying mitigation measures the principles of 'Best Management Practice' (BMP) and 'Best Available Technology Economically Achievable' (BATEA) will be followed.

4.3.3.2 Noise Management

- ❖ Noise generating machines/ equipment shall include built in design requirements to have minimum noise levels meeting as per the EPA 1986 and OSHA requirements.
- ❖ Proper noise barriers/ shields etc shall be provided in the equipment whenever it required.
- ❖ Noisy from equipment shall be adequately attenuated by providing soundproof enclosure, insulation to minimize the noise emission.
- ❖ The inlet air and exhaust gas streams would be provided with silencers for noise reduction.
- ❖ Maintenance personnel working in high noise areas would be provided with adequate personal protective equipment.
- ❖ Further, all the open areas along the plant boundary will be provided with adequate green belt for better noise attenuation.

4.3.4 Ecological Impact

Terrestrial Ecology: During operation of the project, the impacts shall mainly result due to emission of air pollutants (stack emission and fugitive emissions from coal handling area and ash ponds). The particulate matter emitted through the stack may settle on vegetation and interfere with the gaseous exchange through stomatal openings. However, the impacts will be negligible due to the fact that, the predicted value of increase in ground level concentration of suspended particulate matter in ambient air due to operation of the project is very low. The maximum resultant ground level concentration of SO₂, after operation of project has been estimated to be about 41.8 µg/m³ which are unlikely to cause any injury to the surrounding vegetation. Therefore there is absolutely no likelihood of deposition of ash particles on soil or foliage to induce any change in ecosystem.

Aquatic Ecology: The impacts on aquatic ecosystem usually results due to withdrawal of water (reduced flow downstream, entrapment and impingement of organisms) and discharge of effluents (change in thermal regime, change in physico-chemical characteristics of water, discharge of toxic material *etc.*). As the water for the project will be drawn from Mahanadi, which is natural water body, small fish may tend to get entrapped and impinged in the intake system. The entrapped organisms will be subjected to a combination of physico-chemical and mechanical stresses, leading to their destruction.

Smaller organisms such as phytoplankton, zooplanktons are entrainable and subject to entrainment in the treatment system. Suitable screens will be provided at the intake point to prevent entrapment/ impingement. Water drawl will be minimum as the water system of the project has been designated with maximum recycle and reuse of water, there by impact will be least. The project will have a close cycle cooling system with cooling towers; there will be no thermal impact on aquatic eco-system due to operation of the project. Effluents, which will be produced during the operation period, will be treated suitably to achieve 'Zero Discharge' Norm. So that the aquatic life will not get disturbed

4.3.5 Solid Wastes Impact

In the proposed power plant process the most voluminous solid waste generated is in the form of ash. The generation of total ash will be about 2.7 MTPA from domestic coal and 1.18 MTPA from imported coal. For coal handling and transporting system proper control system would be installed to take care of coal dust generated due to handling of coal as it may pollute the surrounding area.

As the total coal consumption will be reduced with the use of imported coal which has higher GCV and also less ash percentage compared to domestic coal, less generation of coal ash is envisaged. A comparative analysis of maximum ash generated from domestic and imported coal is given in **Table 4.11**.

Table 4.11: Expected Generation of Solid Waste

Type of Solid Waste	Quantity of Generation		Mode of Disposal
	Domestic Coal Option	Imported Coal Option	
Ash Content	42-43%	20%	
Ash	2.70 MTPA	1.18 MTPA	As input to cement industries in dry from. Un-utilized ash, if any, will be disposed into ash pond
Bottom ash	0.54 MTPA	0.24 MTPA	
Fly ash	2.16 MTPA	0.94 MTPA	

Proper disposal of ash and its management will not pose any contamination problem to surrounding land environment. The required consent for handling and disposal will be taken before the implementation of the project. Therefore, impacts are not expected due to disposal of solid waste. Detailed ash management plan has been provided in the Environment Management Plan.

4.3.7 Social and Economic Impacts

4.3.7.1 Impact on General Socio-Economic Condition

After the setting up of the proposed power plant, there is going to be generation of employment in the secondary sector. The power situation of the villages in study area is very poor. With the establishment of the proposed thermal power plant the power situation will definitely improve in the adjoining villages.

The mitigation measures to reduce the impact of pollutions are also described in the EMP chapter. Implementation of various pollution control measures as well as ambient environmental conditions to regulatory standards will ensure minimum impact on the health status.

4.3.7.2 Impact on Employment

A coal based TPP of this capacity requires substantial manpower to operate and maintain the plant. For the proposed 2x660 MW Coal-based Thermal Power Project, the estimated

direct employment for the plant alone will be around 500. There will be a great opportunity for the engineers, technical hands and efficient administrative staff available in the state of Chhattisgarh. In addition, there will be scope for indirect employment opportunity of the local people and from adjoining districts of Chhattisgarh due to outsourcing of many work activities of the project. In view of this high potential of employment generation from the proposed project, there would be beneficial impact on the employment generation.

4.3.7.3 Impact on Regional Development

When a big electricity generation unit is set up, many other development activities take place centering on the mother unit. In this case too, when proposed TPP complex is set up in such rural area, several large, medium and small industrial complexes will come up in this area. Thus, the proposed project will have beneficial impact on the regional development of the State.

4.4. SUMMARY OF ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION

The summary of the anticipated adverse environmental impacts and possible mitigation measures are given in **Table 4.11**. The table further describes the mitigation measures to be taken and also identifies the probable sources of the pollution.

Table 4.11: Anticipated Adverse Environmental Impacts & Mitigation

Discipline	Potential Negative Impact	Probable sources	Mitigation measures	Remarks
Construction Phase				
Air Quality	Increase in dust and NO _x	Leveling activity & heavy vehicular movement	Sprinkling water in unpaved construction area and roads. Proper maintenance of vehicles will be done	The impact will be low as the main approach road will have bitumen topping
Water Quality	Increase in suspended solids due to soil run-off during heavy precipitation	Loose soil at construction site	During monsoon season, run-off from construction site will be routed to a temporary sedimentation tank for settlement of suspended soils.	-
Noise	Increase in noise level	Construction equipment	Equipment will be kept in good condition to keep the noise level within 70 dB(A)	Workers will be provided necessary protective equipment e.g. ear plug, earmuffs.
Terrestrial Ecology	Clearing of vegetation	Soil enabling activity	Landscaping and extensive plantation will be done	Plantation in consultation with the local forest department
Socio-economic	Displacement of Households	-	Proper R&R Package	
Operational Phase				
Water	Deterioration of surface water	Discharge from	Closed cycle cooling, reuse and discharge	The plant effluents after treatment will

Table 4.11: Anticipated Adverse Environmental Impacts & Mitigation

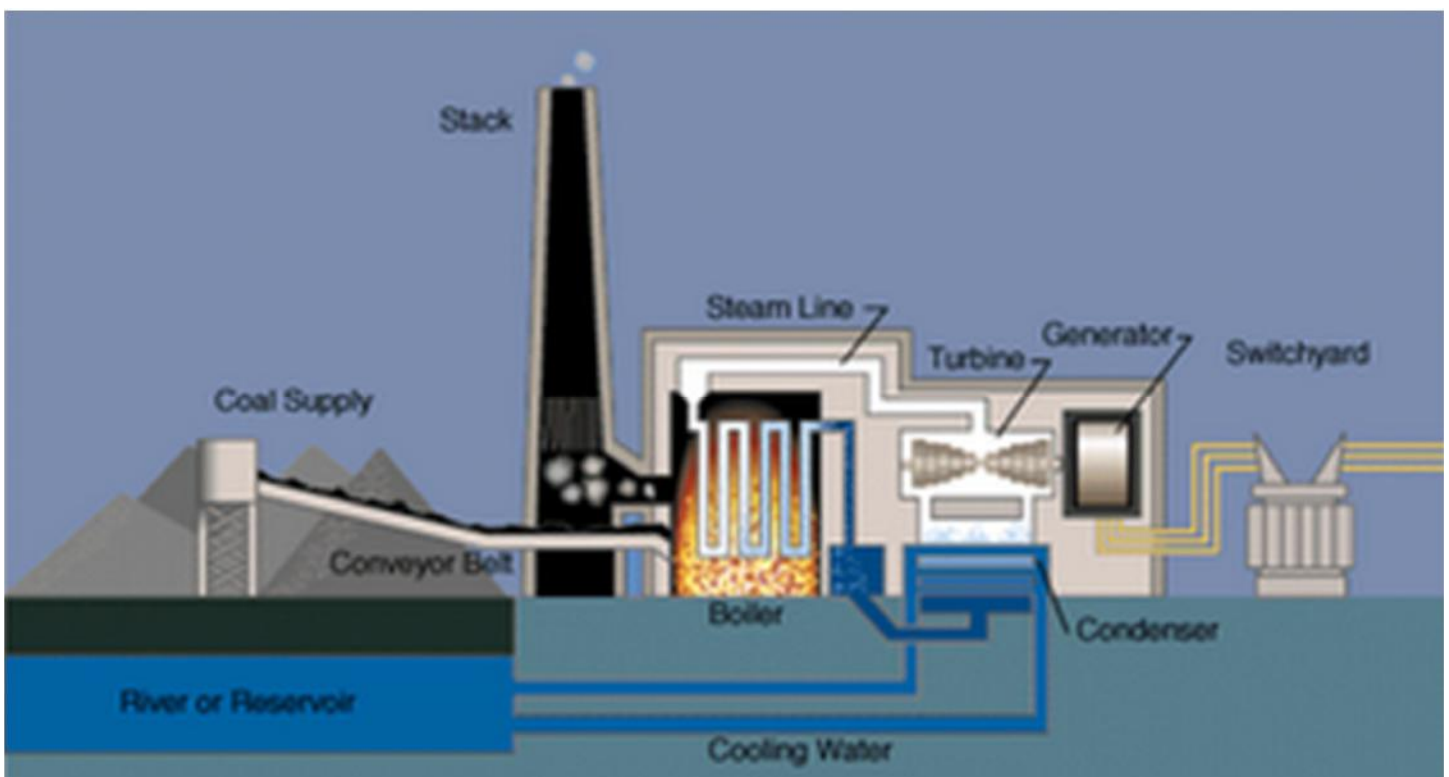
Discipline	Potential Negative Impact	Probable sources	Mitigation measures	Remarks
Quality	quality	various plant units	treatment upto stipulated standards	be reused
Air Quality	Increase in the SPM, SO ₂ and NO _x levels in ambient air	Stack emission and coal stock yards and CHP	Stack of 275 m with a High efficiency ESPs will be installed to control particulates. Stack provided for the proper dispersion of pollutants. Motorable roads in the plant area will be paved to reduce dust emission. Dust suppression measure will be implemented in CHP and coal stock yards	The resultant air quality will conform to the stipulated standard. Space provision is kept in the layout to retrofit FGD in future, if required
Terrestrial Ecology	Impact on plant species	Emission from stack	Emission will be controlled as well as dispersed through appropriate design	As ambient air quality will be within limits, no active injury to the vegetation is expected.
Noise	Increase in noise levels in the plant area.	Equipment in main plant and auxiliaries	Equipment will be designed to conform to noise levels prescribed by the regulatory agencies. Provision of green belt would further help in attenuating noise.	Employees working in high noise areas would be provided earplugs/earmuffs as protective device. Acoustic enclosures for cooling towers will also be provided
Demography and Socio-Economic	Strain on amenities like housing, water sources, sanitation, medical & infrastructure facilities	Influx of people of proposed power plant employees.	No significant impact is envisaged.	Overall socio-economic status of the area is expected to improve.

It is evident from the above table, that the various mitigation measures proposed to be adopted during the construction and operation phase will greatly reduce the scale of environmental impacts.

Similarly, in the operation phase, the various air pollution control systems such as the tall stack, ESPs and dust control systems would restrict the impact on air quality to a marginal level which otherwise would have been high, leading to tangible impacts on the terrestrial ecosystem and soil quality. The different effluent treatment measures will restrict the impact on water quality to a significant level and its corresponding impact on aquatic ecology.

Chapter 5

Alternative Analysis



5. ALTERNATIVES

5.1 WITHOUT PROJECT SCENARIO

There has been a steady increase in demand for electricity in Chhattisgarh since it became a separate state in 2000. The demand in November 2000 was about 1100MW which stands today at about 2500 MW. Due to the policy of the State Government and also the provisions of the Electricity Act, there has been a substantial growth in the capacity of power plants in the State. In fact, today the captive generation in the state is more than the total installed capacity of CSEB.

The per capita consumption of electricity in the state is higher than the national average, at nearly 1100 KWh per annum and it is growing. Nearly 97% of the villages of the state are electrified although the total number of households electrified is only about 54%.

The State Government has taken up a massive programme of expansion of supply of electricity for irrigation. While there were only 60000 agriculture pumps in November 2000, the number of agriculture pumps in the state stands at 2.52 lakhs today. The state has high potential for coal based thermal generation of electricity.

It has been assessed by a study conducted by Power Finance Corporation (PFC) some time back that the state has the potential of producing 35000MW for 100 years. The State Government is making all efforts to make the state a power hub in the country by setting up coal-based thermal power plants. The proposed project will contribute additional 1320 MW of power in the region.

5.2 ALTERNATIVES OF THE LOCATION

For locating a Thermal Power Plant, various factors such as availability of infrastructure and inputs, integration of the technological equipment and systems with specific features of the site, etc. is considered. Chhattisgarh and Madhya Pradesh are rich in mineral deposits and water resources, which are required for power generation. The proposed TPP site has been selected on the basis of general guidelines applicable to set up a Power Plant by CEA.

Initially three sites were selected in District Janjgir-Champa of Chhattisgarh. The identified potential sites were based on the MoEF criteria, and based on remote sensing data. Site Prioritization Matrix (in terms of rank) was prepared and **Site 1** was eventually selected. The description of the three alternate sites is given in **Table 5.1**.

Table 5.1- Location of Infrastructure and Other Sensitive Areas

Parameters	Site 1	Site 2	Site 3
District	Janjgir-Champa	Janjgir-Champa	Janjgir-Champa
Location	Birra Village	Seorinarayan Village	Dabra Village
Nearest Railway Station	Champa, 32 km	Akaltara, 22 km	Kharsis, 27km
Distance from the Water Source in km	Mahanadi, 3 km	Mahanadi, 6km	Mahanadi, 5km

Table 5.1- Location of Infrastructure and Other Sensitive Areas

Parameters	Site 1	Site 2	Site 3
Places of historical/cultural archeological/religious/tourist places/defense establishment <10 kms	No	Lakshmaneshvar Mahadev Temple at Kharaud	No
Environmental Sensitivity as per ESZIS Map	No forest land	No forest land	No forest land
Proximity to Riverine Systems	Hasdeo, more than 640 m	Mahanadi, 6km	Mahanadi, 5km
R&R as per Land Oustees (No. of HHs)	830	365	325
R&R as per Home Oustees (No. of HHs)	Nil	30	250
Consideration in terms of suitability	Considered	Not considered due to proximity to place of religious interest	Not considered due to R&R issues

As seen from the table above, Site 2 was mainly rejected due to its proximity to place of religious interest. In addition to that, about 30 Households (mainly homesteads) were getting affected due to the project.

Site 3 was finally not considered due to large scale displacement which would have occurred due to the plant.

Site 1 was found to be the best site as per the set criteria for site selection was found on the following basis.

- No sensitive receptors are present within 10 km radius from the site.
- The site is at a distance of 3 km from Mahanadi River from where consumptive water is to be drawn for the power project. The area does not fall within 500m from any river system.
- Primarily, the identified area consists of single cropped agriculture land and barren land.
- The survey of all the alternate sites showed that this site does not involve any displacement of home only land is involved.
- Land elevation difference is not very high. Hence, the site will involve optimum requirement of land grading.

5.3 ALTERNATIVES OF THE FUEL

The plant is designed as coal based thermal power project. Hence proximity to the coal mine is vital. The indigenous coal was preferred for the proposed project because of the following reasons:

- The coal block from CIL is under process of being allotted to the project proponent.
- The distance of coal source is very near (approximately 100 km) from the project site of Korba District.
- The coal from the coal block will be transported initially through road till proposed Railway Network becomes operational. Also the site is well connected by well-maintained road.

5.4 ALTERNATIVES OF CONFIGURATION

After considering various configurations for 1320MW, it was decided to install two units of 660 MW for the proposed power plant. The factors which led to the selection of 2X660MW configuration are as follows:

- Availability of technology both from indigenous and imported sources
- High thermodynamic efficiency attainable
- Low specific fuel consumption rate
- Load variation capability if required
- Capability of grid to tolerate any outage
- Optimum specific investment requirements (i.e. Rs. crore/MW)

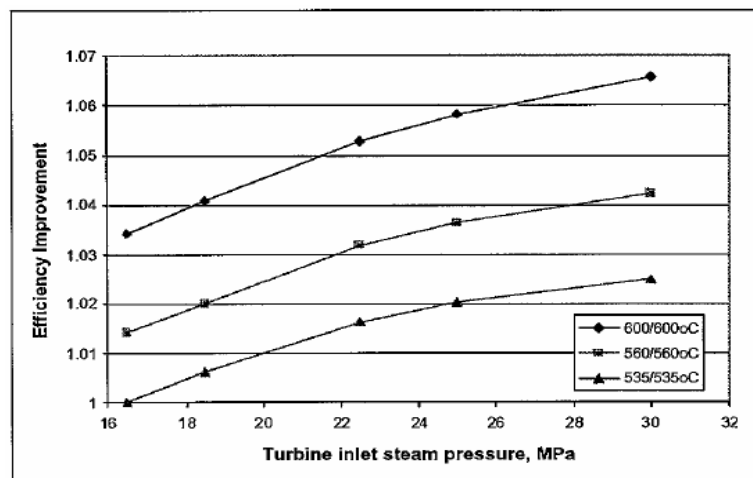
5.5 ANALYSIS OF ALTERNATIVE TECHNOLOGY

The selection of the proper steam generator technology is a critical step in the basic design of a new power project. The fuel to be fired and the steam cycle to be adopted dictates the type of steam generator needed to satisfy the requirements of the project.

As already mentioned, the proposed plant of 2x660MW units will be using super-critical technology. The thermal efficiency of the power plant can be improved by using the steam at super critical condition. The improvement in overall efficiency of the plant compared to sub critical parameters will be at least 2% if the super critical parameters are implemented.

The importance of thermal efficiency of the thermodynamic cycle and the methods to improve the thermal efficiency of the cycle are also analyzed. The indirect costs such as reduction in maintenance cost, auxiliary power consumption, ash dyke land and environmental benefits such as reduction in green house gases; water requirements, etc. are additional advantages to the above increase in efficiency.

The following graph shows efficiency gains that can be typically achieved through the use of higher steam pressure and the temperature on a single reheat cycle.



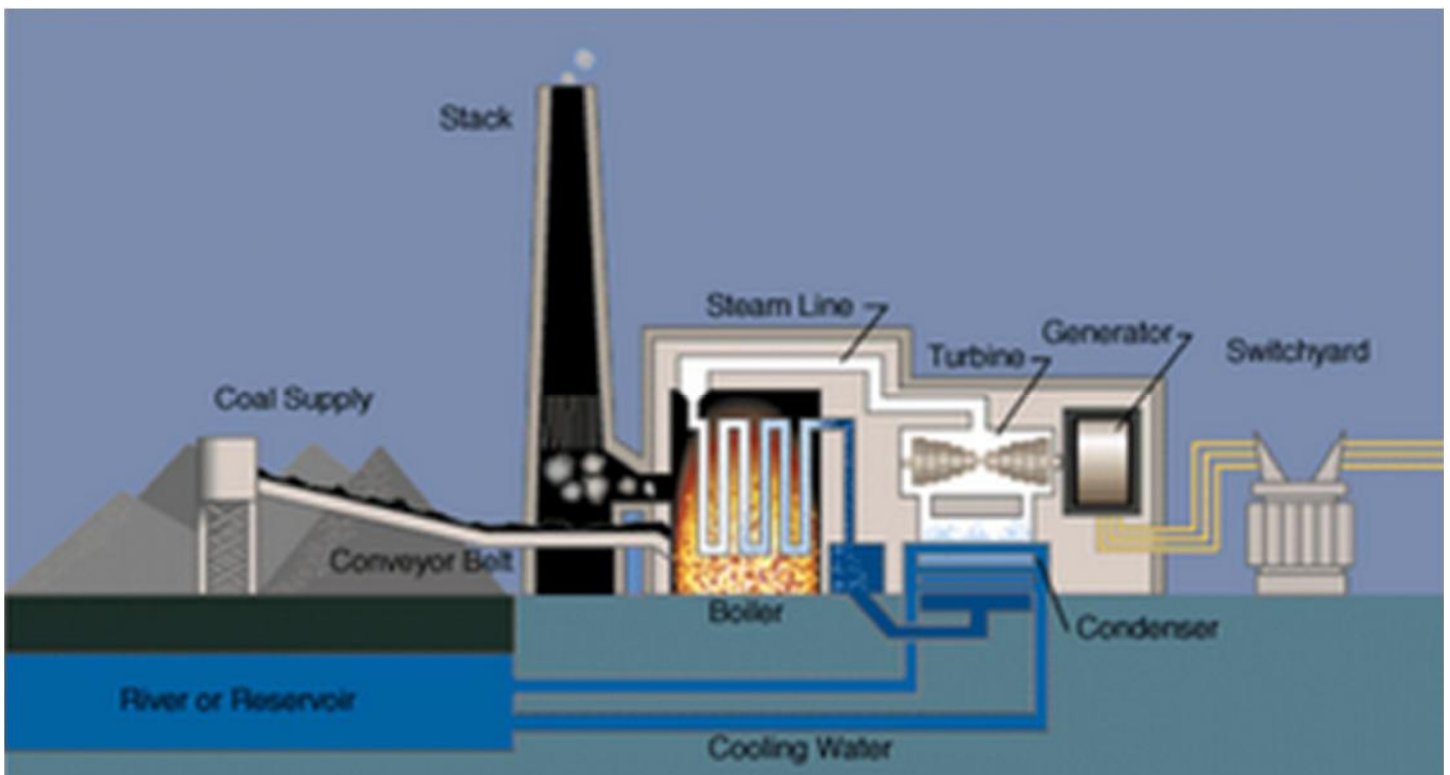
Advantages of Supercritical Thermal Cycle

The Supercritical plant has increased cost associated with the steam generator, steam turbine and piping. However these cost increases are offset by cost savings in balance of plant equipment. The advantages of the supercritical technology are as follows:

- Improvement in power plant efficiency is more than 2%
- Reduction in coal consumption
- Reduction in Green house gases
- Overall reduction in Auxiliary Power Consumption
- Reduction in requirement of consumptive water.
- Sliding pressure operation due to once through system.
- Uniform distribution of heat due to spiral wall arrangement leading to less Boiler tube failure, thereby improving system continuity and availability of the station.
- Low thermal stress in turbine.
- Less start up time of the boiler.

Chapter 6

Environment Monitoring Programme



6. ENVIRONMENT MONITORING PROGRAMME

6.1 PURPOSE

The purpose of the monitoring programme is to ensure that the intended environmental measures are achieved and result in desired benefits to the target population. To ensure proper implementation of the Environment Monitoring Plan (EMP), it is essential that an effective monitoring programme is designed and carried out.

