2.0 PROJECT DESCRIPTION

This chapter deals with the technical details of the proposed power plant, details of infrastructure, various sources of pollution and the measures proposed to control pollution.

2.1 Type of the Project

M/s. Lalitpur Power Generation Company Ltd. (LPGCL), proposes to set-up a coal based thermal power project of 3X660 MW capacity near Mirchwara and Buraugaon villages, Lalitpur District, Uttar Pradesh. Boilers of the project shall be pulverized coal fired super critical type.

2.2 Need for the Project

Electric energy is known to be the vital utility and prerequisite for stimulating the industrial and commercial activities in economic development of the nation. In post-independent era, the country has witnessed significant growth in power sector especially in power generation. However, the demand has escalated so high that in spite of the phenomenal increase in installed capacity of power generation, there has been sustained deficit in power supply and is expected to increase further in future. Thermal power has always remained major component among different types of power generation in India.

In order to cope up with the ever increasing gap in power demand and supply, Government of India has widened the scope of private sector participation in electricity generation by passing a resolution in October 1991 and allowing them to set up power plants. Moreover, the measures initiated through the Electricity Act, 2003 have further enhanced the opportunities to private participation in power sector, especially in thermal power generation.

With a view to harvest the current opportunity, **M/s. Lalitpur Power Generation Company Ltd. (LPGCL),** initiated proceedings for setting up of thermal power plants in the country.

Considering the existing and escalating demand of electricity in the grid, **M/s. Lalitpur Power Generation Company Ltd. (LPGCL),** proposes to develop a power project of 3x660 MW capacity near Mirchwara and Buraugaon villages, Lalitpur District, Uttar Pradesh.

2.3 Project Location and Layout

The site selection was carried out through alternative site evaluation within Lalitpur district. Three (3) alternate sites were identified and evaluated in Uttar Pradesh state, a site Near Mirchwara and Buraugaon villages, Lalitpur district, having major favourable features along with good environmental features, has been identified for the proposed project.

The proposed project side is located in the Micrhwara and Buraugaon villages near Utari river in the district of Lalitpur, U.P. It is about 20-km from Lalitpur town. Lalitpur is connected by rail and road to all major cities of India. The site

has access road from National Highway NH-26 via Lalitpur-Mahrauni road. The proposed plant layout is presented in **Figure-2.1**.

Layout of the power plant has been considering with space requirements for all the equipment, systems, buildings, structures, coal storage area including railway sliding and marshalling yard, ash silos, raw water storage tank, water treatment plant, cooling water pump house etc. Necessary plant drainage system would be provided at the proposed power plant site. In laying out various facilities, following general aspects have been taken into consideration:

- Provision to install 3X660 MW;
- Coal storage yard for 30 days requirement at site for 1980 MW;
- Ash silos for fly ash;
- Raw water supply and storage facilities; and
- Availability of adequate space for fabrication / construction equipment.

All facilities of the plant area will be laid out in close proximity to each other to the extent practicable so as to minimize the land requirement. The layout is planned to facilitate for the smooth movement of men and materials between the various facilities both during construction and operation.

2.4 Project Size or Magnitude of Operation including Resources

The capacity of total power plant will be 1980-MW; three (3) pulverized coal fired super critical boilers each will be installed for power generation. The details of proposed power plant are presented in **Table-2.1**.

TABLE-2.1
DETAILS OF PROPOSED POWER PLANT

Sr. No.	Features	Description
1	Capacity	1980 MW
2	Configuration	3X660
3	Type of boilers	Pulverized coal fired supercritical boilers
4	Boiler Capacity	1983 Tons/hr/unit
5	Power evacuation	400 Kv level to the UPPTCL grid at Paricha, which is 45 km from site
6	Fuel	Coal
7	Source of Coal	Coal India subsidiaries
8	Coal Requirement	8.51 MTPA @ 85% PLF
9	Sulphur content	0.7 %
10	Ash Content in Coal	<35%
	Ash generation	2.75 MTPA (6638.4 TPD)
	Bottom Ash	0.549 MTPA (69 TPH)
	Fly Ash	2.2 MTPA (276.6 TPH)
12	ESP efficiency	99.9%
13	Stack	One twin flue and one single flue stack of 275-m height
14	Water Requirement	5556 m^3/hr