The broad objectives of the environment monitoring program are:

- To monitor impacts on the surrounding environment and the effectiveness of mitigation measures during the construction and operation.
- To ensure that the environmental control systems installed at the plant and are operating satisfactorily.
- To suggest ongoing improvements in management plan, if required, for subsequent effective monitoring.

6.2 POST-PROJECT MONITORING

The monitoring programme has been formulated to take care of impact of proposed project. The monitoring programme for different parameters of environment, outlined in the next few sections, is based on the findings of the impact assessment. The final post-study environmental monitoring programme including number and location of monitoring stations, frequency of sampling and parameters to be covered have been summarized and presented in **Table 6.1**.

6.2.1 Air Quality Management

Continuous Emissions Monitoring System (CEMS)

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

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

Ambient Air Quality Monitoring System

Concentrations of SPM, PM (10 & 2.5), SO₂ and NO_x in the ambient air within the project boundaries and outside the project boundaries adjoining villages will be monitored as per the guidelines stipulated by CECB.

Micro-Meteorological Observations

An Automatic Weather monitoring station will be installed within the plant premises and hourly observations of Micro meteorological parameters wind speed, wind directions, ambient temperature, relative humidity, rainfall etc. will be recorded.

6.2.2 Water Management

Monitoring of Water Consumption

Continuous efforts would be made to reduce the water consumption, and thereby to reduce the waste water generation. Flow meters would be installed at all major water inlet points and flow rates would be continuously monitored.

Monitoring of Wastewater Treatment

The treated effluent would be monitored for the flow rate and quality to identify any deviations in performance of effluent and sewage treatment plants. The monitoring parameters are as per stipulations of CECB. The parameters to be monitor include pH, oil and grease, TSS, TDS, COD, BOD, sodium, sulphates, chlorides, nitrates, and phosphates.

Ground Water Quality

Ground Water Quality and depth of water table will be monitored for any ground water contamination to be monitored. The monitoring locations will be close to the ash pond area.

6.2.3 Noise Levels Management

Ambient Noise levels would be monitored once in a week at major noise generating locations and impact areas within the plant premises and neighboring areas.

6.2.4 Soil

Soil quality for physical and chemical parameters, organic contents and heavy metals at 6 stations, 4 around the disposal areas and 2 stations close to the air quality monitoring stations will be monitored once in three years.

6.2.5 Ecology

Ecological impact will also be monitored for symptoms of visible damage to crops will be done on an annual basis. A comparative analysis of density and diversity of local fauna will be conducted every five years.

6.3 ENVIRONMENT MONITORING PLAN

During the course of construction and operation of the plant, regular monitoring of all environment parameters is required. The suggested monitoring plan for the proposed plant is given in **Table 6.1**.

Table 6.1: Environment Monitoring Programme

Aspect	Parameters	Frequency	Location	Equipment used	Annual Monitoring Budget (INR)
Ambient Air Quality	SPM, PM10, PM2.5, SO ₂ , NO _x , CO	Twice in a week and 24 hour at each station	Five site within the Impact area, including power plant site	Respirable dust Sampler	5,20,000
Stack Emission	SPM, SO ₂ , NO _x	Continuous	Each Stack	In-situ continuous monitors	
Meteorology	Temperature, wind speed and direction, RH, Rainfall,	Continuous on hourly basis	One site inside the plant	Anemometer with data logger and printer facility, thermo-hygrograph, rain gauge	1,46,000
Surface water quality	Physical, chemical and biological parameters including heavy	Monthly	4 locations within the impact zone including Mahanadi and Hasdeo River water	Standard laboratory Equipment	1,50,000

Table 6.1: Environment Monitoring Programme

Aspect	Parameters	Frequency	Location	Equipment used	Annual Monitoring Budget (INR)
Ground water quality	metals				
	Physical, chemical and biological parameters including heavy metals	Monthly	Five station with ash disposal area	Standard laboratory Equipment	1,80,000
Plant effluents	Physical and chemical properties including heavy metals	Monthly		Standard laboratory Equipment	60,000
Soils	Physical and chemical parameters with organic content and heavy metals	Once every year	Around ash disposal site	Standard laboratory Equipment	50,000
Noise level	Noise	Once in a week	Five station close to air quality monitoring stations	Noise level meter	1,30,000
Ecology	Visible damage to crops, density and diversity of local fauna	Yearly	10 km radius from the project site	Field Survey	10,00,000

6.4 INFRASTRUCTURAL FACILITIES FOR MONITORING

The project shall establish an Environmental Management Group (EMG), which will consist of chemists and scientists along with field assistants. A well equipped laboratory along with transportation facility shall be provided to cater to air and water quality sampling. This group will take the responsibility of implementing the environmental monitoring programme detailed in the previous section. Requisite number of such staff would need to be deployed for smooth conduct of the monitoring programme. List of equipment required for environmental monitoring is presented in **Table 6.2**.

Table 6.2: Laboratory Equipment Required For Environment Monitoring

S. No.	Equipment	Quantity
I	Meteorology	
1.	Automatic Weather Station with data logger	1 Set
II	Stack and Ambient Air	
1.	Respirable Dust Sampler/HVS	4 Sets
2.	Vacuum Pump with Electric Motor	2 Sets
3.	Ammeter and Voltmeter	1 Set
4.	DG set	1 Set
5.	Stack Emission Kit with necessary Accessories	1 Set
III	Noise	
1.	Integrated Noise Level Meter with Frequency Analyser and data logger	1 Set
IV	Water	
1.	BOD Incubator	1 No.
2.	Bacteriological Incubator	1 No.
3.	Oven	1 No.

Table 6.2: Laboratory Equipment Required For Environment Monitoring

S. No.	Equipment	Quantity
4.	Muffle Furnace	1 No.
5.	Analytical Balance (Single Pan Digital)	1 No.
6.	Spectrophotometer (Spectronic 20)	1 No.
7.	pH Meter	1 No.
8.	Turbidity Meter	1 No.
9.	Conductivity Meter	1 No.
10.	Thermometer	1 No.
11.	Flame Photometer	1 No.
12.	Atomic Absorption Spectrophotometer	1 Set
13.	Distillation Apparatus	2 Sets
14.	Hot Plate	4 Nos
15.	Reagents and Chemicals	As required.
16.	COD Assembly	1 set

6.5 MONITORING COST

The approximate Environment Management Cost to be incurred by the project proponents are given in **Table 6.3**.

Table 6.3: One-time Cost Provision for Environmental Measures

Sl. No.	Description of Item	Cost (Rs. in Crores)
1	Electrostatic Precipitators	160.0
2	Ash Handling unit	80.0
3	Ash Dyke	65.0
4	Effluent Treatment Plant (ETP)	3.5
5	Dust Suppression System	3.0
6	Control of Fire & Explosion Hazards	16.5
7	DM Plant Waste Treatment Systems	2.0
8	Sewage Collection, Treatment & Disposal (STP)	1.5
9	Environmental Lab Equipment & on-line monitoring equipment	1.5
10	Green Belt (@3lacs/ha	2.0
Total		335

Source: GreenC

As is evident from the table above, the one-time cost for installing pollution control equipments, development of green belt and setting up of laboratory for sample testing will be approximately Rs 335 crores. Other than the above the annual recurring cost for monitoring and green belt maintenance will be about Rs 22.5 lacs excluding the salary and overhead cost of the Monitoring Cell.

6.6 SUMMARY OF MITIGATION AND ENHANCEMENT MEASURES

The specific environmental impacts and mitigation measures at pre-construction, implementation and operation phases are summarized in **Table 6.4**.

Table 6.4: Environment Impacts and Mitigation Measures

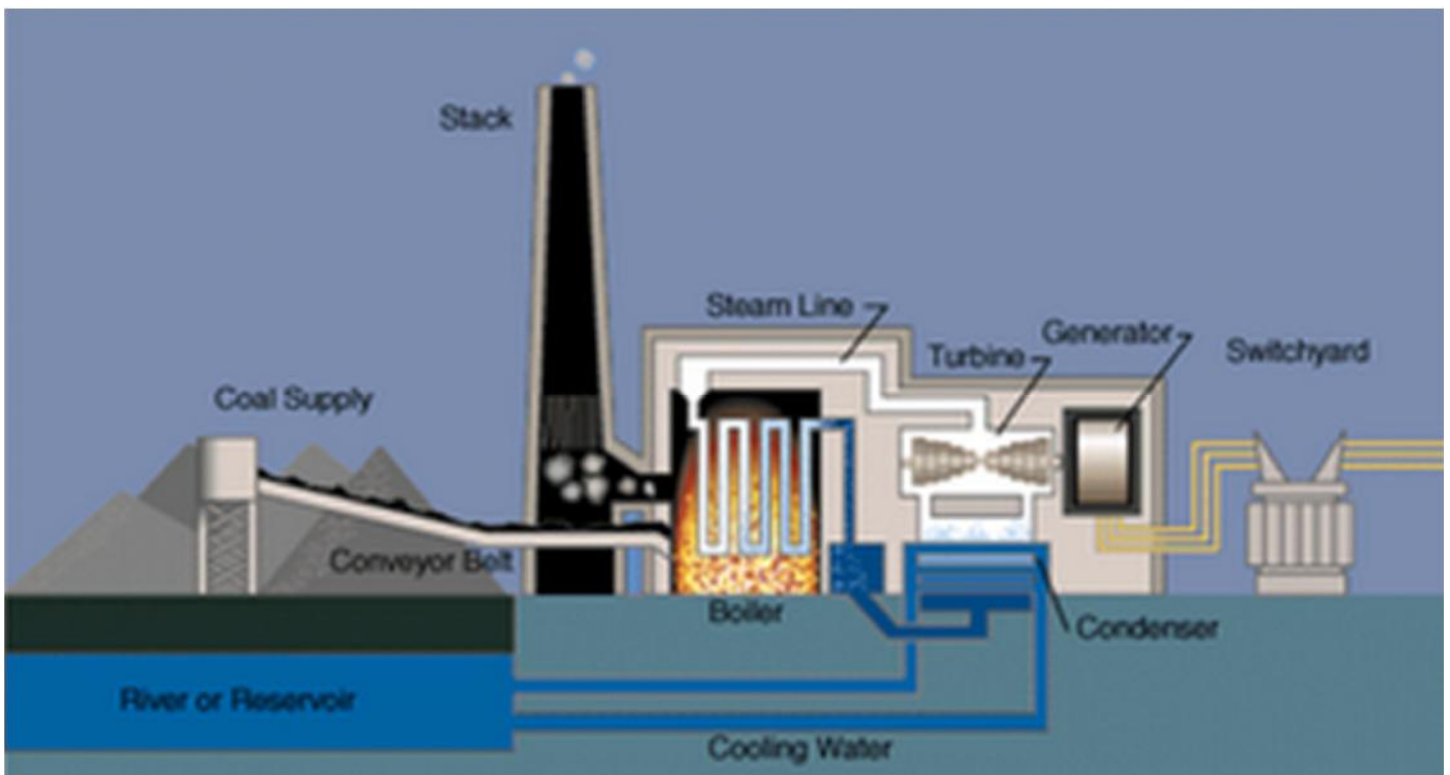
Possible Impact	Mitigation during planning and design	Mitigation during construction	Mitigation during operation
Air Impact	Incorporate consultant and engineers advice	<ul style="list-style-type: none"> Spray water on dry surface generating dust particles Regulate vehicle emission 	<ul style="list-style-type: none"> Implementation of ESP and bag filters Disposal of Ash in slurry form Green belt development
Soil Quality Degradation	Consider strategies to avoid soil quality degradation	<ul style="list-style-type: none"> Removing top soil for construction, turfing and plantation after civil works 	<ul style="list-style-type: none"> Continuous monitoring of soil quality Green belt development Proper ash utilization
Drainage and irrigation	Planning will be done to minimize the impact	<ul style="list-style-type: none"> Proper sanitation facility would be provided to construction workers. 	'Minimum Discharge' Norm prescribed by CPCB will be followed
Groundwater depletion and quality degradation	Surface Water from Mahanadi River will be the source of water for the power plant. So, there will be no impact on groundwater system	<ul style="list-style-type: none"> Project proponent will try to complete water drawl scheme before start of construction activities to meet the construction water requirement from the river source 	-
Surface water pollution	Guidelines suggested by Technical Experts will be incorporated	<ul style="list-style-type: none"> Proper planning will be done 	CPCB norms for 'Zero Discharge' will be followed
Aquatic Ecosystem	Not Applicable	<ul style="list-style-type: none"> Not Applicable 	Not Applicable
Terrestrial ecosystem (disruption to flora and fauna)	Suitable site selection and alignment of roads. Site selection has been made to avoid forest land.	<ul style="list-style-type: none"> Suitable site selection avoiding unnecessary disruption of existing vegetation 	Green belt development to conserve local biota
Disruption of road traffic	Suitable planning for traffic movement as per time schedule	<ul style="list-style-type: none"> Practice caution in use of vehicles to avoid disturbance of regular local traffic 	Monitoring road trafficking situation
Disturbance to water supply	Minimize impediments to water supply	<ul style="list-style-type: none"> Establish adequate alternative water supply source 	Establish adequate alternative water supply and Continuous monitoring
Occupational health hazard	Prevent outbreak of diseases and provide medical assistance	<ul style="list-style-type: none"> Providing health inspection and vaccination Organizing proper disposal procedure of waste Providing adequate sanitary facilities to personnel and workers 	<ul style="list-style-type: none"> Providing health inspection and vaccination Periodic health check-up
Safety of workers	Implement safe working conditions to avoid accident and injuries	<ul style="list-style-type: none"> Adopt appropriate safety measures Provide first aid services 	<ul style="list-style-type: none"> Workers would be provided with hand gloves ear muffs, safety boots, safety goggles,

Table 6.4: Environment Impacts and Mitigation Measures

Possible Impact	Mitigation during planning and design	Mitigation during construction	Mitigation during operation
		<ul style="list-style-type: none"> Make workers aware of risks and how to avoid these 	helmets etc. <ul style="list-style-type: none"> Workers should be trained to follow safe working practices Proper hospital facility would be provided

Chapter 7

Additional Studies



7. ADDITIONAL STUDIES

7.1 INTRODUCTION

As per the conditions of the Terms of Reference given by EAC for preparation of the EIA/EMP Report, several studies were conducted to provide a clear picture of the project area. The studies and activities suggested included

- Public Hearing and Consultation;
- Area Drainage and Hydrogeology Study
- Socio-economic and R&R Study;

Separate study reports have been prepared for Socio-economic, R&R Study and Public hearing. A summary of the above-mentioned studies/activities are given in this chapter.

7.2 PUBLIC HEARING AND CONSULTATION

As per the EIA Notification No. 1533 dated 14th September, 2006 of MoEF, Govt. of India, the public hearing for the proposed 2 x 660 MW coal based super critical thermal power plant was conducted on October 21, 2011, at 12:00 noon. The venue for the public hearing was at the ground adjacent to Irrigation Colony situated in village Birra,

As per the requirements of notification, the date, time and place of public hearing was advertised in daily news paper 'Nababharat' and 'Express News Service' more than one month prior to



the public hearing.

The public hearing was held under the chairmanship of Shri K.L. Chauhan, Upper Collector, Janjgir Champa and Dr. C.B. Patel, Regional Officer, Chhattisgarh Environment Conservation Board, Bilaspur. Consultants GIS Enabled Environment & Neo-geographic Centre was present on behalf of project proponent. The local residents of the proposed project area and residents from neighbouring villages were also present along with media representative. More than 2500 people attended the public

hearing.

Shri Gopal Krishna, Vice President, represented the proponent and briefed the general public about the project and possible environmental impact due to the project. The Upper Collector, Shri K.L. Chauhan then requested the assembled audience to ask for clarifications and give suggestions. Enquiries were raised on issues such as impact of air and water pollution on the villages, impact on the water of River Mahanadi and Hasdeo, compensation for R&R and facilities to be provided by the company. The compilation of the issues raised and the response of the proponent is given below.



After satisfactory responses were given for all queries, the public hearing was formally closed with permission of the Chair. Overall the villagers welcomed the project and said that the plant will improve the quality of life of the people. They requested the proponent to provide proper services in terms of education, health and livelihood generation. Some villagers were not satisfied with the compensation and mode of disbursement, to which the proponent assured that there will be no problem further.

The summary of the important points in form of opinions, comments, suggestions and objections and the reply of their queries by the project

management officials are summarized in **Table 7.1** below and the details given in **Annexure VII**.

The Expert Appraisal Committee during its meeting in June 2012 had desired that the company should reassess the issues and respond suitably. Annexure XIII. Accordingly the Management of company planned its response to meet the expectations of the villagers and EAC members.

Table 7.1: Public Hearing Issues and Updated Response & Action Plan			
No	Issue	Response	Action Plan
1.	Compensation for Land	<ul style="list-style-type: none"> • Around 882 acres of private land is being acquired within the plant area. The acquisition is being done by Chhattisgarh Industrial Development Corporation (CIDC) and post-acquisition, the same shall be leased to the MBPCL. • The Compensation for private land owner is being paid as per the market rate 	<ul style="list-style-type: none"> • At the present rate INR 10 lacs per acre is being given as compensation. Over and above the compensation, MBPCL is paying an amount @ Rs 4 Lakh per Acre as lump sum additional compensation to each Khatedar. This amount has

		<p>determined by Government of Chhattisgarh. This compensation amount includes solatium charges at applicable rate, stamp duty, and compensation for standing trees and crops on land.</p> <p>The R&R Budget is given in Section 7.4</p>	<p>already been deposited in the Office of the District Magistrate</p> <ul style="list-style-type: none"> • So far 76% of farmers have accepted the compensation including additional compensation.
2	Provision for employment	<ul style="list-style-type: none"> • The provision of the R & R Policy of Chhattisgarh Government 2007 duly amended in 2010 shall be followed for providing employment to Project Affected People. • Preference will be given to the land oustees in all categories of jobs including skilled, semi-skilled and non-skilled as per availability of jobs. • Those who would not be provided with employment shall be paid suitable compensation, as approved by Government of Chhattisgarh, as per qualification till the regular employment is provided to them. • The land oustees will be provided employment by providing them shops in Township, petty contracts in the plant, hiring of vehicles and supply of materials. • Company shall provide training for formation of Self Help Groups by Women. • Company shall provide trainings in ITI to eligible persons to enable them to get job opportunities not only in this project but throughout the state keeping in view the vast opportunity. <p>Details are R&R is given in Section 7.4</p>	<ul style="list-style-type: none"> • During construction phase preference will be given got unskilled and semi-skilled jobs. • Agreement will be done with contractors to ensure that job preference is given to affected persons. It is estimated that about 2000 labours will get employment. This activity will start after developer gets NOC under Water and Air Act • On-job and safety trainings will be provided to unskilled and semi-skilled workers • Local ITI has been contacted for providing training in trades of electrical and fitter trade
3	Marginalised farmers due to loss of livelihood etc.	<ul style="list-style-type: none"> • There are around 334 farmers who are falling in the marginalized due to land acquisition for plant. • Each of them shall be provided with employment. 	<ul style="list-style-type: none"> • The benefits to be given to marginalized farmers is given in Section 7.4. An amount of INR 2.5 crores has been earmarked specifically for them
4	Adoption of Village Birra	<ul style="list-style-type: none"> • As a part of adoption of village Birra, Company has already created basic infrastructure as per their demand which includes Library, crematorium, waiting room, boundary wall of Jai Stumbh, Temple flooring, borewell for drinking purpose, fruit sapling plantation etc. • The details of CSR plan is given separately. 	<ul style="list-style-type: none"> • Company has planned for a comprehensive development plan for Birra and other villages as part of its CSR plan. • Detailed CSR Plan is provided in Section 9.9.2
5	Afforestation	<ul style="list-style-type: none"> • Greenbelt plantation will be done around the plant boundary as per norms of MoEF. • More than one lakh trees are proposed to 	<ul style="list-style-type: none"> • Local forest authorities will be consulted regarding choice of species to be planted. An elaborate stage-wise

		be planted in the Greenbelt during construction period in phases.	plantation plan will be developed to ensure proper implementation of green cover.
6	Medical Facilities	<ul style="list-style-type: none"> A mobile health unit with advanced medical equipment along with experienced and qualified Doctor, Pharmacist, Lab Technician and nursing team is already providing services in the area. Free medical checkup are being conducted in the Mobile Health Unit along with it as per the diagnosis and requirement the medicines are being given free of cost as per the need in the PAV's. Besides that free health camps in and around for the PAV's have been organised. Total health budget under CSR head is Rs 1290 Lakh for 5 years. 	<ul style="list-style-type: none"> Health Services will include providing support for setting up Dispensary / Medical Center at CHC with hospitalization facility and necessary equipment's for tests/ treatment/operation
7	Protection of Local Deity	<ul style="list-style-type: none"> There is no archaeologically protected monument within 10km of study area. Archaeological Survey of India (ASI) Raipur has undertaken a joint inspection with state administration and certified that there are no protected monuments in the project area as well as study area. The Shivrinarayan temple is located at a distance of more than 21 kms from plant site. Therefore, this temple and any other temple or local deities are not getting affected due to this project. 	<ul style="list-style-type: none"> ASI Raipur has requested ASI, Delhi to issue the necessary NOC to MBPCL on this account. Letter of ASI, Raipur is enclosed as Annexure XVII.
8	Preservation of Village Pond	<ul style="list-style-type: none"> There is only one pond inside the plant area. Company shall make alternative arrangement to this pond for villagers. A few areas have been identified for relocation of the pond. 	<ul style="list-style-type: none"> A few areas have been identified for relocation of the pond. Ponds in the locality will be strengthened
9	Impact due to pollution from Power plant	<ul style="list-style-type: none"> Super critical technology will be utilized for 2 X 660 MW high technology machine due to less consumption of coal per MW there will be reduction in ash and Carbon dioxide production. ESP would be used for ash collection Chimney height 275 meters has been kept Effluent treatment plant and Waste treatment plant would be used Sewage collection treatment and disposal would be used Ash Dyke would be properly lined/treated to avoid water penetration Ash water recirculation system would be used; 	<ul style="list-style-type: none"> An elaborate Environment Management Plan will be drawn up to ensure least pollution in the area. Environment Enhancement measures such as development of green belt, rainwater harvesting etc will be taken up

		<ul style="list-style-type: none"> • “Zero Discharge” would be followed by using recycled water within the plant. • Green Belt will be developed for controlling coal & Ash particulars with plant boundary, water spray and dust separation system would be used. • Sound production would be within the norms. To control sound pollution enclosures will be provided over the equipment’s and green belt will also be provided. 	
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7.3 HYDRO-GEOLOGY AND AREA DRAINAGE STUDY

A separate Hydrogeology and Area Drainage Study was conducted by M/S Rural Engineering and Environmental Solutions, Narsinghpur, Madhya Pradesh. The scope of the study included the following:

(i) Hydrological Study: To calculate water availability at 75%, 90% & 95% dependability on monthly and daily basis at the selected barrage site based on existing users and new commitments. Siting of intake well, water drawal scheme, preparation of report on water withdrawal scheme was also done.

(ii) Hydro-geological study: Assessment of ground water potential in the plant area based on Geo-electrical resistivity survey in the plant area and available hydro-geological information for the area, aquifer characteristics, verifying geological reports, analysis of ground water table pre monsoon/post monsoon.

(iii) Drainage Improvement Study: Preparation of report on the drainage of the plant and buffer zone, impact of plant effluent on drainage, surface hydrology, delineation of watersheds, its catchments and catchment yields, Impact on water regime, estimation of storm floods and designing of drains based on plant area topography.

From the Digital Elevation model it was founds that the North East part of the study area has elevations in the range of 230.0 m to 232.0 m. The South West part and western part of the study area has lower elevations in the range of 224.50 m to 225.75 m. The Digital Elevation Model has been used to compute the area (within plant boundaries) between different elevation ranges. 110.40 ha (28.45%) of the plant area lies below 226.0 m elevation and the plant area having elevation higher than 226.0 m elevation is 277.61 ha (71.55%). 50.06 % of the area is below 227.25 m elevation. The information derived from the DEM study can be used to arrive at cost effective levels at which different plant components should be finally located. It is recommended that in detailed project planning, this aspect may be carefully examined.

The total water availability in Mahanadi, type of storage required, identification and detailing of water intake point and water drawl structures, has been carried out in the study. Assessment of groundwater conditions and water level has been also conducted. Study of ground water levels for last two and a half decades reveals that the land falls under the category of a natural wetland. If the ground water draft and other activities are stopped, then it will turn into water logged conditions.

Assessment of draft, and recharge from rainfall and from sources other than rainfall (ground water irrigation, canal irrigation, canal seepage, seepage from ponds) has been carried out. Recharge from sources other than rainfall is 110 ha-m. This recharge is assumed to be constant as cropping pattern is almost same over the years. Rainfall recharge by Water

Table Fluctuation Method gives erroneous results for this area perhaps due to erroneous recording of the pre-monsoon water table levels. Rainfall Recharge by Infiltration Method varies from 80.45 ha-m in the year 2000 to 216.06 ha-m in the year 2007.

It is obvious from the well inventory and from Geophysical investigations that the base of aquifer is at 8.0m which can be safely classified to have 10% available space for water, i.e. 0.8m of which 0.638m is 80%. Thus, a rise of nearly 6.5m bringing the water table only at 1.5m depth from ground surface. It is however dependant on the thickness of sand layer part of the aquifer.

A separate hydro-geology and area drainage report is enclosed. **Annexure VI.**

7.4 SES AND R&R PLAN

A separate R&R study in details had been conducted by GIS Enabled Environment & Neographics Centre, Ghaziabad to assess the socio-economic conditions of the Project Affected Households and prepare the R&R plan. The data of the population was collected through household surveys and community consultation. PRA exercise was also carried out with the villagers to find out about their socio-economic conditions and culture.

According to the R&R Study three villages namely Birra, Gatwa and Siladehi will be affected by the proposed project. All these villages will be losing their land only and there will be no homestead displacement. A total of 831 households are getting affected by the project. Most of the houses are kutchha houses, which reflect poor economic status of population. The houses are mostly constructed of mud and country tiles. No community structures such as schools, temples or community halls are getting affected. It has been proposed that the compensation will be made as per the Chhattisgarh R&R Policy. **Annexure XIV.**

The provision of the R & R Policy of Chhattisgarh Government 2007 duly amended in 2010 shall be followed for providing employment to Project Affected People. The report has provided the entitlement framework of all affected families. It has also proposed an implementation arrangement for all R&R activities. All provisions regarding the safeguard of the tribal population has also been taken care.

Keeping in view the concern of EAC members regarding marginalized section of community, the R&R Plan has been revised which includes formulation of specific schemes for landless farmers whose sustenance is supposedly dependent on the land proposed to be acquired for the power project.

The budgetary allocation for the rehabilitation component of the project has been determined based on the anticipated impacts, entitlement, and the requirements to be fulfilled as per the directives under the NRRP 2007 and Govt. of Chhattisgarh Ideal Rehabilitation Policy. The cost of Land Acquisition and R&R is outlined in Table 7.2. Benefits to be given to the Marginalised farmers of the PAV's out of 831 there are 334 Marginalised land oustees who have lost their land from 76% to 100% have been presented in the table 7.3.

Table 7.2: Rehabilitation & Resettlement Budget					
Birra Project : R&R Budget (Main Plant) : Amount in INR					
A	Cost of Compensation	Rate in Lakh	Unit	Quantity	Amount Crores
1. Cost of Land					
I	Compensation for Land	10	Acre	882	88
II	Land Charges, Stamp Duty, Solatium, Fees etc	8820	Percent	~ 44	37

Sub Total (of above)						125
2. Compensation to standing structures on land being acquired						
III	Compensation for Trees	0.01	No.	4564	0.74	
IV	Compensation for Wells	0.29	No.	35	0.1	
Sub Total (of above)						.84
						Total (A) 125.84
B	R & R	Rate in Lakh	Unit	Quantity	Amount Crores	
I	Financial Assistance to Each Khatedar	4	Acre	882	35.28	
II	Training to Youth	0.01	No.	2000	0.2	
III	Training to Affected Family	0.01	No.	200	0.02	
IV	Allotment of Shops in lieu of Employment	2	No.	10	0.2	
V	Technical Training for Future Employment [Vocational Training]	0.1	No.	200	0.2	
VI	Training one time to SHG	0.2	No.	22	0.04	
Sub Total (of above)						35.94
VII	Annuity to each project affected families \$\$	1.2	No.	400	4.8	
VIII	Scholarships to one person from each project affected family for five years @@	0.6	No.	400	2.4	
IX	Marginalised Related		LSM		2.5	
Sub Total (of above)						9.7
Total (B)						45.64
Grand Total						172

\$\$ Annuity has been calculated as a monthly payment of Rs. 2000 for 5 years.

@@ Scholarship expenditure has been considered as Rs. 1000 per month for five years per person.

Table 7.3: Benefits to be given to the Marginalised farmers		
S. No	Activities	Beneficiaries
A	Jobs	
1	The trained youth from the ITI (By Moser Baer)	60
2	50 persons from PAV's have been engaged with local contractors involved in the construction phase of the project	90
3	6 persons of the PAV's have already been given Permanent Job in the company	6
4	4 Persons of PAV's have been engaged in our health project; 4 persons of the PAV's have been engaged in our DLP;	4
5	Shop Allotment	10
6	Job to Skilled Category Technical	10
7	Vehicle to be hired from the PAV's	5
	SUB-TOTAL - A	185
B	Co-operatives	
1	Milk Supply	15
2	Fruits Cultivation	10
3	Vegetables Cultivation	10

4	Poultry	50
5	Fish Farming (Pesiculture) ; Fish Feed preparation Training	25
6	Tusar Production	25
7	Supply of Water	10
	SUB TOTAL - B	145
C	Skilled Trainings	
1	Electrical	5
2	Electronics	5
3	Information and Communication Technology	5
4	Mason	5
5	Plumber	5
6	Fire and Safety	5
7	Driver Training	5
	SUB TOTAL - C	35
D	Semi-Skilled	
1	House Keeping	5
2	Security Guard	5
3	House Cleaning	10
4	Personal Security Guard	5
5	Storekeeper	5
6	Television Repairing	2
7	Refrigeration & Air Conditioning Repairing	2
8	Automotive Repair (Two Wheeler & Four Wheeler)	2
9	Beauty Culture & Hair Dressing	2
10	Gardener	5
	SUB TOTAL - D	43
GRAND TOTAL		408

7.5 Water Availability Study

EAC during its June 2012 meeting had desired additional information with respect to Water Availability as “ Water availability especially during lean season keeping into consideration the riparian needs of Mahanadi/Hasdeo River and details of downstream competing sources shall be submitted. “

In response the Company has visited available documents and approached WRD, Government of Chhattisgarh. The water balance study during lean season keeping into consideration the riparian needs of Mahanadi / Hasdeo River and downstream competing uses has been done and same is enclosed at table 7.4, table 7.5 and table 7.6.

Table- 7.4: Flow Computation during Lean Season				
Lean Season	Scenario-1		Scenario-2	
	April, May , June		April, May	
Average of all years	104.43	Cumecs	39.16	Cumecs
	821.03	MCM	206.37	MCM
100% dependable year	60.60	Cumecs	35.10	Cumecs
	476.50	MCM	184.97	MCM
As per sanction of Government of Chhattisgarh vide its Agenda Point, Lean Season has been considered as two months from April to May. Annexure XVI.				
The Water Balance Study has been done for the "Leanest Year" amongst the observed series of flow to plan for the worst scenario to meet the down stream riparian use and other competing usages of the water of Mahanadi.				

Table-7.5 : Committed Water Requirement from Basantpur Barrage			
Company	Purpose	Annual Requirement (MCM)	Lean Season Requirement (MCM)
KSK Mahanadi	Thermal Power	55	9.17
NTPC Lara	Thermal Power	35	5.82
Jindal India	Thermal Power	36	6.00
Sona Power	Thermal Power	20	3.33
Moser Baer	Thermal Power	36	6.00
Government of Chhattisgarh	Irrigation	36	6.00
Total Consumptive Use		218	36.33
Water Balance Study downstream of Basantpur Barrage			
		Annual Flow (MCM)	Lean Season Flow (MCM)
Flow during Leanest Year (100% dependable year)		7769.89	184.97
Total Consumptive Use from Basantpur Barrage		218	36.33
Downstream flow for use by downstream Competing users from Mironi Barrage and downstream riparian requirement		7551.89	148.64

Table- 7.6: Committed Water Requirement from Mironi Barrage			
Company	Purpose	Annual Requirement (MCM)	Lean Season Requirement (MCM)
Athena CG Ltd.	Thermal Power	35	5.83
NTPC Lara	Thermal Power	26.6	4.43
Shyam Century Ltd.	Thermal Power	22	3.67
Government of Chhattisgarh	Irrigation	34	5.67
Total Consumptive Use		117.6	19.60
Water Balance Study downstream of Basantpur Barrage			
		Annual Flow (MCM)	Lean Season Flow (MCM)
Flow during 100% dependable year		7551.89	148.63
Total Consumptive Use from Mironi Barrage		117.6	19.60
Downstream flow for use by downstream Competing users and downstream riparian requirement beyond Mironi Barrage		7434.29	129.04
Downstream flow requirement from Mironi Barrage during lean season to meet riparian requirement and other competing users @ 20% of storage capacity of Barrage vide GoCG letter No. 281/Tech/Janjgir-Champa/2013 Dated 12/02/2013			7.55
Therefore, the downstream riparian use including competing users requirement during lean season is fully met with.			

As per the water availability study of observed water flow of Mahanadi river by Central Water Commission from 1978 to 2008, 2000-01 is the leanest year with 100% dependable year.

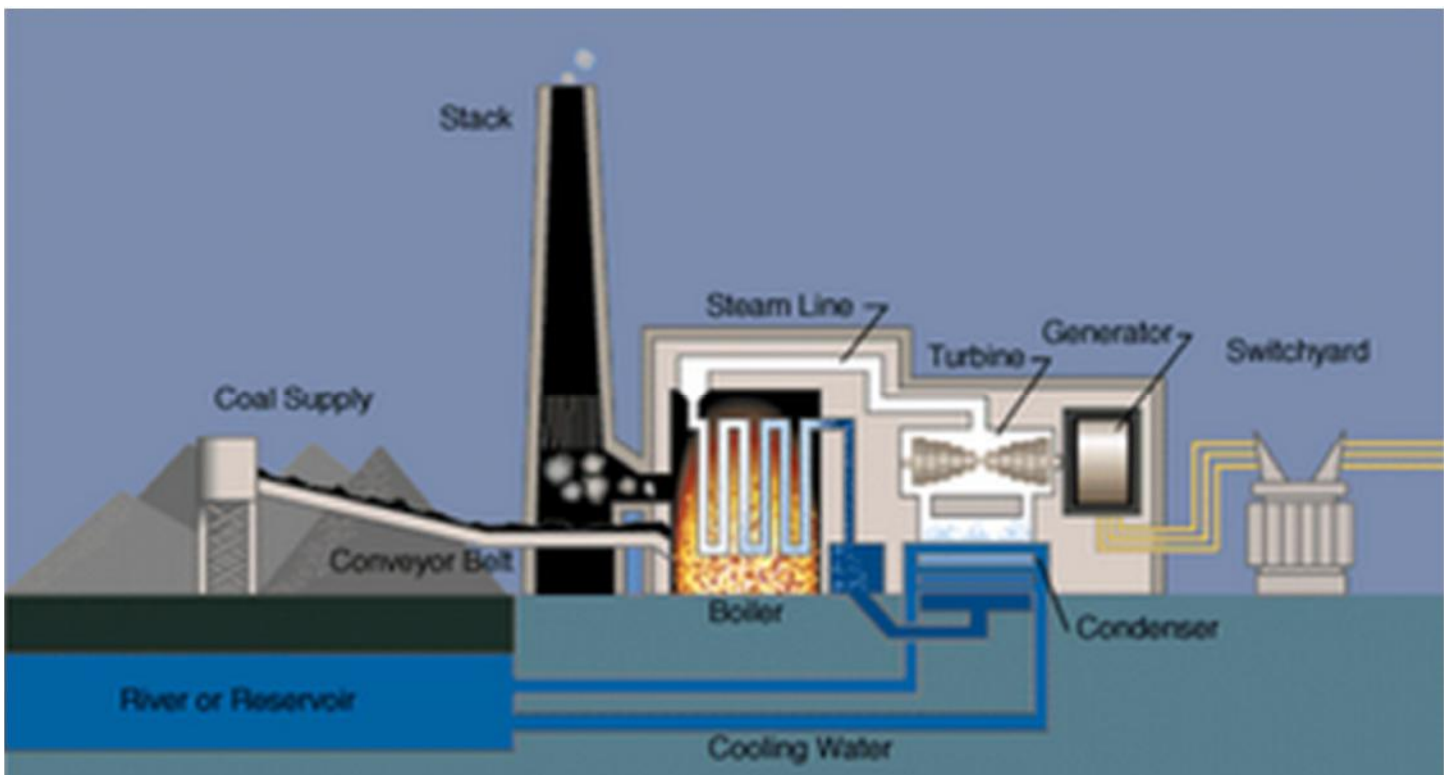
As the intent of the EAC is to ascertain the water regime during lean season for the worst scenario, the lean season flow for 100% dependable year has been considered for assessment of meeting the downstream riparian requirement as well as other downstream competing uses of the water flow after meeting the upstream requirement of various proposed thermal power plant.

Based on the comprehensive analysis it is found that the downstream riparian use including competing users requirement during lean season is fully met with both from Basantpur Barrage and Mironi Barrage as well.

It is important to note that the water for our plant shall be withdrawn from upstream of Basantpur Barrage and this barrage is being constructed by State Government of Chhattisgarh

Chapter 8

Project Benefits



8. PROJECT BENEFITS

8.1 IMPROVEMENT IN THE PHYSICAL INFRASTRUCTURE

It is usually envisaged that setting up of a large power plant helps in developing the infrastructure of the locality. Facilities such as schools, community centres, health centres are usually part of the development activities undertaken by the plant.

Although the infrastructure facility of the study area is quite good in comparison to rural areas, there is further scope of development in the future. Infrastructures such as better roads, well-developed public transport system are required for the area. These facilities will automatically develop once the plant becomes operational.

Various infrastructural facilities like pucca roads, communication, water supply, educational and recreational facilities, dispensaries, libraries etc. needed for the local society will be provided by the project proponents.

8.2 IMPROVEMENT IN THE SOCIAL INFRASTRUCTURE

Social and community infrastructure and services will be provided in response to the need of the local communities. This will enhance the quality of life, equity, law and order, and social well being through community support; safety and security; sports; recreation and culture; justice; housing; health and education. The proposed project is expected to contribute towards improvement in quality of life of local people and it shall generate inputs for industrial/economic development in the region. Guidelines are given to proponents for protection of workmen likely to be engaged from the nearby villages. The following measures are suggested for minimizing the adverse impacts on socio-economic and human interest:

- Communication with the local community should be institutionalized on regular basis by the project authorities to provide as opportunity for mutual discussion
- For social welfare activities to be undertaken by the project authorities, collaboration may be sought with local administration, Gram Panchayat, Block Development Office etc. for better co-ordination.

In order to maintain good Industrial Relations and to implement the project smoothly, following facilities have been envisaged at the proposed power plant:

- Essential facilities like drinking water, toilets, and bathrooms, proper fencing, and leveled ground with proper drainage, sanitation arrangements, and adequate illumination arrangements shall also be provided. PCO, canteen and grocery shop are also envisaged near residential colony.
- Provision of ambulance with doctor and First Aid shall be kept.
- All contract workers and staff shall be provided personal protective appliances and safety gadgets. Safety during project implementation will be accorded highest priority. Regular awareness programmes shall be conducted to create and sustain a safe working culture.
- Rest rooms, canteen, drinking water near the workplace shall be provided for contract workers as well as transporters, etc. Hygienic working conditions shall be maintained at workplace.

- Designated officials will ensure proper maintenance of infrastructure created for contract labours and to take immediate corrective actions whenever required after regular inspection.

8.3 EMPLOYMENT POTENTIAL

At present the socio-economic conditions of the people in the study area is not good mainly due to low agricultural productivity. It was found that it is difficult for the people to sustain their livelihood on agriculture and was looking for other means of livelihood. So the proposed project will have a positive impact on the socio-economic conditions of the people by providing direct and indirect employment in the plant. Also the project shall enhance economic growth of the area in general. Cost of land and other properties in the area will increase.

Permanent workers should be covered by proper insurance/other schemes such as benefits in case of injury, sickness, temporary and permanent disability through workers' compensation in the event occupational accidents and diseases, and compensation for survivors in the event of work-related death.

Plant should have reasonable working hours that should not exceed the number of hours prescribed by India's law and regulations. The workers would be paid as per the Minimum Wages Act.

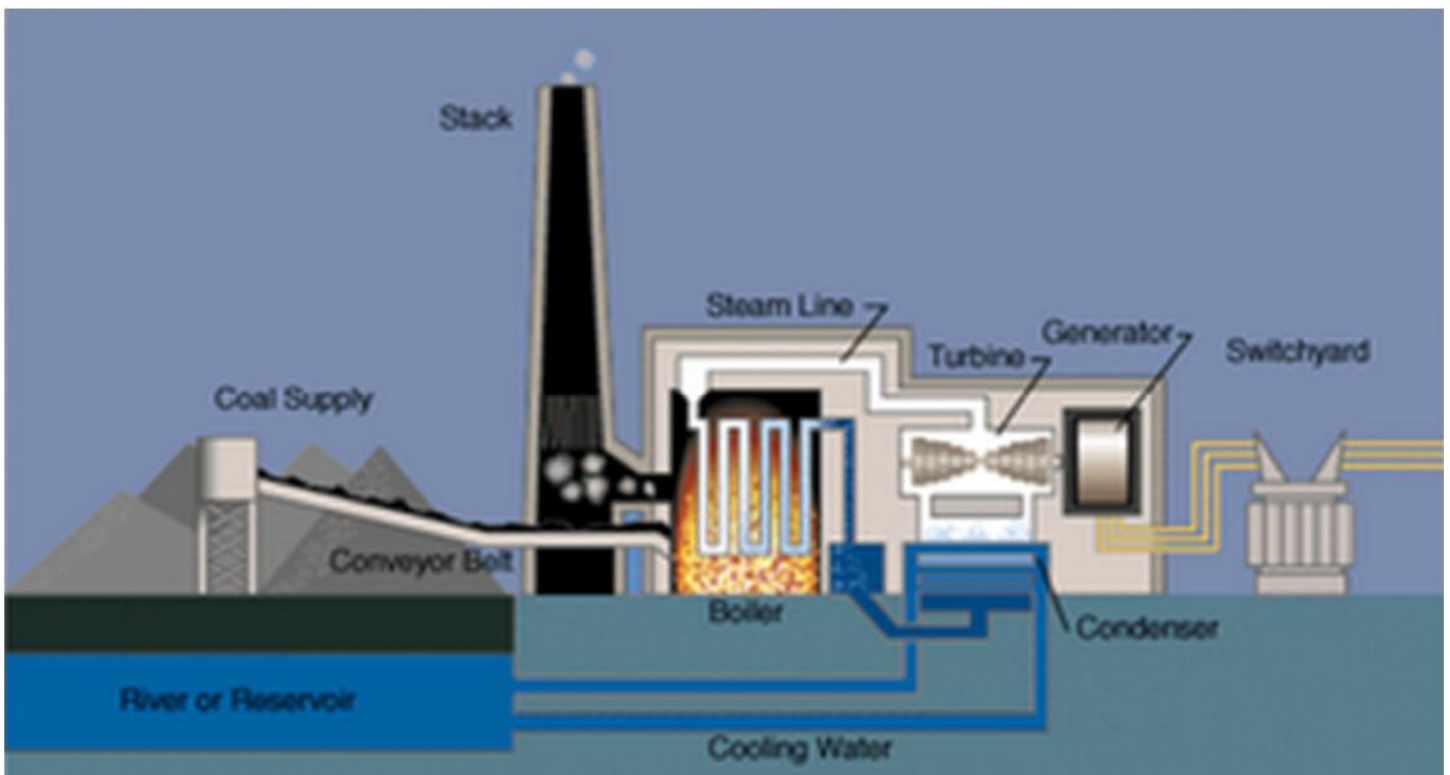
8.4 OTHER TANGIBLE BENEFITS

The other benefits that the project will provide are as follows:

- Shall provide closer interaction and understanding between people from different regions, culture, social traits etc.
- Shall improve in the general living standards and knowledge sharing bringing modern outlook and vision for growth and economic prosperity.
- The power plant shall benefit the State and Central governments by way of royalty, sales tax, duties etc. from this project. This in turn will help in development activities by Government in the area.

Chapter 9

Environment Management Plan



9. ENVIRONMENT MANAGEMENT PLAN

9.1 ENVIRONMENT MANAGEMENT PLAN

The Environment Management Plan (EMP) outlines the environmental management system that will be implemented during the detailed design and construction stage of the project for minimization of deleterious effects and implementation of enhancement measures. The EMP embraces environmental management issues comprising of beneficial impacts as well as long-term adverse impacts and their remedial measures.

The plant management should implement a sound Environment Management Plan (EMP), which will make environment protection an essential requirement. Prediction of the potential environmental and social impact arising due to development activities are considered as the basics of EIA process. An equally essential element of this process is to develop measure to eliminate, offset, or reduce adverse impacts to acceptable levels and enhance the beneficial ones during implementation and operation of the projects. The integration of the project planning is done by clearly defining the environment requirements within an Environment Management Plan (EMP). The Management Action Plan aims at controlling pollution at the source level to the maximum possible extent with the available and affordable technology followed by treatment measures before they are discharged. Specifically, the EMP lays stress on key environmental aspects and issues of the project during operation phase by:

- Identifying potential environmental impacts;
- Recommending mitigation measures for the negative impacts;
- Identifying opportunities for enhancement measures;
- Providing an organizational framework for operating Environment Management System and other functions of the project by assigning roles and responsibilities for environmental monitoring and management;
- Formulating Environmental Action Plans (EAPs) which specify mitigation, periodic and annual monitoring activities during project implementation and operation.