Source: LCTPL, Project Report

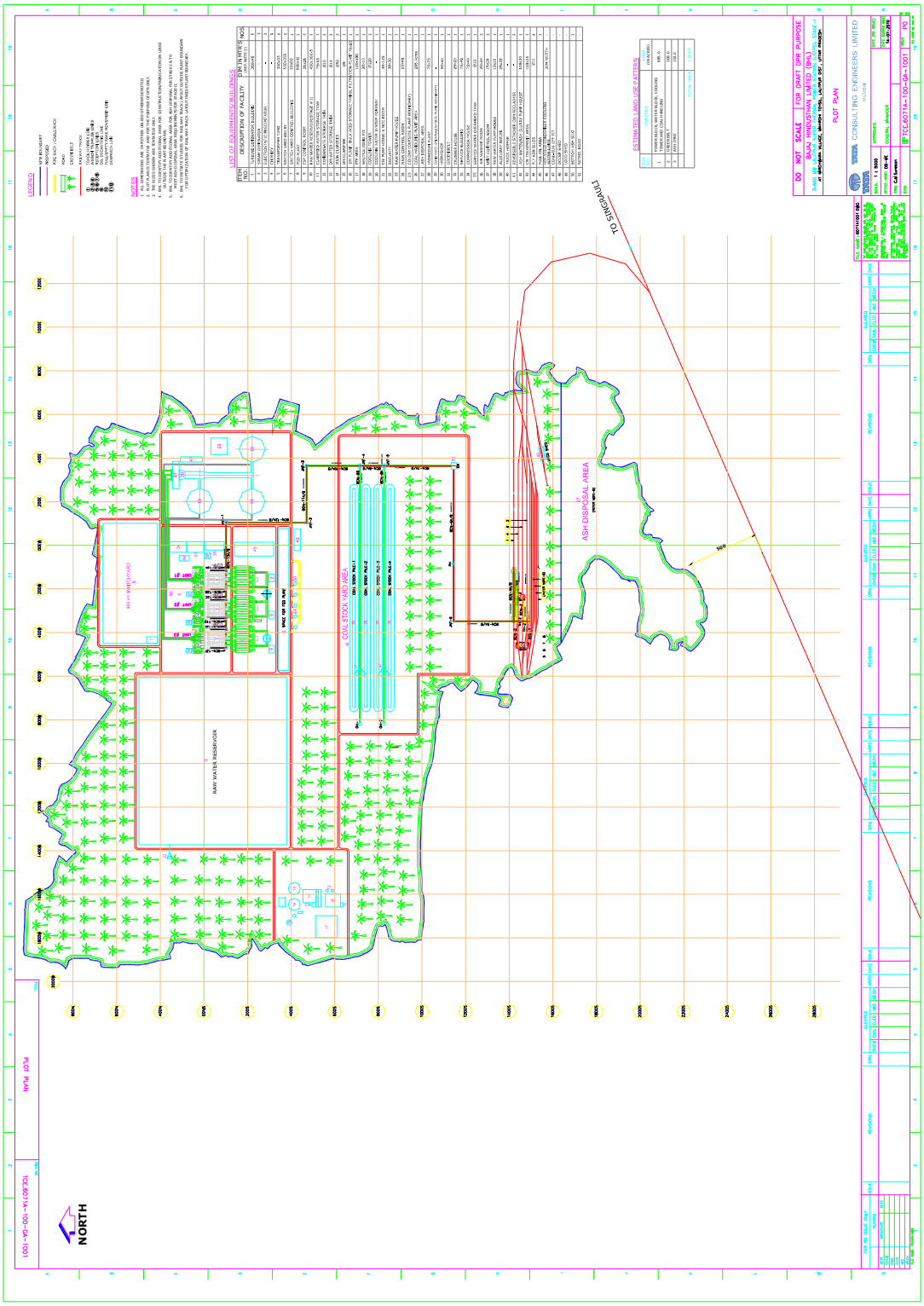

FIGURE-2.1
PLANT LAYOUT PLAN

2.4.1 Land Requirement

The total land required for the proposed power plant is 1282.2 acres. The break-up of the landuse for the proposed power plant is given in **Table-2.2**.