In this context, MB Power (Chhattisgarh) Limited shall deploy qualified and competent staff for the project. They are also in the process of developing appropriate human resources development policy. Capacity strengthening of the existing engineers/staff to address environmental issues will be emphasized.

9.2 COMPONENTS OF ENVIRONMENT MANAGEMENT PLAN

In this chapter Environmental Management Plan has been dealt for both construction and operational phase of the proposed 2 x 660 MW Coal based (Super Critical) Thermal Power Plant. The following are the components of EMP:

- ❖ Monitoring programme/plan
- ❖ Mode of Implementation
- ❖ Institutional Arrangements.
- ❖ Mitigation measures of negative impacts and technological provisions

Monitoring Programme/Plan

The Monitoring Plan for the construction and operation phase has been already described in Chapter 6.

Mode of Implementation Schedule and Reporting Procedures

Various mitigation measures and their mode of implementation with responsible group for implementation have been identified and are given in **Table 9.1** and **9.2** below.

Table 9.1: Mode of Implementation of Mitigation Measures For Construction Phase

Mitigation Measures	Mode of Implementation	Agency
Air Environment		
Water sprinkling in vulnerable areas	Specified in civil construction package and site inspection	Civil Construction Group
Proper maintenance of vehicles and construction equipment	Site Inspection	Construction Group
Transportation of construction material in covered trucks, wherever possible	Site Inspection	Construction
Noise environment		
Proper maintenance of vehicles, equipment and machinery	Site Inspection and records	Construction Group
Provision of acoustic covers/ enclosures on equipment and machinery	Specified in contract award and inspection	Environment, Health & Safety (EHS) group
Provision of earmuffs/ earplugs to the workers in high noise areas and enforcement of its use	Specified in contract award and inspection	
Water Environment		
Channelisation of effluents from construction area through existing network of drains	Site development and specified in the contract award documents	Civil Construction Group and EHS
Construction of temporary sedimentation tanks for the effluents from construction area	Site development and specified in the contract award documents	
Solid Waste Management		
Disposal of surplus earth and construction debris	Site development and specified in the contract award documents	Civil group
Socio-economic Environment		
Provision of environmentally safe camping area for the migrant laborers	Site development and specified in the contract award documents	CSR Team
Arrangements for water supply and sanitation	Site development and specified in the contract award documents	

Table 9.2: Mode of Implementation of Mitigation Measures for Operation Phase

Mitigation Measures	Mode of Implementation	Agency
Air Environment		
High Efficiency ESPs	Integral Part of Main Plant Package	O&M group
275 m High Stack	Civil Construction Package	O&M group
Coal Dust Extraction and	Integral Part of Main Plant	Coal handling group

Suppression Systems	Package	
Water cover over ash pond/ sprinklers in dry areas	Part of Operation and Maintenance System	Ash handling group
Reclamation of ash pond after abandonment	Part of Operation and Maintenance System	Ash handling and horticulture groups
Water Environment		
Cooling Towers	Part of Main Plant Package	O&M Group
Main Plant Effluent Treatment Plant including Central Monitoring Basin	Part of Main Plant Package	O&M (Water Treatment Plant) Group
Ash Water Treatment	Part of Main Plant Package	O&M (Ash Handling) Group
Sewage Treatment Plant	-	Township Administration Group
Noise Environment		
Design of equipment	Included in Technical Specification	-
Provision of acoustic enclosures/ barriers/ shields to reduce noise	-	-
Provision of personal protective equipments like ear plugs and ear muffs	-	-
Solid Waste Management		
Dry fly ash collection and loading system	Part of main plant package	Ash handling group
Disposal of Unused Ash	-	Ash handling group
Township Solid Waste		Township Administration Group
Others		
Afforestation and Green Belt Development	-	Horticulture group
Control of Fire and Explosion Hazard	Part of Main Plant Package	EHS
Environmental Laboratory Equipment		Chemist

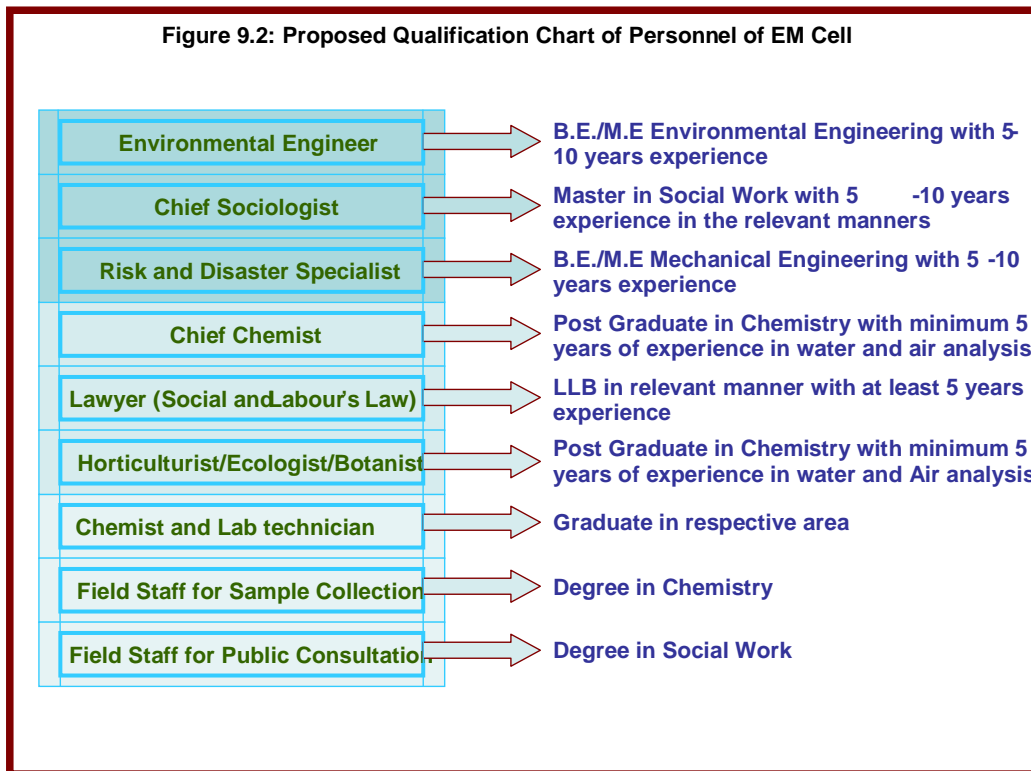
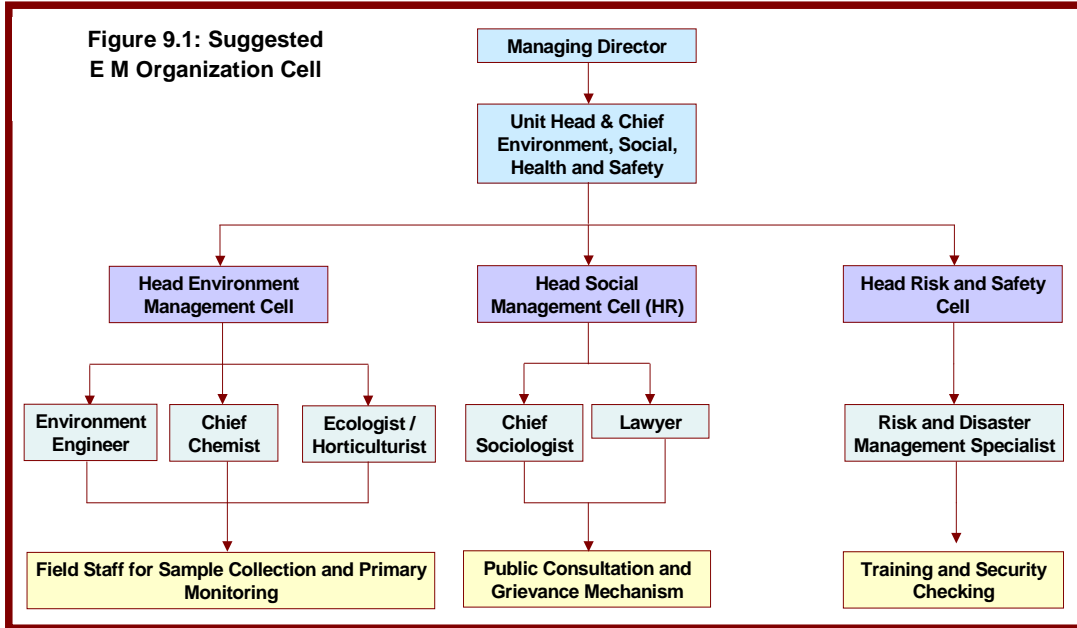
9.3 ENVIRONMENT MANAGEMENT CELL: STRUCTURE AND RESPONSIBILITIES

A separate environment management cell comprising of a team of experienced and qualified personnel reporting to a very senior level executive preferably an environmental engineer is proposed. He will be assisted by well trained staffs comprising of environmental and safety specialists. Staff will be trained for environment control measures like air, water quality monitoring, solid waste management, noise abatement etc. Staff would also be trained to operate ESP and other pollution control equipment at optimum efficiency.

The Environment Management Cell will be responsible for managing the following activities related to environment function of proposed power plant:

- Coordinate and manage the EMP implementation during pre-construction, construction and operation phase
- Appoint dedicated environment staff to manage environmental monitoring responsibilities
- Manage and coordinate environmental monitoring and control

- Coordination with other sections of the plant and government agencies in relation to environmental management activities
- Implement and monitor greenbelt protection and plantation activities
- Safety specialist will ensure safe working practices in all the sections of the plant



9.4 IMPLEMENTATION OF ENVIRONMENT MANAGEMENT SYSTEM (ISO 14000)

A structured and certified environment management system is suggested at the industry level for ensuring that all the activities, products and services conform to international environmental and social requirement. These shall include latest international technologies and practices, certification of Environmental Management System to ISO 14001, assess how an organization handles environmental risks. ISO 14001 is the international standard for Environmental Management Systems. This generic standard is applicable to any organization in any industry. For the proposed thermal power plant, the Environmental and Social Management System and its set up, role and responsibilities will be based on the requirement of ISO 14000 certification.

9.5 ENVIRONMENT MANAGEMENT PLAN: CONSTRUCTION PHASE

Based on the findings of the impact assessment and considering the necessity to limit environmental impact during construction, a general guideline has to be ascertained. Figure 9.3 outlines the implementation of the EMP during construction ensuring compliance with environmental rules, regulations and standards.

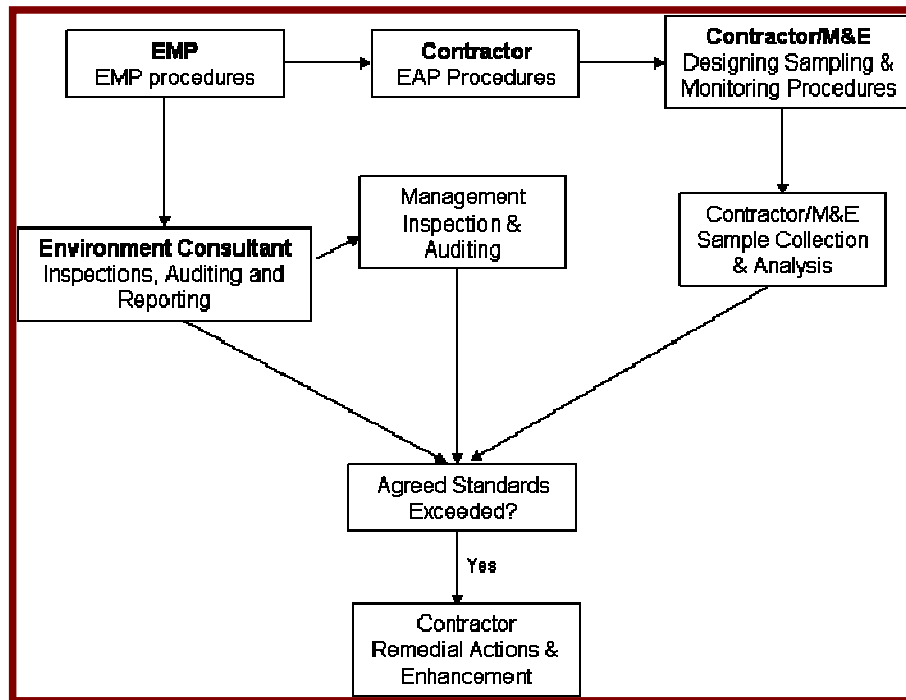


Figure 9.3: Outlines for EMP implementation during Construction Phase

9.5.1 Site Management Plan

Sites for construction and labour camp should be clearly demarcated to prevent occupational hazards. The company will ensure provision for necessary basic needs and infrastructure facilities such as water supply, medical facilities, sanitary facilities, housing, domestic fuel etc. For sewage treatment, soak pits and septic tanks will be used. All labourers will be discouraged from using wood as fuel.

The land of the proposed thermal power plant is more or less flat. It is predominantly covered with sandy loam and clayey soil as topsoil. Minor leveling would be required during construction. Before commencing the earthwork, available sparse vegetation would be removed. Due to the construction and transportation activities, dust will be generated. Water will be regularly sprinkled to reduce dust. Low lying area if any will be filled with earth excavated during the construction work.

Preparation of site will involve generation of large quantities of waste material. Site grading operations will also involve stockpiling of backfill materials. Due care needs to be taken to avoid water pollution problems during rainy season due to washout of waste material from dumpsite. At the construction site, where petroleum powered equipments are used and temporary storage of petroleum products (highly inflammable) is done safety norms will be strictly followed. Care should, therefore, be taken to avoid all sources of ignition at such places.

The existing infrastructure of roads will be used for the activities for construction. If required, the roads will be strengthened by the proponent as per requirement.

Workers engaged during construction phase would be provided with temporary housing facilities at planned labour colonies located nearer to project site. Haphazard growth of labour camps should be avoided.

On completion of construction work all temporary structures; surplus materials and wastes should be completely removed. Dumping of construction waste on agricultural land should be prohibited and stockpiles should be provided with gentle slopes. The solid wastes such as paints, lubricants, oil, diesel containers or any other bio-degradable wastes that have leachable constituents should be disposed as per CPCB guidelines.

9.5.2 Air Quality Management

The generation of dust, suspended particulate and emission of oxides of nitrogen and sulphur dioxide in the atmosphere will increase due to fuel combustion machines and transport vehicles during the construction phase. Land surfacing activity and vehicular movement will lead to increase in the level of dust and NO_x in the atmosphere. In order to minimize smoke generation, the vehicles should be maintained properly, and only "PUC" certified vehicles of contractor should be deployed at site for ensuring that diesel powered vehicles are properly maintained to minimize the exhaust emission as well as noise generation.

Fugitive dust emission will occur due to construction activity, like handling of material and transportation within the plant premises. Extensive tree plantation will be carried out along the plant boundary to control spread of fugitive emission. During dry weather conditions, it is necessary to control the dust emission arising out of the excavation, leveling, and transportation and stockpiling activities by water sprinkling. Following care would be taken for management of air quality during construction phase.

- i) The storage and handling of soil, sub-soil, topsoil and materials will be carefully managed to minimize the risk of wind blow down material and dust.
- ii) There will be no on-site burning of any waste arising from any construction activity.
- iii) Dust masks should be provided to construction workers, while carrying out operations that may entails potential for dust generation.
- iv) All vehicles delivering construction materials or removing soil will be covered to prevent escape of dust.

9.5.3 Water Quality Management

The surface water quality is not likely to be affected due to the construction work and excavation of topsoil, as there is no terrestrial surface water on/near the places where construction will take place. Suspended solids in the runoff water during construction in rains, estimated for about three months in a year, will be arrested in temporary sedimentation tanks.

During the construction of the proposed power plant there is not likely to be ground water contamination as there will be no discharge of wastewater. The only major source of potential impacts arises from uncontrolled runoffs from the labour camps into ground water bodies. The proponents should be obligated to follow the procedures so as not to pollute ground water. Sufficient and appropriate sanitary facilities should be provided in order to maintain hygienic conditions in the camp of construction laborers. The wastes such as sanitary wastes should be treated in septic tanks followed by soak pits of appropriate size and technology. The solid waste generated should be collected and disposed in an appropriate manner either at a landfill site or used as compost for agriculture uses. Area for maintenance of vehicles should be so located that contamination of groundwater by accidental spillage of oil can be prevented.

9.5.4 Noise Management

Noise produced during construction phase may have significant impact on the existing ambient noise levels. The noise level of vehicles and machines shall be within prescribed norms by regular maintenance. Though the effect of noise on the nearby inhabitants due to construction activity will be negligible, noise prone activity should be restricted to the extent possible during daytime in order to have minimum noise impact during nighttime. Onsite workers should strictly use noise protection devices like earmuffs. All construction machinery should be maintained to minimize the noise levels generated.

9.5.5 Waste and Hazardous Material Handling

Recycled aggregates will be used for filler applications and as sub-base for roads. Site grading operations will also involve stockpiling of backfill materials. The topsoil removed for the purpose of construction will be stored properly so that it can be reused later for green-belt development. Recyclable wastes such as plastics, glass fibers and insulations will be sold to recyclers.

During the construction phase, many toxic substances such as paints, solvents, wood preservatives, pesticides and sealants will be used. The wastes generated will be stored in sealed containers, labeled and disposed as required by the Hazardous Waste Storage, Handling and Transportation Rules of Environment Protection Act 1989. Efforts will be made to use less of hazardous chemicals during rainy seasons and special care has to be taken to store these materials. Employees and contractors have to be educated to handle hazardous wastes and materials.

Due care will be taken to avoid water pollution problems during rainy season due to washout of waste material from dumpsite. At construction site, petroleum powered equipments and temporary storage of petroleum products (Highly inflammable) may lead to fire hazard, if safety norms are not strictly followed. Therefore, care should be taken to avoid all sources of ignition at such places.

9.5.6 Ecological Aspects

Green Cover: In order to prepare the site for the construction work there might be cleaning of shrubs present at the site. To counter the said situation proper landscaping and tree plantation in advance would be advantageous. Tree plantation (large size species) should be

undertaken at the time of preparation of site so that they would grow to considerable size by time of commissioning of the proposed project. Construction workers should be provided with domestic fuel so as to prevent cutting of trees for firewood.

Flora and Fauna: Primarily the land required for setting up Thermal Power Plant is agricultural lands and there are not many large trees. Thus, the floral significance at the proposed plant site is negligible and impact of construction on flora will be negligible.

9.5.7 Socio-economic Environment

Given that the project and related developments like construction camps will be dependent on local resources (power, water), during both construction and operations, the only likely impact on infrastructure would be on the roads. Considering the high traffic during construction phase an effective traffic management scheme should be developed to avoid congestion on the nearby and local roads.

The people who will be losing their land due to the project (approximately 831 land oustees) will be provided with all facilities as per the Chhattisgarh R&R Policy.

9.5.8 Health and Safety

Medical care will be provided for the labourers in the camps. Awareness programs will also be conducted on communicable diseases and their spread. The movement of heavy equipment should be done with proper precaution to prevent any accidents on the road. Occupational risk should be minimized at the project site through implementation of a full proof safety system. Speed limit set for movement of vehicles will be 20 km/hr on village roads to reduce risk of accidents or injuries.

Safety training should be provided to all construction workers on operation of equipment. Security should also be extended during non-working hours to ensure there is controlled access to the machinery and equipment.

9.6 ENVIRONMENT MANAGEMENT PLAN: OPERATION PHASE

During operation phase of the proposed project, pollution impacts are envisaged on air, noise and land/biological components of the environment as per the impact predicted in this study. However, in order to ensure predicted impact levels and to further mitigate the impacts wherever possible from proposed project on individual environment component, the following mitigation measures are recommended:

9.6.1 Air Environment

Coal based thermal power plants emit fly ash as the major pollutant besides varying degrees of other pollutants namely: coal dust, sulphur dioxide and oxides of nitrogen etc. Therefore it is recommended to monitor the concentration of PM10 and 2.5, SPM, SO₂ and NO_x in the ambient air at regular intervals at predetermined locations.

The control measures to combat air pollution due to proposed power plant have been formulated under two categories, i.e. for individual units as well as for the whole power plant in general. These are delineated hereunder:

- **Coal Handling System:** Dust emission is mostly of fugitive type and necessities installation of close conveyor system along with suitable dust trapping/control facility at various transfer points. At coal yard, to prevent dust emission due to wind, frequent spraying of water is recommended. This also helps in preventing spot fires.

- **Coal Crusher and Bunkers:** For the fine dust control, bag filters have been successfully tried in such operations. Better efficiency dry collection system shall prove to be long term cost effective because of possibility of coal recovery in the process.
- **Flue Gas:** For high efficiency collection of fly ash in flue gas from the boiler, a high efficiency ESP is proposed to be installed in this plant and that would be designed to limit the emission of the particulate matter for permissible level. Sprinkling of water will be applied at the dust generating areas.

As far as gaseous pollutants namely NO_x and SO₂ are concerned, control measures will be taken by provision of 275m stack as per regulations in the EPA, 1986.

General Measures: The following air pollution control measures have been recommended for implementation at the proposed power plant:

- Furnaces and boilers should be operated with minimum excess air so that fuel consumption is reduced and NO_x emissions are minimized. Low NO_x burners should be installed for further reduction in NO_x emission.
- The stack should have sufficient capacity to take care of emergency release conditions, for additional load of flue gas under boiler start up and shutdown periods.
- All the internal roads shall be asphalted to reduce dust emission due to vehicular movement.
- The combustion units shall be maintained properly for obtaining optimum efficiency and to ensure that the emission rates remain within estimated levels.
- The fugitive emissions of coal dust from storage facilities, from crushers and at coal transfer points should be reduced by adopting appropriate measures like cyclones/ bag filters/ water sprinklers/ fog system.

9.6.1.1 Air Quality Monitoring

All monitoring will be carried out as per the conditions stipulated by the State Pollution Control Board.

Flue Gas O₂ and CO Monitoring: These would be monitored at the economizer outlet. In addition, O₂ would be monitored at the air pre-heater outlet. For this purpose, CO and O₂ analyzers would be installed separately.

Stack Emission: It is proposed to monitor particulate emission using an opacity meter on the stack. The stack monitoring will be utilized to keep a continuous check on the performance of Electrostatic Precipitators, which will be interlocked with the operation of boiler.

In addition to this, the concentration of RSPM/SPM and levels of SO₂ and NO_x in the ambient air and in the nearby villages should be monitored as per the direction of the State Pollution Control Board. The ambient air monitoring should be carried out at regular intervals from the selected locations. One sampling system per unit would be provided. There will also be online stack monitoring done for all important stacks.

Micro-meteorological observations: There should be installation of a permanent weather monitoring stations within the plant premises. The dry bulb temperature, wet bulb temperature, wind speed, wind direction, cloud cover, rainfall should be monitored and recorded daily.

9.6.2 Water Environment

The project will have a closed cycle cooling system with cooling towers. Steam generator blow down water would be flashed in an atmospheric flash tank. It is proposed to lead steam generator blow down after quenching with service water to a recovery pond.

Fuel oil storage areas will be provided with concrete embankments to contain spills. Regular oily wastewater shall be treated before discharge. Areas, prone to spillage shall be connected to a drainage system and will undergo adequate treatment.

A stilling pond will be provided by the side of ash pond to allow ash water to flow from settling pond where the suspended solids will be reduced by alum addition. The water thus clarified will be pumped to ash water tank for recirculation to ash handling system.

ETP would be planned, completed and commissioned along with the commissioning of the proposed power plant. Following measures are recommended for ETP:

- Evaluation of the effluent treatment plant for its performance after its commissioning should be undertaken at regular intervals to keep a check on the treated effluent quality.
- Trained personnel should be engaged for operating the effluent treatment plant.
- In-plant control measures should be implemented to minimize the quantities of wastewater generation.
- In addition to the above, to keep control on biological treatment, regular monitoring of effluent quality is also recommended.

9.6.2.1 Wastewater Management for Individual Sections

- *Demineralization (DM) Plant Effluent*: During treatment, acidic and alkaline effluent will be generated periodically. The effluents need be collected in a neutralizing pit where the acidic and alkaline effluents will be neutralized with each other. This will be pumped and mixed with other effluents in the polishing pond after filtration.
- *Boiler Blow-down*: The boiler blow down does not require treatment to achieve the limits but relies on operating at sufficient blow down levels to prevent the build-up of contaminants. Also, by operating with proper chemistry in the condensate and feed water systems, copper and iron are not present in significant quantities in the blow downstream. The boiler blow down is also directed to the guard pond.
- *Effluent from Oil Handling Areas*: The effluent carrying oil spillage etc. should be taken to oil/water separation. The decanted oil (containing small amount of water) should be taken to an oil separation tank for further separation. The decanted oil may be stored in a tank for reuse. The supernatant water need be sent to the polishing pond.
- *Effluent from Ash Pond*: The drain and overflow water from the ash pond would flow from settling pond to stilling pond and from stilling pond to the clarifier where the suspended solids will be reduced by addition of alum/electrolyte. The clarified water will be pumped to the ash handling system.
- *Domestic Waste from the plant*: Domestic wastewater will be treated in Sewage Treatment Plant. The treated sewage from the plant will meet stream standards and would be used for plantation and secondary uses.
- *Air Pre-heater Wash Water Effluent*: Frequently, the air pre-heaters of the boilers need to be washed. The washed water would be led to the respective settling basins located near the boilers. From the settling basins, dust-laden water would be pumped at suitable intervals, to the guard pond.

- *Rain (Storm) Water Drainage:* Rain harvesting structures will be constructed on top of all available structures so that the rain water can be recycled for plant requirements. The rain (storm) water removed from the building roofs and yard area grade level surfaces would be directed through the open ditches and culverts to the storm drainage piping. All ditches would be concrete lined 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 ditches.
- *Monitoring of Waste from the Plant:* All the treated effluent will be monitored regularly for the flow rate and identified parameters of quality, so that performance efficiency of treatment systems are evaluated and necessary changes recommended from time to time.

General Recommendations for Wastewater Management: The measures recommended for ETP should be planned, completed and commissioned along with the commissioning of the Proposed Power Plant.

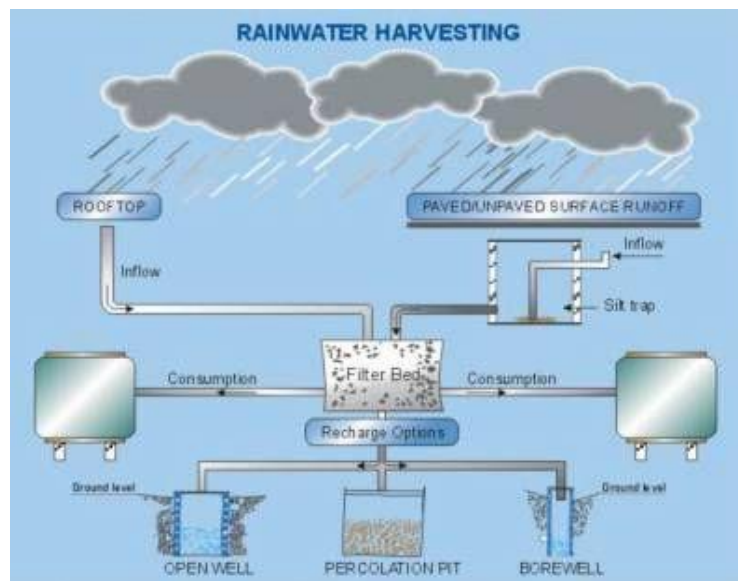
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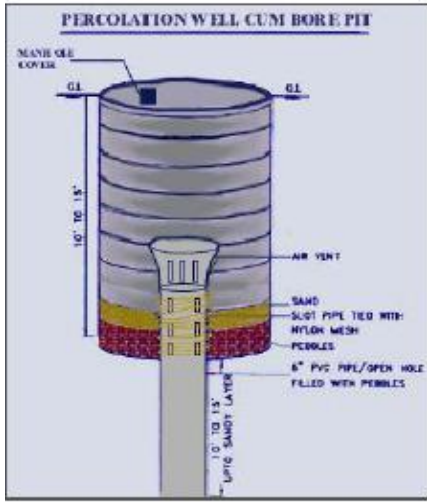
9.6.2.2 Rainwater Harvesting

Rainwater Harvesting will be implemented at proposed plant to conserve storm water. Rainwater harvesting typically has two different approaches which are collection and storage of rainwater and channeling surface run-offs to ground water recharging structure.

In the first approach, rainwater collected from roofs, pavements and roads after rain will be diverted to a collecting underground tank(s). Sand or pebbles will be provided depending on the end use of the water i.e. whether it will be used for sanitary purpose, horticulture/ landscape gardening etc.

System will be designed based on quantity of rainwater collected from well-defined surface areas and for the rainfall data applicable to the site. Oil filters will be put in all drain heads to ensure that no oil and grease from the surface gets mixed with the percolated water.





In the second approach, rain water from surface run-off will be directed towards recharging the ground water aquifer directly through the various types of structures such as, percolation pits, Dug cum Bore wells and Mini Artificial Aquifer, etc. The type of structure suitable for a site will be depending on the topography, lithology of the site and depth at which the ground water aquifer exists. The water can also be sent back to the reservoir for use at a later stage in the plant due to the scarcity of water in this region.

The details of rainwater harvesting methods and structures will be done during detailed engineering.

9.6.3 Noise Environment

Manufacturers and suppliers of noise generating devices/machines like steam turbine generator, compressors and other rotating equipment shall be asked to provide acoustic enclosures for noise control by adopting appropriate design and state of art technology for fabricating/assembling machines.

Proper noise barriers/ shields etc shall be provided around the equipment wherever required. Noise from equipment shall be adequately attenuated by providing soundproof enclosure and insulation to minimize the noise level.

9.6.3.1 Recommendations for Noise Management

To reduce the impact of noise, shock absorbing techniques may be adopted

- All opening like covers, partitions may be acoustically sealed
- The operator's cabin (control rooms) should be properly insulated with special doors and observation windows
- The operators working in the high-noise areas would be strictly instructed to use ear-muffs/ear plugs
- Noise levels may be reduced by the use of absorbing material on floors, walls and ceilings
- There will be thick vegetation in the plant premises to attenuate continuous noise.

9.7 ASH MANAGEMENT

Considering use of indigenous coal with approximately 42-43 % ash, it is estimated that on an average about 2.70 MTPA (PLF 90%) of ash will be produced from the plant. Fly ash collected in the ESP hoppers, air pre-heater hoppers and from the economizer hopper will be directly conveyed to the slurry sump through collector tank and wetting unit. Jet pumps will be installed for pumping the fly ash in the slurry form to ash slurry sump for further disposal to ash pond. Bottom ash evacuation shall be through Jet Pulse System for evacuating through bottom ash Hopper or Dry Bottom Ash Handling system.

Bottom ash which will constitute about 20% of total ash generation will be conveyed to and collected in silos in the form of high concentration slurry.

Fly Ash will be utilized for brick making and cement manufacturing purposes. Fly ash will further be used as light weight aggregates and for paving of roads.

The Ministry of Environment & Forest has come out with a draft notification with revised norms for ash utilization. As per the new notification dated 06.11.2009 “New coal and, or lignite based thermal power stations and, or expansion units commissioned after this notification to achieve the target of fly ash utilization as given below:

- At least 50% of fly ash generation One year from the date of commissioning
- At least 70% of fly ash generation Two years from the date of commissioning
- 90% of fly ash generation Three years from the date of commissioning.”
- 100% of fly ash generation four years from the date of commissioning

Considering the Notification, the ash to be diverted to ash dyke would be as follows:

Year	Ash Generation	Ash Utilization		Ash Diverted to Ash Storage Yard	Cumulative Total
	MTPA	%	MTPA	MTPA	MTPA
1 st	2.7	50	1.40	1.40	1.40
2 nd	2.7	70	1.90	0.80	2.20
3 rd	2.7	90	2.43	0.27	2.47
4 th	2.7	100	Nil	0	2.47

Total Ash Generation (90% PLF)	=	2.70 MTPA
Bottom Ash Generation (20%)	=	0.54 MTPA
Fly Ash Generation (80%)	=	2.16 MTPA

The Boiler Ash will be collected from the boiler's hopper precipitator and fly ash from the electrostatic precipitator hoppers. The permeability of soil was found to be about 1.83×10^{-4} K(cm/sec). A clay lining is recommended for lining of the ash dyke as it will provide perfect lining for the ash pond. For utilization of ash Letter of Intent (LOI) has been received from cement manufacturing companies in Chhattisgarh State.

9.8 HAZARDOUS SOLID WASTE MANAGEMENT

Hazardous solid waste in the form of waste oil, spent ion exchange material and water pre treatment clarifier sludge will be generated from the power plant. The oil will be collected in MS drums and will be sold to the recycler registered with CECB / Central Pollution Control Board. Sludge will be dried, bagged and sent for land-filling. Spent Ion exchange material will also be sent for land-filling.

9.9 SOCIAL ENVIRONMENT

The proposed project is expected to contribute towards upliftment of local people's quality of life and it shall generate inputs for industrial/economic development in the region. Following guidelines are given to proponents for protection of workmen likely to be engaged from the nearby villages, as also a discussion towards the end covering community benefits. MBPCL should take adequate steps to get local people into confidence so as to avoid any misconceptions amongst the people in future. The following measures are suggested for minimizing the adverse impacts on socio-economic and human interest:

- Communication with the local community should be institutionalized as done on regular basis by the project authorities to provide an opportunity for mutual discussion.
- Social welfare activities may be undertaken by the project authorities in collaboration with local administration, gram panchayat, block development office etc. for better co-ordination.

It is envisaged that upon implementation of community development programmes/welfare measures as recommended in environmental management plan would lead to increase in subjective quality of life index. QoL(s), which ultimately result in increase of cumulative quality of life QoC (C) in the project area.

9.9.1 Labour Welfare

Social and Awareness Programmes: Awareness programmes will be organized to help and educate the local people about potential hazards and the disaster management as well as environmental management plan being undertaken at project site. This will be done in the collaboration with local administration.

Employment and Social Insurance: Management would ensure that every permanent worker has employment security benefits. They would be covered by proper insurance/other schemes such as benefits in case of injury, sickness, temporary and permanent disability through workers' compensation in the event of occupational accidents and diseases, and compensation for survivors in the event of work-related death, to all workers in the industry, irrespective of their employment status.

Medical facilities, provision of safety gears will also be made available to all categories of workers.

Working Hours: Industry will have reasonable working hours that would not exceed the number of hours prescribed by India's laws and regulations. Working hours will be fixed to provide adequate periods of rest. There will be short break during working hours, depending on the nature of job to recover their vigilance and physical fitness; sufficient breaks for meals; daily or nightly rest; and weekly rest. The workers will be paid as per the Minimum Wages Act. They are not generally encouraged to work for more than 48 hours in a week. If they are to work, adequate incentives would be provided to them.

Aesthetic Environment Development: As regards aesthetic environmental development of social forestry and road side plantations shall be encouraged through tree plantation derives in the project region.

Drinking water: Proposed power plant will have an adequate supply of drinking water. A supply of drinking water will never be connected to a supply of water that is unfit to drink. Workers would not be allowed to wash their clothes or take their bath adjacent to drinking water sources.

Sanitary and washing facilities: The workers will be provided with toilet and bathroom facilities. Adequate bathing/washing facilities will be provided to enable workers to meet personal hygiene. Washing facilities would be conveniently accessible but situated so that they are not themselves exposed to contamination from the workplace.

Heat stress and wet conditions: Management will take measures for workers exposed to heat stress or wet conditions, which includes prevent heat-related illnesses; protect workers from excessive UV radiation; protect workers from weather/climatic conditions likely to contribute to injury or illness. For the prevention of heat stress, Industry authority would minimize exposure of workers to the sun by proper work organization and scientifically designing workplaces. The plant management will provide training, to enable detection workers early signs of disorders; protect workers by appropriate personal protective

equipment and clothing; require persons continually working under exposure of sun to undergo routine medical surveillance for the purpose of detecting skin lesions; and also supply drinking water to the workers.

Lighting: Where natural lighting is not adequate to ensure safe working conditions, and during nighttime, adequate and suitable lighting, including portable lighting, should be provided at every workplace.

Restroom and Canteen Facilities: For the workers in the plant, facilities such as restroom, canteens, etc will be provided. This will be also applicable to contractual workers during construction as well as operation phase.

To assess the status of environment during the plant operation, crucial environmental parameters should be monitored on regular basis. Any deterioration in environmental status due to the plant operation could be judged by comparing with the base line condition of environment. Importance of monitoring lies in the fact, that it determines the efficiency of the different pollution controlling measures. So, monitoring is as important as to control the pollution.

9.9.2 CSR Activities and Community Development Plan

MBPCL will be having their own CSR activities which will encompass developmental and social activities. The CSR activities will aim to minimize the adverse socio-economic impacts of the plant and help in overall development of the area.

- Workforce available locally will be preferred for employment depending upon their suitability (experience and knowledge).
- Providing vocational training to the women folk as part of welfare activities will greatly enhance and improve their economic strength. Self help women groups will be encouraged in nearby villages and proper training will be imparted.
- Job oriented skill training courses may be organized through Industrial/Technical Training Institutions for Educated Youth (both for male and female), like O&M of electrical, home appliances, tailoring, plumbing, automobile repairs, welding and fabrication and any other project related specific trades.

MBPCL will give priority attention to preserve the common property resources of study area like village roads, ponds and grasslands. Public relations strategy will be formed where the following actions will be implemented: Providing employment to local population; providing training to local people and later employing them in the plant as per their skill and job knowledge, buying local goods and services; encouraging local entrepreneurship around the plant and colony, involving women participation in conservation efforts and creating awareness about environmental health and pollution, encouraging respect for local traditions and religious beliefs and promoting local folk dance and music. Some of the community development schemes include tree plantation on avenue roads and other open spaces, providing free health check-up facility and medicines to the poor villagers, providing assistance to construct school building, providing scholarships to deserving and needy students, giving educational aids to poor students, constructing community centers at some villages, constructing drinking water facilities like tube-well in some villages, sponsoring sports tournaments and summer coaching camps etc.

9.9.3 Action Plan

The details of the CSR commitment for development of the local population proposed to be carried by MBPCL are given below. It has been estimated that about Rs 31 crores will be spent as part of CSR activities. The budget allocation for the activities has been mentioned in **Annexure XV**.

Short Term Plan:

- Formation of women Self Help Groups.
- Linkage of SHG with Income generating activities.
- Focused Health initiative.
- School Uniforms to students in tribal hamlets.
- Adoption of ITI
- Infrastructure support to existing Health-care Facilities.
- Mid-day meals in neighboring schools.
- Tree plantation and creation of greenbelt zone
- Donation of school furniture and maintaining school building in targeted area.
- Support training to villages for plantation of Herbal plants for commercial use.

Long Term Plan**Health**

- Providing support for setting up of Dispensary
- Mobile hospital facilities with Ambulance Service along with Pathology Lab facilities.
- Awareness programmes & Health camps.
- Immunization camps
- Nutrition programmes for Pregnant Ladies and Children.
- Awareness Camp for livestock in the village.

Infrastructure

- Water facilities including restoration of ponds, digging bore wells, hand pumps, constructing water tanks, purification facilities etc
- Rural roads, parks, sports facilities
- Creating common facilities like community centre, restoration of religious facilities, panchayat bhawans etc .
- Water harvesting facilities.

Education

- Construction and restoration of Schools.
- Providing computers/ equipment/furniture to schools
- Support to deserving/meritorious BPL students by providing free books.
- Adult education programme.
- Placement support to skilled youth with better employers.
- Computer literacy programme.

Skill Development & Livelihood Generation

- Creating skill training centers with infrastructure, equipment, material etc
- Strengthen infrastructure and equipment and academics in nearby ITIs and skill development centres
- Providing training to local youth and place them in commercial/industrial organization
- Create cottage industry clusters of SHGs(Self Help Groups) in various products.
- Capacity building of farmers through training, technical support & better marketing avenues

Other

- Sports competition
- Financial help to needy people
- Socio economic studies.
- Financial help to community level events.

9.10 GREEN BELT DEVELOPMENT

With a view to attenuate air pollutants, to absorb noise and to care of uptake of water pollutants, it is recommended to develop a greenbelt, all around the boundary and at several locations within the power plant premises.

9.10.1 Criteria for Selection of Species for Greenbelt

The plant species suitable for greenbelt development need to be selected based on the following criteria:

- Fast growing;
- Thick canopy cover;
- Perennial and evergreen;
- Large leaf area index;
- High sink potential ;
- Efficient in absorbing pollutants without significantly affecting their growth; and
- Suitable for the local seasons.

A concept of three-tier green belt development viz. rows of permanent trees in say 20 m width, followed by avenue trees with medium canopy in a width of approximately 10 m may be planted along the periphery of the plant, thereby developing approximately 50 m wide green belt all along the plant boundary.

The various services / utility areas within the plant would be suitably graded to different elevations. Natural features of the plant site would be retained as far as possible to integrate with the buildings to form a harmonious / pleasant environment. Areas in front of various buildings and the entrance of power plant would be landscaped with ground cover, plants, trees based on factors like climate, adaptability etc. The green belt would consist of native perennial green and fast growing trees. Trees would also be planted around the coal stock pile area and ash disposal area to minimize the dust pollution.

The plant species that may be useful for development of thick green cover keeping in view the nature of pollutants expected from power plant and pollution attenuation coefficient of plants, the following plants species are short listed for plantation.

Guidelines for Plantation: The design and implementation of greenbelt within and around the complex of proposed power project shall follow the guidelines published by CPCB. About 1500 trees will be planted per hectare. The species identified for greenbelt development would be planted using pitting technique. The filling of soil should be completed at least 5-10 days before actual plantation. Healthy saplings of identified species should be planted in each pit. The plant species that may be useful for development of thick green cover with keeping a view the nature of pollutants expected from power plant and pollution attenuation coefficient of plants, the following plants species are short listed for plantation.

Schedule of the Green Belt: Native plant species will be introduced in the proposed greenbelt and plantation areas in consultation with local forest department. Species composition of plantation area will be heterogeneous in nature. The proposed year-wise development of greenbelt is discussed below:

- **1st & 2nd Year:** Plantation in the outer zone will be initiated with the commencement of construction work.
- **3rd Year:** Plantation will be done in the secondary zone and along the road sides.
- **4th Year:** Greenbelt will be developed around buildings, open space and primary zone. Besides, mixed area plantations will be developed after finalization of actual size and strength of equipment. Area earmarked for greenbelt in plant area is shown in Plot Plan.

Cost: The cost of greenbelt development will mainly include the soil handling and sapling costs including preparation of agricultural soil and use of biocides and fertilizers and cultures of Azotobacter and Rhizobium. The costs will depend on local edaphic factors including distance of nearest nursery and sapling survival rates. About Rs. 2 crores has been earmarked for the greenbelt development.

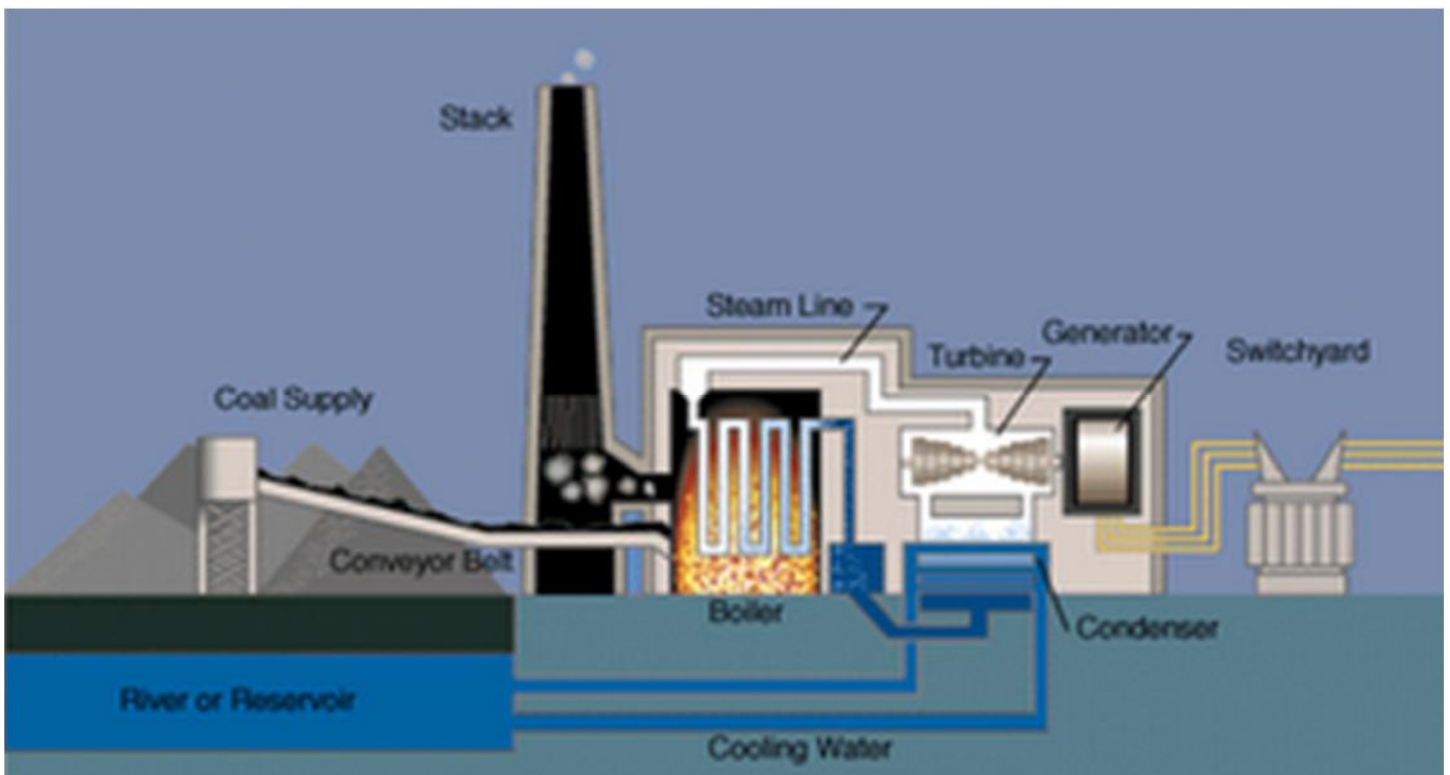
Table 9.4 Species recommended for greenbelt Development

S No	Scientific Name	Local Name
1	Abutilon indicum	Kanghi
2	Acacia spp	Khair
3	Adina cordifolia Roxb	Haldu
4	Aegle marmelos	Bael
5	Ailanthus excelsa	Mar Maharakha
6	Albizia spp	tugli
7	Alstonia scholaris	Chattiyani
8	Anona squamosa	Custard apple
9	Anona reticulata	Iuvuni
10	Anogeissus latifolia	Dhaura
11	Azadirachta indica	Nim
12	Bauhinia purpurea	Khairwal
13	Bauhinia racemosa	Astha
14	Bahinia varigata	Kachnar
15	Dalbergia sisoo	Shisham
16	Delonix regia	Mayarum
17	Diospyros melanoxylon	Tendu
18	Duranta repens	-
19	Eucalyptus spp	Lemon scented gum
20	Ficus spp	Bargad
21	Gardenia iasminoides	Karinga
22	Grevillea robusta	Silvar oak
23	Hibiscus rosa sinensis	Jasum
24	Holoptelia integrifolia	Kanju
25	Ixora spp	-
26	Lagerstroemia parviflora	Phurush
27	Lawsonia inermis	Mehndi
28	Madhuca longifolia	Mahwa
29	Mongifera indica	Amri

30	Ouginia oojeinensis	Sandan
31	Phoenix sylvestris	Khajur
32	Phyllanthus acidus	Harfaravri
33	Polyalthia longifolia	Devdaru
34	Populus deltoides	Coroline poplar
35	Syzygium cumini	Jaman
36	Tamarindus Indica	Lmli
37	Terminalia arjuna	Arjuna
38	Thevetia peruviana	Pila kaner

Chapter 10

Risk Assessment



10. RISK ASSESSMENT

10.1 INTRODUCTION

The occurrence of an event or sequence of an events falling in accident category are expected to result into potential risks to human habitat and assets (inside as well as outside project premises). Accidents of varied severity occur due to several reasons such as operational errors, natural calamities and third party interactions. A disastrous situation at an industry/ facility may arise due to accidental releases resulting in either fire and explosion or lethal toxic effects, which eventually leads to loss of life, damage to property and / or ecological imbalances.