TABLE-2.2
BREAK-UP OF LANDUSE

Sr. No.	Description	Area (Acre)	Area (Ha)
1	Main Plant – Includes raw water reservoir, coal handling plant, auxiliary structures, stores and miscellaneous buildings	820	331.98
2	Ash disposal area	103	41.70
3	Green belt	309	125.10
4	Rail and water corridor	50.2	20.32
Total		**1282.2**	**519.1**

Source: DPR,LTPL

TABLE-2.3
VILLAGE WISE LAND BREAK-UP

Land Category		Area (ha)			
		Buraugaon	**Mirchwara**	**Total**	**%**
Farmer's Land	Single crop	379.362	109.32	488.62	94.14
	Double crop	0	0	0	0.0
	Non Agricultural	0	0	0	0.0
	Sub total	379.362	109.32	488.62	94.14
Barren		17.567	12.864	30.431	5.862
Total Land		**396.929**	**122.184**	**519.113**	**100**

2.4.2 Fuel Requirement, Source, Quality and Transportation

2.4.2.1 Fuel Requirement

The primary fuel to be used for the power generation will be coal. The estimated coal requirement for 3X660 MW power plant will be 8.51 MTPA, considering gross calorific value of 4200 kCal/kg, 85% PLF and with a heat rate of 2239 kCal/kWh. Coal linkage is under process.

Support fuel Light Diesel Oil (LDO) will be used only for cold start and Heavy Fuel Oil (HFO) from the local refineries.

2.4.2.2 Fuel Source

The coal will be sourced from subsidiary of Coal India.

2.4.2.3 Support Fuel Quantity and Storage

Apart from coal, HFO/LDO will be used as auxiliary fuel. The estimated annual requirement of HFO/LDO is about 14000 MT. The details of fuel oil storage are given in **Table-2.4.**

TABLE-2.4
DETAILS OF FUEL OIL STORAGE

Fuel	No. of Tanks	Design Capacity (KL)
LDO	2	750 (each)
HFO	2	1500 (each)

2.4.2.4 Fuel Quality

The percentage by weight proximate analysis of coal considered for the project is given in **Table-2.5**. Similarly, the characteristics of HFO and LDO to be used in the project are given in **Table-2.6**.

TABLE-2.5(A)
TYPICAL INDIGENOUS COAL ANALYSIS

Sl. No.	Particulars	Design Coal	Worst Coal
1.0	**Proximate Analyses**		
1.1	Moisture, %	13	13
1.2	Ash, %	27	32
1.3	Fixed carbon, %	31	28
1.4	Volatile matter, %	29	27
1.5	GCV, KCal/kg	4600	4200
1.6	Sulphur	0.6	0.7
2.0	**Ultimate Analyses**		
2.1	Carbon, %	46.78	43.53
2.2	Hydrogen, %	3.28	3.07
2.3	Sulphur, %	0.6	0.7
2.4	Nitrogen, %	0.91	0.84
2.5	Oxygen (by difference), %	8.43	6.86

TABLE-2.5 (B)
HEAVY METAL ANALYSIS

Sr. No.	Parameter	Unit	Value
1	Mercury (Hg)	mg/kg	0.12
2	Lead (Pb)	mg/kg	207.0
3	Zinc (Zn)	mg/kg	109.0
4	Cadmium (Cd)	mg/kg	<0.1
5	Arsenic (As)	mg/kg	0.30
6	Chromium (Cr)	mg/kg	75.0

TABLE-2.6
TYPICAL CHARACTERISTICS OF HFO AND LDO

Sr. No	Particular	Units	Heavy Fuel Oil HV GRADE	Light Diesel Oil (LDO)
1	Flash Point	°C (min)	66	66
2	Viscosity	Centistoke at 50 °C	370	2- 20
3	Ash Content	% (max)	0.1	0.02
4	Water Content by volume	% (max)	1	0.25
5	Sediments by weight	% (max)	0.25	0.25
6	Total Sulphur by weight	% (max)	4.5	1.8
7	Acidity in Organic	-	Nil	Nil