For a proposed developmental project, especially the one which deals with hazardous materials (highly inflammable, toxic, corrosive, etc.), it is essential to visualize risk associated with the worst possible accidents in all vulnerable units, operations/ areas corresponding to the project. The outcome will be ultimately useful in planning and implementation of risk preventive/ mitigation measures through engineering/ technological interventions in various phases of project implantations such as layout design; selection of material equipment/ units etc., and also through preparedness for emergency management.

10.2 HAZARD IDENTIFICATION AND MODELS USED

The identification of specific scenarios is based on the assessment of likely events and incidence of failures. In most of the cases stored quantities of liquid fuel and chemicals are considered in hazard identification. **Table 10.1** provides the details of storage of fuel and chemicals.

Table 10.1- Maximum Stored Quantities of Fuels and Chemicals

Material Stored	Maximum Storage	Mode of Storage	Storage Conditions	
			Pressure	Temperature
HFO	4000 KL (2x2000 KL)	Two vertical cylindrical storage tanks	Atmospheric	Ambient
LDO	1000 KL (1x1000 KL)	One vertical cylindrical storage tank	Atmospheric	Ambient
Chlorine	4 tonners	Cylindrical storage tonners	Atmospheric	Ambient

10.3 LIKELY EVENTS DUE TO VARIOUS HAZARDS

Fire and chemical release may occur due to the storage of fuel and chemicals. In case of failure of the systems, the likely incidents to occur are listed in **Table 10.2**.

Table 10.2- Likely Incidents in case of Systems Failure

Fuel / Chemical Stored	Likely Incident			
	Fire ball	Pool fire	Toxic Release	Explosion
HFO	No	Yes	No	No
LDO	No	Yes	No	No
Cl ₂	No	No	Yes	No

10.4 SELECTED FAILURE CASES

In view of plant layout developed for the site and hazard identification, failure cases as selected for consequence analysis are provided in **Table 10.3**.

Table 10.3- Incident Considered for Consequence Analysis

Fuel / Chemical	Incident
HFO	Pool Fire due to shell rupture
LDO	Pool Fire due to Shell rupture
Cl ₂	Leakage

10.5 MODELS USED TO COMPUTE ZONE OF INFLUENCE

In order to compute the zones of influence, due to various incidents as listed above, standard equations and models were used in the risk analysis. The details of all such equations / models used are referred to as below.

Chlorine vapour dispersions were evaluated with the help of Aloha Dispersion Model; the equations used are available in "Process Plant Layout", and "Guidelines for Chemical process Quantitative Risk Analysis", by AIChE, Center for Chemical Process Safety, American Institute of Chemical Engineers, New York. These equations have found acceptance during project appraisals.

10.6 RISK ASSESSMENT AND CONSEQUENCE ANALYSIS

Consequence analysis is that part of risk analysis which considers individual failure cases and damages caused by them. To predict the hazardous outcome of accidents and their possible effects, consequence analysis is generally employed. The analysis is carried out on a variety of preconceived scenarios. The purpose and benefits that are likely to be derived by carrying out consequence analysis include:

- Improvement in plant layout
- Meeting statutory requirement
- A part of overall risk analysis
- Protection of public in nearby areas
- A training tool

The results of consequence analysis provide information about the effects from an accident scenario, thus helping in dealing with the situation. The analysis also better an understanding of the risks involved in the area.

10.6.1 Approach

The present risk analysis as undertaken has two basic considerations:

- The proposed project will use HFO and LDO as secondary fuel and start-up fuel respectively. These fuels are flammable.
- To prevent growth of organic matter and micro organisms, which tend to foul condenser tubes etc, chlorine is the most common biocide use. The system is based on conventional gas chlorination using evaporator – chlorinators proposed to be housed in building close to the cooling tower and CW pumps.

- HFO and LDO storage tanks burst, and leakage of chlorine were subjected to consequence analysis. The outcome of this analysis provides information about possible hazards due to accidents or tank failures.

10.6.2 Intrinsic Hazards of HFO, LDO and Chlorine Storage

Hazardous and other toxic properties of these materials, under consideration, are provided in Material Safety Data Sheets (MSDS).

10.6.2.1 Effects of Release

Pool formation occurs through HFO and LDO storage tank release causing different levels of thermal radiation incident. However, the pool fire will remain confined within dyke provided around storage tanks.

Toxic chlorine gas can spread to long distances forcing exposures to different levels of doses; the highest may prove to be lethal.

10.6.2.2 Damage Criteria

In order to appreciate the effects produced by various scenarios, including thermal radiation and toxic release, the criteria laid down are based on both physical and physiological effects.

- HFO / LDO released accidentally will normally spread out and form a pool. If its pool finds ignition source, a fire is likely to occur. Any person caught in the fire is likely to suffer fatal burn injuries. Therefore, in the consequence analysis, the distance to which Lower Flammable Limit (LFL) value persists is taken to indicate the area which may be affected by fire. Any other combustible materials within fire zone are also likely to catch fire and secondary fire may ensue. It may be mentioned that due to HFO / LDO spillage the evaporation of diesel vapours will be insignificant and, as such, no Lower Flammable Limit (LFL) and Upper Flammable Limit (UFL) values for HFO/LDO are reported in literature. Hence due to HFO, LDO spillages pool fire may result if there is an immediate ignition source.
- Thermal radiation due to fire may cause various degrees of burns on human bodies. Moreover, their effects on inanimate objects like equipment, piping or vegetation also need to be evaluated to assess the impact. **Tables 10.4** provide the effects due to thermal radiation intensity.

Table 10.4- Damage due to Incident Radiation Intensity

Incident Radiation Intensity (kW/m ²)	Types of Damages
62.0	Spontaneous ignition of wood
37.5	Sufficient to cause process equipment damage to
25	Minimum energy required to ignite wood at infinitely long exposure (non piloted)
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.
4.5	Sufficient to cause pain to personnel unable to reach over within 20 sec; however blistering of skin (1st degree burns) is likely
1.6	Will cause no discomfort during long exposure

- The release of chlorine vapours will have damaging effects on human being. The toxic effects of chlorine vapours are provided in **Table 10.5**.

Table 10.5- Damage due to Chlorine Vapours

Parts of Chlorine (ppm)	Type of damage
0.2-0.4	Threshold of odour perception with considerable variation among subjects (a decrease in odor perception occurs over time);
1-3	Mild, mucous membrane irritation, tolerated for up to one hour;
5-15	Moderate irritation of the respiratory tract;
30	Immediate chest pain, vomiting, dyspnea, and cough;
40-60	Toxic Pneumonitis and pulmonary edema;
430	Lethal over 30 minutes;
1000	Fatal within a few minutes.

10.6.2.3 Meteorological Conditions

Meteorology plays a vital role in the propagation, dispersion and diffusion of toxic gases and hydrocarbon vapours. The fire also propagates in downwind direction provided wind speeds are appreciably higher. The meteorological condition is required as input data for the computations of zones of influence of various incidents for different fire intensities. The dominant wind directions, average temperature, wind speed range during various months are commonly observed parameters. One source of such long term and reliable data is India Meteorological Department (IMD) which runs an observatory, at Champa. The climatological data of this observatory has been analyzed for the predominant wind speed range and temperature and used in computations.

The dispersion of gas ultimately depends on the meteorological condition. For worst case scenario extreme conditions are considered. Dispersion is much dependent on stability condition and wind speed. In winter night temperature may come down drastically and F stability are considered in addition to D class as this predicts minimum dispersion thus affecting people at a greater distance. Wind may blow to any direction, but long term meteorological data show the predominant wind directions for a specific location. In day time high temperature of 40.7°C is considered as this will raise the internal pressure of cylinders / storage systems and in case of loss of containment the release rate will be high. A high wind speed of 5.0 m/s is considered. A night time winter condition with minimum temperature of 15.8°C and wind speed of 2 m/s is considered. These conditions will predict the maximum impact zone towards South-west & Western direction of the plant.

Two atmospheric conditions have been considered for buoyant plume dispersion calculations:

- Pasquill stability category D (Neutral) at wind speed of 5 m/s (represented as 5D)
- Pasquill stability category F (Stable) at wind speed 2 m/s (represented as 2F)

Unstable weather conditions such as pasquill stability categories A or B and higher wind speed have not been considered as these conditions will facilitate better dispersion and thus result in smaller flammable masses in cloud.

10.6.2.4 Consequence Analysis

Consequence analysis was carried out for identified selected failure cases. Consequence analysis quantifies vulnerable zones. For the selected accidental scenarios, after vulnerable zone is defined, measures can be proposed to minimize damages caused.

10.6.3 HFO and LDO Tanks on Fire

The tanks (2x2000 KL) on fire scenario are presented in **Table 10.6** with distances of various intensities. The distance of occurrence of 4.5 kW/m² radiation intensity, sufficient to cause first degree burn, has been calculated at 62.1 m. Plant personnel not involved in fire fighting shall remain beyond this distance.

Table 10.6- Distances of Occurrence of Various Thermal Radiation Intensities due to Rupture of all two (2x2000 KL) Heavy Fuel Oil (HFO) Tanks

Radiation Intensity (kW/m ²)	Distance (m)	Types of Damages
62.0	16.7	Spontaneous ignition of wood
37.5	21.5	Sufficient to cause process equipment damage to
25.0	26.4	Minimum energy required to ignite wood at infinitely long exposure (non piloted)
12.5	37.3	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.
4.5	62.1	Sufficient to cause pain to personnel unable to reach over within 20 sec; however blistering of skin (1st degree burns) is likely
1.6	104.2	Will cause no discomfort during long exposure

LDO tank on fire scenario are presented in **Table 10.7**.

Table 10.7- Distances of Occurrence of Various Thermal Radiation Intensities due to Rupture of LDO (1x1000 KL) Tank

Radiation Intensity (kW/m ²)	Distance (m)	Type of damage
62.0	10.5	Spontaneous ignition of wood
37.5	13.5	Sufficient to cause process equipment damage to
25.0	16.6	Minimum energy required to ignite wood at infinitely long exposure (non piloted)
12.5	23.4	Minimum energy required for piloted ignition of wood, melting plastic tubing etc.
4.5	39.0	Sufficient to cause pain to personnel unable to reach over within 20 sec; however blistering of skin (1st degree burns) is likely
1.6	65.4	Will cause no discomfort during long exposure

10.6.4 Chlorine Release

It is proposed to house 4 chlorine tonners (each containing 900 kg) at the dosing site, 2 in operation and 2 standbys.

It has been assumed, as worst-case scenario, that the liquid line of the 1-ton chlorine container is sheared by mechanical impact, causing release of liquid chlorine through 2 mm diameter hole.

Table 10.8- Distances of Occurrence of Various Concentration due to 2 mm hole leakage in Chlorine Tonner

Concentration of Chlorine (ppm)	Type of damage	Distance (m) in 2F	Distance (m) in 5D
0.3	threshold of odor perception with considerable variation among subjects (a decrease in odor perception occurs	4000	2100

Table 10.8- Distances of Occurrence of Various Concentration due to 2 mm hole leakage in Chlorine Tonner

Concentration of Chlorine (ppm)	Type of damage	Distance (m) in 2F	Distance (m) in 5D
	over time);		
2	mild, mucous membrane irritation, tolerated for up to one hour;	2100	770
10	moderate irritation of the respiratory tract;	712	328
30	immediate chest pain, vomiting, dyspnea, and cough;	341	182
50	toxic Pneumonitis and pulmonary edema;	243	138
430	lethal over 30 minutes;	62	41
1000	Fatal within a few minutes.	40	22

The nearest settlement is located at distance of 1.0 km from the Chlorine handling place. In the present scenario the dispersion is likely to extend upto a distance of maximum 770 m for 2 ppm concentration in 5D condition. The leakage scenario has been calculated for 60 min. However, in general there is too much possibility to control the chlorine leakage in less than 60 min of time. The IDLH value is for the worst case scenario, whereas the probability of such meteorological conditions coinciding with the failure of the cylinder is remote.

10.7 MITIGATION MEASURES

10.7.1 General Mitigation Measures

- Fire is one of the major hazards, which can result from auxiliary fuel (LDO & HFO) storage tanks. Fire prevention and relevant code enforcement is one of the major responsibilities of project proponent. The fire service facility should be equipped with:
 - Smoke and fire detection alarm system
 - Water supply
 - Fire hydrant and nozzle installation
 - Foam system
 - Water fog and sprinkler system
 - Mobile Firefighting equipment
 - First aid appliances
- Smoke and fire detection, fire hydrant & nozzle installation etc. as indicated above shall be included as part of all major units at the proposed project
- Periodic maintenance of all protective and safety equipment
- Wind socks/wind cock should be installed at suitable height and with proper visibility to check the prevailing wind direction at the time of accident
- Periodical training/awareness should be given to work force at the project to as refresh courses handle any emergency situation
- Periodic mock drills should be conducted so as to check the alertness and efficiency of the DMP and EMP and corresponding records should be maintained
- Signboards including emergency phone numbers and no smoking signs should be installed at all appropriate locations
- Plant shall have adequate communication system
- All major units/equipment shall be provided with smoke/fire detection and alarm system

- All electrical equipments shall be provided with proper earthing. Earthed electrode shall periodically tested and maintained
- Emergency lighting shall be available at all critical locations including the operator's room to carry out safe shut down of the plant, ready identification of fire fighting facilities such as fire water pumps, fire alarm stations, etc.
- In addition to normal lighting each installation shall be equipped with emergency (AC) and critical (DC) lighting.
- All electrical equipments shall be free from carbon dust, oil deposits, grease, etc.
- Cable routing shall be planned away from heat sources, gas, water, oil, drain piping, air conditioning ducts, etc.
- Cable route markers shall be provided in the permanent way at the location of changes in the direction of cables at the intervals not more than 30 m and at cable joint locations.
- Chlorine detectors should be provided at relevant locations

10.7.2 Project Specific Mitigation Measures

10.7.2.1 Chlorine Tonners

For chlorine tonners following control/containment measures are recommended.

- Chlorine from pressure relief devices should go to an expansion tank or to gas absorption system
- Complete chlorination plant shall be located indoor.
- Chlorine leak absorption system shall be provided for chlorination plant to neutralize chlorine leakage from chlorine tonner.
- To prevent the large release of chlorine to atmosphere, monitoring and feedback facilities for early detection leaks and emergency shutdown shall be provided
- There should be facilities in the form of water curtain for absorption of chlorine released during an emergency as chlorine is highly soluble in water
- Flow control valves at key points should be installed to prevent excess chlorine flow from the tonner with multiple level safety per line
- Chlorination plant shall be provided with adequate nos. of chlorine tone containers, instrumentation, panels, chlorine leak detectors etc.
- Immediate actions needs to be taken for evacuation of all personnel in case of accidental release of chlorine
- Eye wash stations and emergency shower stations should be provided at appropriate locations especially in the vicinity of Chlorine storage and dosing facilities
- The stand by chlorine tonners shall be kept / stored at isolated covered warehouse at safe distance. It shall be provided with sufficient high (about 6 m) roof ventilation, chlorine detection and water spray system inside storage facility
- Conduct awareness programmes on regular basis in order to educate villagers around the project about the consequences of possible health hazards and their precautionary measures during accidental conditions

10.7.2.2 Auxiliary Fuel System

- Protective systems with high reliability and availability should be designed to ensure that these physical conditions are maintained
- Dyke would be provided for LDO and HFO storage tanks

- Co-ordination with local authorities such as fire, police, ambulance, district administration & nearby industries would be ensured to manage / control meet any eventuality
- To prevent the hazard of static electricity, the fill and recirculation lines to the storage tanks shall discharged below the liquid level.
- The 4.5 kw/m² heat intensity radiation will not spread beyond the plant boundary.
- The following arrangements are suggested for LDO/HFO storage tanks:
 - One independent high level alarm and trip off liquid inlet-line.
 - One low level alarm with trip off device.
 - Provision of auto deluge water sprinkler system for each bulk storage tank. The auto deluge water sprinkler would be set to start working at a temperature of 660 C.
- The ST turbine building, switchyard, transformer yard, administrative building canteen, first aid center, fire stations etc. should be located safely, if viewed in the light of worst accident scenarios.
- In case of any tank on fire or fire in the vicinity, the cooling of adjoining tank should be resorted promptly in addition to tank on fire so that the tank shall of neighbouring tanks does not give away.
- The night vision wind stocking be mounted on top of administrative building, main plant building and storage tanks is preferred so that people can move in upwind directions in the event of massive spillage or tank on fire.
- No machinery of vital importance like fire fighting pump house, hydrant and fuel oil pump house should be placed out of at radiation contours of 37.5 kW/m² heat intensity.
- Maintenance plays a vital role in proper upkeep of plant. One important function is the monitoring of equipment health, pipelines and machines. Adoption of system like thickness survey (including supports) maintenance practices will improve plant performance and safety. Normally, failure rates of equipment and pipes are influenced by maintenance practices especially when plant starts aging.
- The proposed site is located under zone-III as per IS:1893. Analysis and design of structures to resist the seismic forces are to be carried out as per the provisions of IS:1892 2002/1985 (latest).

It is recommended that strict adherence to standards and accepted maintenance and operation of the plant plays a vital role in proper up keep of the plant. The monitoring of the health of equipment, pipeline and machines, thickness survey will improve plant performance and safety.

10.8 DISASTER MANAGEMENT PLAN

It will have the synonymous meaning as that of an emergency which may affect several sections within the plant and/or may cause serious injuries, loss of lives, extensive damages to property or serious disruption of works inside and/or outside the plant premises. Such a situation may occur due to a malfunction of the normal operating procedures, but may also be caused due to cyclone, flood, or deliberate act of arson or sabotage.

Emergency planning is an integral part of the overall loss control program and is essential for any well run organization. This is important for effective management of an accident / incident to minimize losses to people and property, both in and around the facility.

The important aspect in emergency management is to prevent by technical and organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses. Not only are unrecognized hazardous conditions which

could aggravate an emergency situation be discovered, the emergency planning process also brings to light deficiencies such as lack of resources necessary for effective emergency response. Emergency planning also demonstrates the organization's commitment to the safety of employees and increases the organization's safety awareness.

The format and contents of the Emergency Response Plan (ERP)/On-Site Disaster Management Plan (DMP) has been developed taking into consideration the regulatory guidelines, other applicable documents and accepted good industrial practices formulated as a result of lessons learned in actual emergencies requiring extensive emergency response.

Disaster can be defined as an "occurrence of undesired events of such magnitude so as to create a situation in which normal pattern of life within the facility is suddenly disrupted, adversely affecting not only the personnel and property within the facility but also in its vicinity."

As per the Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000, "major accident" means – an incident involving loss of life inside or outside the installation, or ten or more injuries inside and / or one or more injuries outside or release of toxic chemicals or explosion or fire or spillage of hazardous chemicals resulting in on-site or off-site emergencies or damage to equipment leading to stoppage of process or adverse affects to the environment;

Such an occurrence may result in on-site / off-site implications like:

- Leakage of flammable material,
- Fire and/or explosion

Incidents having off-site implications can be:

- Natural calamities like earthquake, cyclone, landslide etc.
- Air raids / Crashing of aircraft or flying objects.
- Chlorine leak.

Incidents, which could also lead to a disaster, are:

- Agitation / forced entry by external group of people
- Sabotage

An important aspect of the disaster is its unforeseen nature. Thus, by definition itself, a disaster is impossible to control completely. However, occurrence of events which lead to a disaster may be minimized through proper technology and engineering practices.

10.8.1 Disaster Management Plan On-Site & Off-Site

The On-site and Off-site emergency plans cover personnel employed at proposed Plant. The Emergency Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operation in the same order of priorities. The objective of the emergency plan is to make use of the combined resources of the plant and the outside service to achieve the following:

- Reliable and early detection of an emergency and careful planning
- The availability of resources for handling emergencies
- Safeguard the personnel located in the premises
- Minimize damage to property and environment
- Organize rescue and treatment of affected persons
- Initially contain and ultimately bring the incident under control
- Identify any casualties

- Provide authoritative information to the news media
- Secure the safe rehabilitation of affected persons
- The command, co-ordination and response organization structure along with efficient trained personnel
- Preserve relevant records and equipment for the subsequent enquiry into the cause and circumstances of emergency.

10.8.2 Nature of Hazards and Occurrences

A thermal power plant stores a number of chemical (such as liquid chlorine, hydrochloric acid, sodium hydroxide, and hydrazine) and flammable/combustible materials (such as furnace oil, light diesel oil, coal, hydrogen) which are hazardous in nature. The hazards are identified along the probable areas of occurrence.

Table 10.9: Hazards with Probable Areas of Occurrence

Nature of Hazard	Potential areas/ location
Fire Hazard (slow isolated or ash spreading)	<ul style="list-style-type: none"> • Coal handling plant • Cable galleries • Fuel oil handling and storage areas. • Transformer and switch yard areas. • Oil and lubricant stores. • Boiler area
Explosion Hazard	<ul style="list-style-type: none"> • Transformers. • Boiler. • Coal dust in mills and boilers.
Bursting of pipes & vessels	<ul style="list-style-type: none"> • Steam pipes due to high pressure/temperature. • Acid and oil pipe lines.
Release of gases/dust	<ul style="list-style-type: none"> • Chlorine in water treatment plant • Hydrogen in turbo generators area of main plant and H₂ plant • Pulverized coal dust from mills and associated piping. • Fly ash from chimneys and ash ponds and ESP hoppers • Coal dust in transfer points, coal handling plant crusher and mill area.
Release of liquid	<ul style="list-style-type: none"> • Chemical tanks in water treatment plant. • Fuel oil tank in fuel oil handling section.

10.8.3 Initial Emergency Response Organization

Shift-in-charge would lead initial response organization in an emergency condition. Upon the detection of an emergency condition, the Shift-in-charge assesses the conditions and, if an Emergency Action Level is exceeded, classifies the emergency, assumes the role of Main Controller. Command and control, at this stage functions from the Main Control Centre, operating as the Emergency Control Centre.

On the direction of the Main Controller, the designated Communications Coordinator notifies off- site agencies and plant management. If additional support is required for mitigation, the Main Controller, using weather information available in the Main Control Centre, assesses the extent and area of the hazard and initiates protective action as necessary.

Table 10.10: Emergency Organization of the Proposed Plan

• Overall In-charge
• Site Controller
• Incident Controller
• Communication Officer

- Liaison Officer
- Section In-Charge
- Emergency Response Team
- Fire and Rescue Controller
- Security Controller
- First Aid & Medical Controller
- Transport/Civil Supplies Controller

Main Controller

Main controller would co-ordinate the response action from the control room with the support of the control room staff. However, as the emergency escalates and the emergency response organization begins to be deployed, the emergency management centre should be moved to the designated Emergency Control Centre (ECC), where the entire response organization would operate. The Main Controller would operate from this location together with his staff, except for such personnel, as the Shift-in-Charge, who may be directly involved at the scene of the accident. He will:

- Relieve the Incident Controller of responsibility of the main Controller.
- Analyze the emergency and decide on the emergency level warning.
- Direct, co-ordinate and supervise the emergency response activities.
- Ensure on-site and off-site personnel protection, safety and accountability.
- Ensure that the casualties if any are given medical attention and that the relatives are informed, if necessary.
- Arrange for relief of personnel when emergency is prolonged.
- Liaison with the off-site emergency response personnel, departments and organizations such as fire and police officials and other statutory bodies and advise them of all likely effects of the incident outside the facility premises (if any).
- Regulate traffic movement within the facility.
- Ensure preservation of evidence for inquiries to be conducted by statutory authorities.
- Authorizes, termination of emergency by sounding of “All Clear” siren, which will be a continuous, long siren for one minute.

Site Controller

The Site Controller operates from the ECC and is responsible for supervising and co-ordinating the activities of those functions involved in mitigating the consequences of the accident. He will keep the Main Controller informed of the situation from time to time. He will immediately proceed to the scene of emergency and assess the situation. The Incident Controller should be equipped with a distinctive, fluorescent jacket for easy identification (which should be provided in the Emergency Control Centre). He will:

- Help the Main Controller organize and direct the emergency response activities keeping in mind the safety of personnel and minimizing loss and damage to property.
- Formulates strategies and advise the Main Controller of the actions to be taken to mitigate the consequences of the accident.
- Maintain direct communications with the on-site Field Operations Coordinator / incident controller.
- Co-ordinate the activities aimed at organizing, requesting and obtaining additional resources (both as equipment and personnel) to support the field operations.
- Co-ordinate with the Security-in-charge and Safety Officer.
- Check for casualties.

- Arrange for rescue of trapped workers and those in a state of shock.
- Get all non-essential workers safely evacuated after stopping all those jobs, which are not required during an emergency.
- Set up a communication system with the ECC through telephone, wireless and / or messenger system.
- Pending arrival of the Main Controller, direct the shutting down and evacuation from the facility and call outside emergency services, if necessary.
- Allot jobs to the emergency squad.
- Report all developments to the Main Controller.
- Preserve all evidence for use in the subsequent enquiry.

Incident/Field Operations Controller

The Incident Controller or Field Operations Controller is the highest ranking emergency response organization officer at the direct scene of the accident with headquarters located as close as possible to the location where the emergency field operations are carried out, with due regard for safety, of course.

The Field Operations Controller must be a person with good technical expertise and familiarity with the facility. Duties of Incident controller include:

- The direction and co-ordination of all field operations at the scene of the accident.
- On-scene accident assessment.
- The implementation of on-site response actions to protect facility personnel and the public (protective actions).
- The implementation of on-site response actions to bring the emergency under control (support and emergency control actions).
- The co-ordination of these actions with the Site Controller at the ECC.

The Administration Function

This function should provide the necessary administrative and clerical support to relieve the technical personnel from such responsibilities. The Administration Manager would assume the role of the Administration function. The duties include:

- Immediately proceed to the Emergency Control Centre (Control Room / Main gate).
- Work as a liaison officer during the emergency.
- Under the direction of the Main Controller, handle police, press and other enquiries, receive reports of roll call from emergency assembly areas and pass on the absenteeism information to the Incident Controller.
- Ensure that injured receive adequate and immediate medical attention.
- Inform the nearby hospitals and call for ambulance, if required.
- Control traffic in and out of the facility and ensure that alternate transport is available when required for casualties.
- Maintain prior agreed inventory of emergency equipment in the Emergency Control Centre and make up for shortages.

In addition, this function has the important task of keeping chronological records of what is happening during the emergency, and preparing reports for the Main Controller and his staff. This includes:

- Recording any change in the emergency action level status.
- Keeping track of all external agencies notified.
- Keeping track of emergency personnel intervening.

- Keeping track of emergency personnel notified and arriving at the scene.
- Maintaining a record of the changes in the emergency organization structure as higher officials arrive to relieve lower-ranked personnel.
- Keeping a record of all events affecting the emergency.
- Keeping a record of all of the decisions made and emergency actions taken during the emergency operations.
- Updating maps and wall charts displaying the spreading of the emergency (e.g., units affected by fire, areas affected by evacuation orders), and maintaining a record of them.
- Updating the same charts showing the position of the emergency squads or fire fighters, and keeping a record of them.
- Recording the arrival of special emergency materials or equipment (this may be especially important for later financial accountability).
- Recording any fact of relevance occurring during the emergency.

The chronological log is extremely valuable both during and after the emergency. The greatest advantage of such a system is to keep the situation updated. This information can then be used by the emergency co-ordination staff to assess the situation and make appropriate decisions.

In addition, such a log can be used after the emergency is over to assess responsibilities and proper conduct of the emergency operations, and for determining financial liabilities that may have been incurred in order to bring the emergency under control. Records can also be extremely useful in planning for future emergencies, and for training purposes.

10.8.4 Fire and Rescue Operations

This fire and rescue operation team should be typically composed of personnel from the different facility departments. The team should have basic training in the handling of various types of emergencies. Fire is the most common hazard in the facility. The team members should be capable of recognizing different types of fires and the appropriate extinguishing agent for fighting these fires. They should also be able to handle the available firefighting equipment including hoses, nozzles, portable extinguishers and fixed fire fighting units.

The fire and rescue team leader (Fire & Safety Officer) should report directly to the Incident / Field Operations Controller and make important decision regarding the response to the particular emergency.

The duties of the fire and rescue team leader include:

- Overall in-charge of the fire fighting operations.
- Inform the Main Controller if external fire tender / firefighting equipment / materials / Mutual Aid are required.
- Liase with the utilities and arrange for external water supply / diesel for hydrant pump / D.G. Sets, etc.
- Maintaining adequate supplies for firefighting equipment and facilities.

10.8.5 Logistics Function

This function is responsible for making the necessary supplies available to the response teams during the emergency. Also, the function has the task of organizing and maintaining the staging area and providing temporary storage for emergency supplies and equipment for rapid deployment. The function is also responsible for co-coordinating, hiring, Controlling and operating all emergency vehicles such as ambulances, trucks for transportation of emergency materials and supplies and other emergency transportation vehicles.

The person responsible for this function, the Logistics Coordinator, in this case the Store In-charge, should report to the Site Controller and keep him updated on available supplies and equipment, needed for an emergency. A list of emergency materials and equipment is as follows:

- Fire extinguishers
- Fire hoses and nozzles
- Personal protective equipment, including full protective clothing, self-contained breathing apparatus, and respirators.
- Emergency lights and power generators
- Spill control agents for the decontamination of toxic spills of different classes of chemicals
- Fuel for the operation of emergency vehicles and machinery (if any).

10.8.6 Medical Function

The primary responsibility of the Medical Function during an emergency is to provide first-aid to victims of the accident, and to ensure their prompt transportation to a hospital/ nursing home when required. This function would be assumed by the Medical Officer. In this regard, the Medical Function will work closely with the Logistics Function to organize such as emergency transportation system. In addition, the Medical Function is responsible for the establishment of a first-aid station for the immediate treatment of possible victims, which should be appropriately equipped with medical supplies, oxygen, resuscitators, and other supplies and the emergency response personnel are familiar with first aid administration.

Depending on the types of hazards present at the facility, the function will provide information on the nature and properties of the substances are responsible for possible injuries, and on the type of most appropriate emergency treatment of injured or exposed personnel. This type of information is contained in the Material Safety Data Sheets (MSDS) for the substances of concern.

The duties of the Medical Officer also include:

- Arrange for first-aid treatment.
- Establish contact and co-operate with local hospitals also ensure that the most likely injuries (e.g. cuts, burns etc.) can be adequately treated at these facilities.
- Advise the Main Controller and his staff on industrial hygiene matters
- Make arrangements for treating and transporting the injured to the hospitals wherein arrangements are made to handle such emergencies.
- Inform the above hospitals of the situation and apprise them of the antidotes that would be necessary for treatment.
- Maintain the list of blood group of each employee with special reference to rare blood groups.

10.8.7 Security Function

During the initial phase of an emergency, the security personnel may be in-charge of communications within the facility as well as outside agencies, before being relieved by the appropriate coordinator. The position of the Security Controller could be handled by the Security officers and assisted by the Inspectors, and guards. However, the main responsibility of this function is to ensure that facility security is maintained. The duties of this function include:

- Raise the alarm by sounding the siren.
- Inform the Plant-in-charge / Shift-in-charge.

- Close the gates(s) and ensure that unauthorized persons / vehicles do not enter the premises.
- Instruct the security guards to occupy pre-determined posts for controlling the security of the facility.
- Control the entry of authorized personnel, such as officials of outside agencies and other personnel that may be required at the facility.
- Control the escorting of outside official agency representatives and other appropriate personnel to the corresponding facility liaison personnel, as per instructions. Also ensure that media representatives are not directly admitted to the Emergency Control Centre (in order to minimize any unnecessary interference during emergency operations).
- Be in-charge of personnel accountability during the emergency. Should some facility employees be unaccounted for, and presumed to be still in the area affected by the emergency, security should alert the Incident Controller, who will then initiate a search and rescue operation (if feasible).
- Direct the exit of facility personnel in case of evacuation, and co-operate with external police forces to organize and direct evacuation operations for the public, if necessary.
- Arrange for proper transport for required personnel in the facility during an emergency
- Ensure that the affected area is not crowded by non-essential persons.
- Provide assistance in fire fighting and rescue operations

10.8.8 Emergency Squad Function

The responsibilities of the emergency squad function are as follows:

- Isolate equipments in accident area.
- Evacuate non-essential personnel and visitors.
- Maintain record of evacuated personnel.
- Act as fire-fighters in controlling the emergency.
- Act as runners and messengers.
- Act as first-aiders and rescuers and handle casualties / persons overcome by fire.
- Provide details of casualties.
- Providing lighting in the area.
- Carry out any other job assigned by the Incident / Field Operations Controller.

10.8.9 Transport In-Charge / Maintenance Manager

The duties of this function include:

- Keep all the vehicles and drivers ready, maintain constant contact with the Main Controller / Medical Officer and dispatch the vehicles as per their needs.
- All drivers on duty at the facility will, on sounding of the alarm, rush back to their department and await instructions.
- A minimum of two vehicles should be kept standby at the facility for the emergency use and for transporting critically injured to hospital.

10.8.10 Communication Coordinator

The communication coordinator is assigned to the Telephone Operator. The responsibility of this function would be to:

- Notify the location of emergency to the Security Department, Emergency Squad members, Main Controller, Incident Controller, Safety Officer and Administrative Officer.

- On receipt of instructions from the Main Controller or his designated, notify the fire brigade/police/hospitals/District Collector/Factory Inspector.
- Keep the switchboard open for emergency calls and transmit the same to the concerned personnel effectively.
- Refrain from exchanging any information pertaining to the emergency and refer any queries from authorized persons to the Main Controller.

10.8.11 Personnel of the Affected Area

They will:

- Continue to handle the emergency as per the laid down procedures and as guided by the Incident Controller.
- Avoid crowding of the affected area by unwanted personnel.
- Stop all non-essential work / unwanted operations.
- Remove unwanted persons from the area to a “Safe Assembly Points / area” (which should be marked on the site plan).

10.8.12 Declaration and Termination of Emergency

The declaration of an On-site or Off-site emergency will be made by the Site Controller. Sirens will be used for annunciation of facility emergency as indicated in the document.

The notification for start and termination of the emergency will be sent to:

- District Magistrate
- Nearby industries, if any
- Police Superintendent of the area

The message will include the following:

- Identification of the emergency e.g. fire, explosion, etc.
- Date and time of the accident.
- Details concerning accident/emergency and probable affected areas.
- Type of the accident

10.8.13 Recovery, Facility Re-Entry and Restoration of Services

The recovery and re-entry phase will begin after the declaration of termination of emergency. This determination would be made by the Main Controller. The recovery plan should be flexible enough to adapt to existing conditions. Not all of the conditions that may be encountered in an emergency can be anticipated in advance. Detailed plans and procedures for recovery operations should be prepared at the time they are needed.

Re-entry operations should be performed by the Re-entry Team under the leadership of the Main Controller. The team will consist of personnel knowledgeable in procedures and facility layout. In the Re-entry planning process, the team will gather available information on the nature of the emergency and its present status by method such as discussions with the operations personnel on-shift. Necessary protective clothing and equipment should be available for the team before re-entry is authorized.

Specific procedures for recovering from an emergency and re-entering the facility can hardly be provided, since they will have to be determined on a case by case basis. Depending on the type of accident and the severity of the damage suffered. However, Provision should be made for the following:

- Organizing a re-entry team.
- Inspecting the damaged area.
- Declaring the emergency concluded and making the “all clear” known to the facility

employees and the community.

- Deciding which employees should report to work and notifying them.
- Beginning an investigation into the causes of the emergency.
- Assessing the damage to the facility.
- Transferring necessary operations to alternative locations.
- Decontaminating the damaged area.
- Restoring services to the damaged area.
- Clearing up the debris.
- Salvaging material and equipment affected by the emergency.
- Restoring the parts of the facility affected by the emergency.
- Determining responsibilities and instituting possible insurance and damage claims.

10.8.14 Off-Site (Notifying External Agencies)

Depending on the type and severity of emergency, the Main Controller should notify the appropriate external agencies. The major emergencies should be notified to:

- Law enforcement departments – Factory Inspectorate, Pollution Control Board, Police station.
- Fire departments and other response teams – Fire Brigade
- Hospital and emergency medical services
- Ambulance services
- Local Government officials
- Local environmental agencies

10.8.15 Making the Emergency Known to the General Public

In a situation where the public can be affected by the accident, two possible courses of action can be taken - evacuation or sheltering inside buildings and houses. Whichever action is decided upon, the public must be informed of it. This can be quite a challenging task, to the point of becoming nearly impossible if an effective communication procedure is not already in place.

Siren system can only be effective if the public is already aware of what actions to take if the alarm is sounded. The content of the messages should be as brief and clear as possible, and provide information on the action to be taken. In addition, the public should be asked to refrain from using the telephone (to minimize the potential for line overload), and to notify neighbours of the emergency (again, without using the phone). Should evacuation be recommended, the messages should inform the public of where the designated relocation areas are, and which evacuation routes to follow.

10.8.16 Training and Education

Regular training will be provided to all personnel who have a role in planning and operational response to an emergency. The main goal of training for emergencies is to enable the participants to understand their roles in the response organization, the tasks associated with each position and the procedures for maintaining effective communications with other response functions and individuals.

The training objectives are:

- To familiarize personnel with the contents and manner of implementation of the DMP and its procedures.
- To train personnel in the performance of the specific duties assigned to them in the DMP and in the applicable implementing procedures.

- To keep personnel informed of any changes in the DMP and the implementing procedures.
- To maintain a high degree of preparedness at all levels of the Emergency Response Organization.
- Train new personnel who have moved within the facility organization.
- Test the validity, effectiveness, timing and content of DMP.
- Update and modify the plan on the basis of experience acquired through exercises and drills.

10.8.17 Emergency Response Plan Review

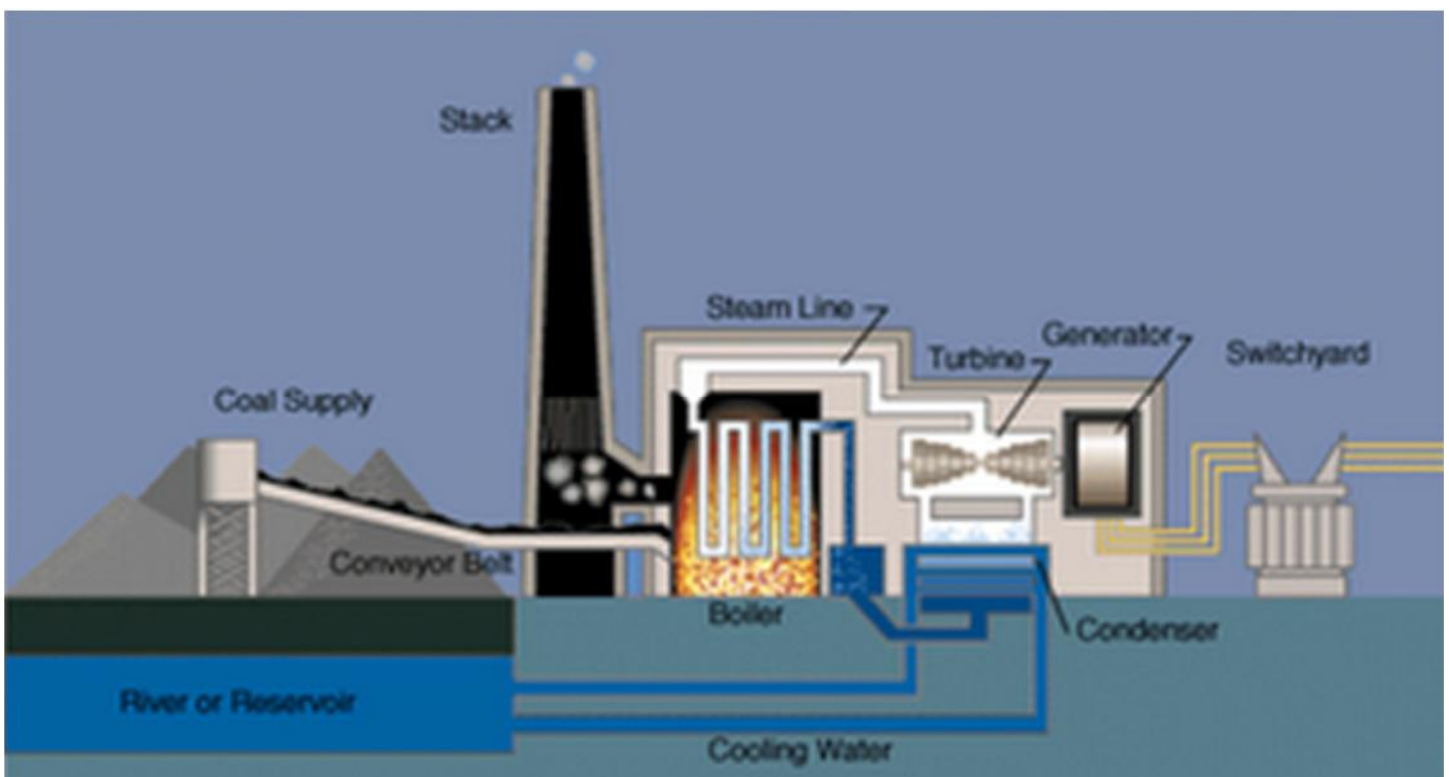
The Emergency Response Plan and associated implementing procedures should be reviewed to ensure compliance with relevant regulations and applicable state and local emergency plans and written agreements with mutual aid agencies also.

The DMP should be reviewed under the direction of the Plant – In - charge which should encompass the plan, response procedures, equipment, training, drills and interfaces with local emergency management agencies. The need for changes is based upon the following aspects:

- Written evaluations of drills and exercises which identify deficiencies or more desirable methods, procedures, or organizations
- Changes in key personnel involved in the organization
- Changes in the facility organization structure
- Modifications to the facility which could affect emergency planning

Chapter 11

Clean Development Mechanism



11. CLEAN DEVELOPMENT MECHANISM

11.1 INTRODUCTION

The Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol allowing industrialized countries with a greenhouse gas reduction commitment to invest in emission reducing projects in developing countries as an alternative to what is generally considered more costly emission reductions in their own countries. The CDM is supervised by the CDM Executive Board (CDM EB) and is under the guidance of the Conference of the Parties (COP/MOP) of the United Nations Framework Convention on Climate Change (UNFCCC).

The current modalities and procedures for the CDM focus on activities that reduce emissions. A CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy efficient boilers.

India has high potential for CDM projects, particularly in the Power Sector. The Baseline Carbon Dioxide Emissions from power sector have been worked out by CEA based on detailed authenticated information obtained from all the operating power stations in the country. The Baseline would benefit all prospective CDM project developers to estimate the amount of Certified Emission Reduction (CERs) from any CDM project activity.

India has a strong commitment to reduce its emissions of greenhouse gases. Ministry of Power has accorded high priority to the CDM projects in the power sector.

11.2 KYOTO PROTOCOL

The convention established the Conference of Parties (COP) as its supreme body. During COP3 in Kyoto, Japan, the Parties agreed to a legally binding set of obligations for 38 industrialized countries and 11 countries in Central and Eastern Europe, to return their emission of GHGs to an average of approximately 5.2% below their 1990 levels over the commitment period 2008-2012. This is called the Kyoto Protocol to the convention. The Protocol entered into force on February 16, 2005 and targets six main greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydro fluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur Hexafluoride. Recognizing that relying on domestic measures alone to meet the emission targets could be difficult, the Kyoto Protocol offers considerable flexibility through following three mechanisms:

- *Joint Implementation (JI)* which allows countries to claim credit for emission reduction that arise from investment in other industrialized countries, which result in a transfer of 'emission reduction units' between countries;
- *Emission Trading (ET)* which permits countries to transfer parts of their 'allowed emissions' (assigned amount units); and
- *Clean Development mechanism (CDM)* through which industrialized countries can finance mitigation projects in developing countries contributing to their sustainable development.