Sr. No	Particular	Units	Heavy Fuel Oil HV GRADE	Light Diesel Oil (LDO)
8	Density	gm/ml at 15°C, (max)	890-950	850-870
9	Pour Point	°C (min)	20 for Summer	21 for Summer, 12 for Winter
10	Carbon Residue by weight	%	7.74	7.74
11	Gross Calorific value	Kcal/Kg	10270	10500

2.4.2.5 Fuel Transportation

The indigenous coal will be transported by rail to the project site from the mine. The imported coal will be shipped to Kandla port from Indonesia and from their cola will be transported by rail to project site. It is envisaged that the coal will be transported by Bottom Opening Broad Gauge (BOBG) wagons or BOXN wagon. The dedicated rail siding is proposed in the project for smooth movement of coal.

2.4.3 Water Requirement

The total water requirement for the project will be about 5556 m^3/hr which will be sourced from Rajghat Dam (Betwa canal system) at a distance of 50- km from the project site. Recirculating closed cooling water system with cooling tower is considered using clarified water for turbine condenser cooling. The raw water is used for condenser cooling, the cycle make-up and other consumptive water requirements after appropriate treatment. The raw water will be brought to the plant by pipeline. The water balance diagram is shown in **Figure-2.2.** The water allocation letter is enclosed in **Annexure-III.**

TABLE 2.7
WATER REQUIREMENT OF POWER PLANT

All the values are given in m^3/hr

Sr. No.	Description	DM Water	Filtered Water	Clarified Water	Raw Water
1	Power cycle makeup				
2	DM Plant regeneration Waste	10	-	-	10
3	Make up to DM plant	69		-	69
4	Potable water for plant	-	9.5	-	9.5
5	Potable water for colony	-	45	-	45
6	Filter backwash	-	5	58	63
7	Supply to filters	-	-	-	0
8	Service water	-	-	291.6	291.6
9	Fire water makeup	-	-	-	
10	CW evaporation	-	-	4011	4011
11	CW Blow down	-	-	746	746
12	CW makeup	-	-	-	0
13	Clarifier sludge@2.0%	-	-	-	0
14	Supply to clarifiers	-	-	-	276
15	Reservoir losses & Design Margins@2.15%	-	-	-	34.9
	Total raw water requirement	**79**	**59.5**	**5106.6**	**5556**

Source: DPR, M/s LTPCL

FIGURE-2.2
WATER BALANCE

2.4.4 Manpower

The proposed power plant will require skilled and semi-skilled personnel during operation, maintenance and administration of the proposed plant of 3X660 MW. People from neighbouring villages, if found suitable, shall be employed during construction and operational phases. The total manpower of power plant during Operational and Maintenance (O&M) is estimated to be about 600 persons. In addition to that opportunities will be provided to work for services indirectly. Preference will be given to educated, skilled and unemployed persons of near by villages.

2.4.5 Township

Township will be provided to cater to around 600 personnel. Land available in the Mirchwara / Buraugaon village will be utilized for township.

2.4.6 Transport Facilities

The mode of transportation of coal will be by rail. The rail line between Lalitpur to Singruali line is under construction which is about 0.5-km from site. The National Highway (NH-26) is located at a distance of 30-km from proposed project site.

2.4.7 Health and Sanitation

To ensure optimum hygienic conditions in the plant area, proper drainage network will be provided to avoid water logging and outflow. Adequate health related measures and a well equipped safety and environment department will be provided to ensure clean and healthy environment.

2.5 Utilities for the Proposed Plant Operations

In the proposed plant, various utilities will be provided for the smooth and efficient functioning of the plant. The proposed utilities are discussed in subsequent sections. The power plant process flow diagram is given in **Figure-2.3.**

2.5.1 Coal Handling System (CHP)

Coal will be received in the plant by rail facility. In-plant total stockpiles capacity has been considered for 30 days, to take care of any contingencies in receipt of coal. Suitable stacking and reclaiming arrangement will be provided to transport and handle the Coal from the in-plant stockpile.

Capacity of the coal handling system is estimated based on the following criteria:

- To optimize the size of the coal handling capacity and keeping in mind the availability of maximum size crushers and feeders, each 3x660 MW units is envisaged to have a separate coal handling system with 2400 TPH stream capacity.