At COP-7 in Marrakech, Morocco in 2001, the Parties agreed to a comprehensive rulebook "Marrakech Accords" on how to implement the Kyoto Protocol. The Accords set out the rules

for CDM projects. It also intends to provide Parties with sufficient clarity to consider ratification.

11.3 OUTLINE OF THE PROJECT PROCESS

An industrialized country that wishes to get credits from a CDM project must obtain the consent of the developing country hosting the project that it will contribute to sustainable development. Then, using methodologies approved by the CDM Executive Board (EB), the applicant (the industrialized country in our case) must make the case that the project would not have happened anyway (establishing additionally), and must establish a baseline estimating the future emissions in absence of the registered project. The case is then validated by a third party agency, a so-called Designated Operational Entity (DOE) to ensure the project results in real, measurable, and long-term emission reductions. The EB then decides whether or not to register (approve) the project. If a project is registered and implemented, the EB issues credits, so-called Certified Emission Reductions; CERs (one CER being equivalent to one metric tone of CO2 reduction), to project participants based on the monitored difference between the baseline and the actual emissions, verified by an external party called a DOE.

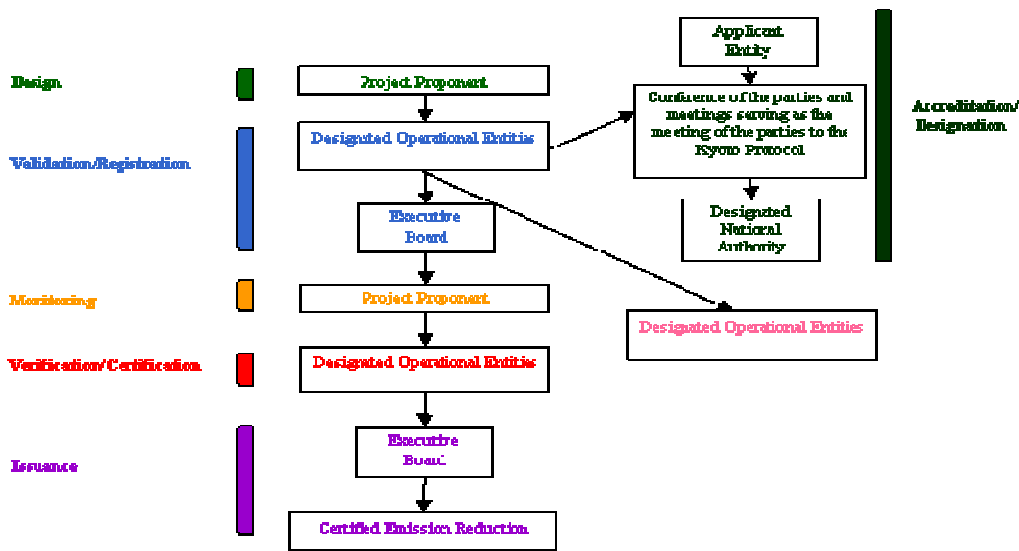


Figure 11.1: Project Process

11.4 ELIGIBILITY

The project proposal should establish the following in order to qualify for consideration as a CDM project activity:

11.4.1 Additionalities

Emission Additionality: The project should lead to real, measurable and long term GHG mitigation. The additional GHG reductions are to be calculated with reference to a baseline.

Financial Additionality: The funding for CDM project activity should not lead to diversion of official development assistance. The project participants may demonstrate how this is being achieved.

Technological Additionality: The CDM project activities should lead to transfer of environmentally safe and sound technologies and know-how.

11.5 SUSTAINABLE DEVELOPMENT INDICATORS

It is the prerogative of the host Party to confirm whether a clean development mechanism project activity assists it in achieving sustainable development. The CDM should also be oriented towards improving the quality of life of the very poor from the environmental standpoint. The following aspects should be considered while designing CDM project activities:

- **Social well-being:** The CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contributing to provision of basic amenities to people leading to improvement in their quality of life.
- **Economic well being:** The CDM project activity should bring in additional investment consistent with the needs of the people.
- **Environmental well-being:** This should include a discussion of the impact of the project activity on resource sustainability and resource degradation, if any, due to the proposed activity; biodiversity-friendliness; impact on human health; reduction of levels of pollution in general;
- **Technological well-being:** The CDM project activity should lead to transfer of environmentally safe and sound technologies with a priority to the renewable sector or energy efficiency projects that are comparable to best practices in order to assist in up-gradation of the technological base.

11.6 PROJECT

The project activity aims at reducing Green House Gas (GHG) emission by setup the 2 x 660 MW coal based Super critical Thermal Power Plant in District- Janjgir-Champa, State – Chhattisgarh. The project intends to go for CDM benefit as the project is using supercritical technology for power Generation.

11.7 CALCULATION OF CO₂ EMISSION

11.7.1 Types of Emission Factors

The CDM methodologies, which have been approved to date by the CDM Executive Board, distinguish a range of different emission factors. In the Indian context, the following four are most relevant, and were therefore calculated for each regional grid based on the underlying station data:

Weighted average: The weighted average emission factor describes the average CO₂ emitted per unit of electricity generated in the grid. It is calculated by dividing the absolute CO₂ emissions of all power stations in the region by the region's total net generation. Net generation from so-called low-cost/must-run sources (hydro and nuclear) is included in the denominator.

Simple operating margin (OM): The operating margin describes the average CO₂ intensity of existing stations in the grid, which are most likely to reduce their output if a CDM project supplies electricity to the grid (or reduces consumption of grid electricity). "Simple" denotes one out of four possible variants listed in ACM0002 for calculating the operating margin. The simple operating margin is obtained by dividing the region's total CO₂ emissions by the net generation of the stations serving the region excluding low-cost/must-run sources. In other words, the total emissions are divided by the total net generation of all thermal power

stations. Hydro and nuclear qualify as low-cost/must-run sources, and their net generation is therefore excluded from the denominator.

Build Margin (BM): The build margin reflects the average CO₂ intensity of newly built power stations that will be (partially) replaced by a CDM project. In accordance with ACM0002, the build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation. Depending on the region, the build margin covers units commissioned in the last five to ten years.

Combined Margin (CM): The combined margin is a weighted average of the simple operating margin and the build margin. By default, both margins have equal weights (50%). However, CDM project developers may choose to argue for different weights. In particular, for intermittent and non-dispatchable generation types such as wind and solar photovoltaic, ACM0002 allows to weigh the operating margin and build margin at 75% and 25%, respectively (see ACM0002, Version 06). However, the combined margins shown in the database are calculated based on equal weights.

11.7.2 Regional Grids

As stated above, the Indian power system is divided in five regional grids, namely Northern, Eastern, Western, Southern and North-Eastern. They are listed below.

Table: 11.1: Geographical Scope Of The Five Regional Electricity Grids

Northern	Western	Southern	Eastern	North-Eastern
Chandigarh	Chhattisgarh	Andhra Pradesh	Bihar	Arunachal Pradesh
Delhi	Gujarat	Karnataka	Jharkhand	Assam
Haryana	Daman & Diu	Kerala	Orissa	Manipur
Himachal Pradesh	Dadar Nagar Haveli	Tamil Nadu	West Bengal	Meghalaya
Jammu & Kashmir	Madhya Pradesh	Pondicherry	Sikkim	Mizoram
Punjab	Maharashtra	Lakshadweep	Andaman-Nicobar	Nagaland
Rajasthan	Goa			Tripura
Uttar Pradesh				
Uttaranchal				

Source CEAs user guide baseline

For the purpose of calculating the emission reductions achieved by any CDM project, the CDM Executive Board requires that the “project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints”. This implies that the grid emission factors are most appropriately calculated at the level of the five regional grids.

11.8 BASELINE DATA

The prevailing baseline based on the data for the fiscal year 2010-11 is shown in following Table. The calculations are based on generation, fuel consumption and fuel quality data obtained from the power stations.

Table 11.2: Weighted Average Emission Factor, Simple Operating Margin, Build Margin and Combined Margin of All Grids for FY 2010-11 in TCO₂/Mwh

Region	Average	OM	BM	CM
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NEW NE	0.80	0.97	0.86	0.91
South	0.75	0.94	0.73	0.84
India	0.79	0.96	0.83	0.90

Source CEAs user guide Ver7 baseline

Typical standard data were used wherever precise information was not available. Inter-regional and cross-border electricity transfers were also taken into account for calculating the CO₂ emission baseline.

11.8.1 Calculation Approach – Station Level

CO₂ emission of thermal stations was calculated using the formula below:

$$\text{Abs CO}_2 (\text{station})_y = \sum_{i=1}^2 \text{Fuel Coni},y \times \text{GCVi},y \times \text{EFi} \times \text{Oxidi}$$

Where:

- Abs CO₂,y : Absolute CO₂ emission of the station in the given fiscal year ‘Y’
- Fuel Coni,y : Amount of fuel of type I consumed in the fiscal year ‘Y’
- GCVi,y : Gross calorific value of the fuel I in the fiscal year ‘Y’
- EFi : CO₂ emission factor of the fuel I based on GCV
- Oxidi : Oxidation factor of the fuel i

The emission factors for coal and lignite are based on the value provided in India's initial National Communication under the UNFCCC (Ministry of Environment & Forests, 2004).

Specific CO₂ emission of Stations (Spec CO₂,y) were computed by dividing the absolute emissions estimated above by the station’s net generation (Net Geny):

$$\text{Spec CO}_2 (\text{Station})_y = \text{Abs CO}_2 (\text{station})_y / \text{Net Gen (Station)}_y$$

Emission Reduction:

- Station Heat rate = 2152 Kcal/ Kwh
- Calorific Value of Coal = 3500 Kcal/Kg
- Specific Fuel Consumption = 0.615 kg/kwh
- CO₂ intensity of the power plant = (44/12) x Specific Fuel Consumption X Percentage of Carbon in the Respective fuel (Kg/Kwh)
- = (44/12) x 0.615 x 0.3534 Kg/Kwh
- = 0.79

Where,

0.615 = Specific Coal Consumption of proposed 2 x 660 MW unit

35.34% = Fixed Percentage of carbon in the coal

- Net Generation of the plant = 1320 MW x PLF x Operating Hours
- = 1320 x 1000 kW x 0.90 x 8760
- = 10407 Gwh
- Average for the west Grid = 0.80 kg/kwh



Plant Carbon Intensity = 0.79 kg/kwh

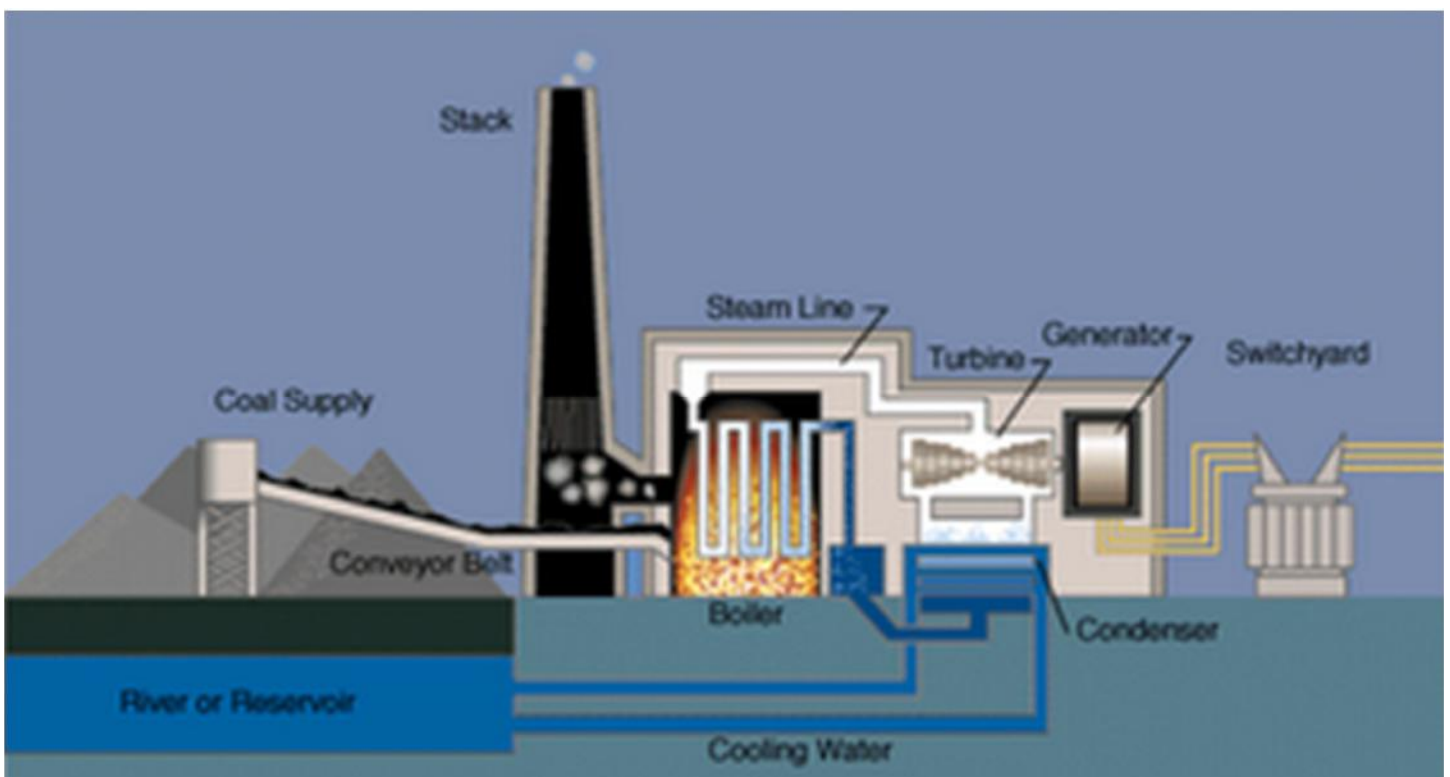
Therefore Gross reduction in CO₂ emission = Net Generation x Difference between Average and Plant intensity
= 10406880000 x (0.80- 0.79)
= 10406880000 x (0.01)
= 104,068,800 kg/year
= 104,069 tons/year

*** Percentage of Carbon has been taken on approximation basis**

From the above table it is cleared that Plant Carbon Intensity for the plant is 0.79 kg/kwh. The expected reduction in CO₂ emission is 104,069 tons/year. The intensity of the plant is quite less compared to the average of NEW NE grid. Hence, the proposed project will help to reduce the GHG emission, through using fuel efficient super-critical technology. However the PIN document of the project is under preparation and will be submitted to MoEF subsequently.

Chapter 12

Consultant Disclosure



12. DISCLOSURE OF CONSULTANT

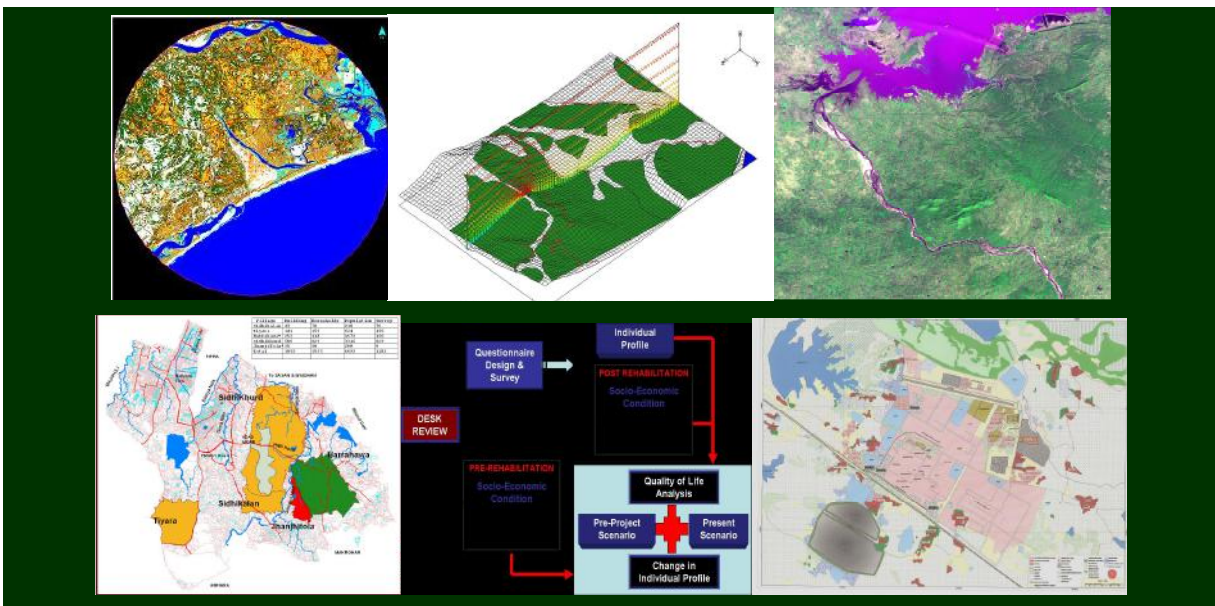
12.1 OUR GROUP

The **GIS Enabled Environment & Neo-Graphic Centre (GREENC)** is a company with a vision to take up paradigm of development planning in sustainable economic development and environment protection.

The **GREENC** comprises of group of professionals drawn from development related fields. The core members of **GREENC** team hold experiences in Developmental Planning, Pollution Control, Economic Analysis, Social Work and Information Technologies. In addition there is a panel of senior associates and young voluntaries facilitating the various programmes.

The primary aim of the Company is to sensitize policy planner and local people about their development needs through capacity building process.

The **GREENC** facilitates managerial and technical expertise to people and associations for development of areas and regions.



NABET Accreditation: GIS Enabled Environment & Neo-Graphic Centre has provisional accreditation from NABET subject to certain conditions for the following areas of EIA.

- Thermal Power Plant
- Mining of minerals for Opencast mining;
- Metallurgical Industries
- Highways, railways, transport terminals, mass rapid transport systems,
- Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions
- Townships and Area Development projects including industrial estates/parks, SEZ

12.2 MISSION

GREENC was launched with the full support of a dedicated and strong group of experienced professionals. **GREENC** is dedicated to providing the highest quality consulting services focused on environment and development, urban and rural planning, transportation, with integrity and commitment to our clients and our communities.

GREENC has an understanding of the local point of view, direct responsiveness to issues and the continuous personal responsibility of key professionals. **GREENC** has the background, the experience and the perceptual insight to anticipate project needs and to fulfill the requirements of clients. **GREENC** provides a broad spectrum of technical skills in the following areas:

12.3 WORK AREAS

Environmental Impact Assessment: We have undertaken many EIA studies and clearances for thermal power plant; road and highways; Special Economic Zones (SEZs); urban infrastructure projects etc. The areas of specialization are as follows:

- Environmental Management Plan
- Disaster Management Plan
- Risk Assessment
- Rehabilitation & Resettlement Plan
- Pre-feasibility Report
- Detailed Project Report
- Geo-Technical Investigation

Project Experience

GREENC has successfully completed more than 40 EIA and allied studies in the areas of Thermal Power Plants. Other than this **GREENC** has completed more than 50 EIA reports for steel plants, coal mines, fertilizer plants, and infrastructure projects.

Laboratory Services

GREENC have a well-equipped laboratory for monitoring and analysis of environmental pollutants and Soil Investigation.

S. No.	Name of the Equipment	Quantity
1	Refrigerator	1
2	Deep Freeze	1
3	BOD Incubator	1
4	Hot Air Oven	3
5	Muffle Furnace	1
6	Autoclave	1
7	Water Bath	2
8	Centrifuge	2
9	Water Distillation Assembly (Glass)	2
10	Vacuum Filtration Pump	2
11	Inoculation Hood	2
12	Aquarium for Bioassay & Aerators	1
13	Depth Sampler	1

S. No.	Name of the Equipment	Quantity
14	Bottom Sampler	2
15	Filtration Assembly	1
16	Atomic Absorption Spectrophotometer	2
17	Gas Chromatograph	1
18	UV-Visible Spectrophotometer	1
19	Micro Analytical Balance	2
20	Specific Ion Meter	1
21	Analytical Balance	2
22	Physical Balance	1
23	pH Meter	6
24	Conductivity Meter	6
25	Turbidity meter	2
26	Compound Microscope	2
27	Flame Photometer	2
28	Sound Level Meter	6
29	High Volume Sampler APM-410 and 415 with APM 411	10
30	Respirable Dust Sampler APM-451, APM-460 with APM41144 Nos.	14.
31	CO detector tubes	27
32	Gas Sampling Kit	6
33	Personal Sampler	8
34	Automatic Weather Station	5

12.4 MAIN PERSONNEL INVOLVED IN THE STUDY

Manpower associated with preparation of the EIA Report is as below.

Ms Nandini Chowdhury, M Tech	EIA Coordinator
Mr. Nilanjan Das, M Phil (Social Work)	Social Expert
Mr. Venkat Ramana Puranam, M.Tech. (Environment Engineering)	Air and Water Expert
Mr. Saurabh Garg, M.Sc. (Environment Science)	Air and Noise Expert
Ms. Rajashekhar Tummala, M.Sc. (Ecology and Environment Science)	Ecology Expert
Mrs. Aditi Ganguly, M.Sc. (Geology)	Geology and Soil Expert
Mr. Anoj Kumar Choudhary, M.Tech (Environment Science & Engineering)	Air and Risk Expert
Ms. Anshu Gupta, M.Sc. (Geography)	Land-use Mapping Expert
Mr. Sayak Basu, M.Sc. (Environment Science)	Chemical Analyst
Mr Harender Kumar, M.Sc. (Mathematics)	Climatology Expert

Involvement in the study: Sample Analysis and preparation of baseline data. Other than the above, teams were deployed for meteorology, air and noise monitoring, and for collection of samples of water and soil.

LIST OF ANNEXURE

Annexure No.	Name of Annexure
Annexure I	ToR Letter Issued by MoEF
Annexure II	ToR Compliance Status
Annexure III	Environment & Pollution Standards
Annexure IV	Hourly Meteorological Data
Annexure V	Name of the Villages in study area
Annexure VI	Hydrological, Hydrogeological and Area Drainage Study
Annexure VII	Details of Public Hearing
Annexure VIII	Water Approval Letters
Annexure IX	Fuel Supply Agreement
Annexure X	Imported Coal Transportation and Logistics
Annexure XI	Ash Utilization Letter
Annexure XII	Certificate of Non Forest Land
Annexure XIII	Expert Appraisal Committee Minutes of Meeting June 2012
Annexure XIV	Chhattisgarh Policy - Rehabilitation and Resettlement
Annexure XV	Corporate Social Responsibility
Annexure XVI	Agenda Note - Water Resources Department, GoCG
Annexure XVII	Archeological Survey of India – No Objection Certificate
Annexure XVIII	Maps and Toposheet
Annexure XIX	NRSA – ISRO Satellite Image