- Each pair of 3x660 MW units will have 2x100% streams of conveyors and associated accessories 8x50% crushers have been envisaged. Capacity of the crushers and associated screens and feeders will be of 1200 TPH.

- The operation of coal handling system will be 13 hours in a day – which will be adequate to handle 24 hours of coal requirement for 3x660 MW units.

- Designed to handle worst coal.

The design data for coal handling plant is given in **Table-2.8**.

TABLE-2.8
CHP WITH INDIAN COAL FOR 3X660 MW

Sr. No.	Particulars	Unit	Quantity
1	Coal GCV	kcal/kg	4200
2	Turbine heat rate	kcal/ kWhr	1900
3	Boiler efficiency	%	85
4	Station heat rate	kcal/kWhr	2239
5	Coal consumption per hour	TPH	1080
6	Coal consumption per day	TPD	25920
7	Coal consumption per year at 85% PLF	Million TPA	8.51
8	Operating hours for coal handling system	Hour	16
9	Design capacity for the coal handling system	TPH	2400

Coal received from rail system is directly sent to the crushers. Crushed coal is stacked in stack piles. Two (2) no. stacker reclaimer will be provided for stacking and reclaiming the crushed coal. Crushers will be provided to bring down the size of coal for the pulverizing.

3x100% capacity belt conveyors will be provided, 2x100% from each track hopper. Individual bunkers will be provided for each mill. For each unit, the bunkers will have a total storage capacity of 16 hours of operation at BMCR load. From the bunkers, the coal will be fed to mills by raw coal feeders.

The coal handling plant will be provided with the facility for recording the quantity and analysis of the raw coal received in the station and fed to the bunkers. In-line magnetic separators, bunker level indicators, flap gates in bifurcating chutes, chute vibrators, sump pumps (for underground areas) will be provided, where-ever necessary, to make the system efficient and trouble free.

Suitable pollution control measures like dust extraction and dust suppression systems shall be provided at different transfer points and crusher houses and ventilation system to supply fresh air in underground tunnels will be provided. In addition, roof extraction fans will be provided in essential areas like crusher house and boiler bunker floors. Air conditioning for control room and pressurized ventilation with unitary air filter unit for MCC buildings of coal handling plant will be provided.

Stockpile areas shall be provided with automatic garden type sprinklers for dust suppression as well as to reduce spontaneous ignition of the coal stockpiles. Plant effluent is used in ash handling system for equipment sealing and cooling and the same will be reused for coal dust suppression system. Necessary water distribution network for drinking and service water with pumps, piping, tanks, valves etc. will be provided for distributing water at all transfer points, crusher house, control rooms etc.

A centralized control room with microprocessor based control system has been envisaged for operation of the coal handling plant. Except locally controlled equipment like travelling tripper, dust extraction/ dust suppression / ventilation equipment, sump pumps, water distribution system etc., all other in-line equipment will be controlled from the centralized coal handling control room but will have provision for local control as well. All necessary interlocks, control panels, MCC's, mimic diagrams etc. will be provided for safe and reliable operation of the coal handling plant. Scheme for proposed Coal handling system is shown in **Figure-2.4.**

2.5.1.1 Dust Control

Dry fog jet spray type dust suppression system would be provided for all transfer points in the junction towers / transfer houses / crusher house. Plain water type dust suppression system would be provided all around the stockpile to suppress the dust generated and to keep dust nuisance to the minimum. The bunker ventilation system would be provided with bag filters to trap the dust generated while loading coal into bunkers and to vent out dust free gases/air.

2.5.1.2 Coal Yard Drainage

Drainage channels would be constructed to take all the effluent from the coal stock yard, which would be ultimately led to a coal pile run-off pit. The coal pile run off pit will have two compartments. The coal particles will settle down in the first compartment and relatively clean water will over flow to the second compartment. A sump pump would be provided to pump the water to the plant drains.

2.5.1.3 Fire Protection

Fire hydrants would be provided at all tunnel entry points, junction towers, transfer houses, crusher house, bunker bay and along the overhead conveyors. Spray system would be provided inside the conveyor galleries. Fire hydrants would also be placed along the periphery of the coal stockpile for fire fighting.

The flow diagram of coal handling system is shown in **Figure-2.4.**

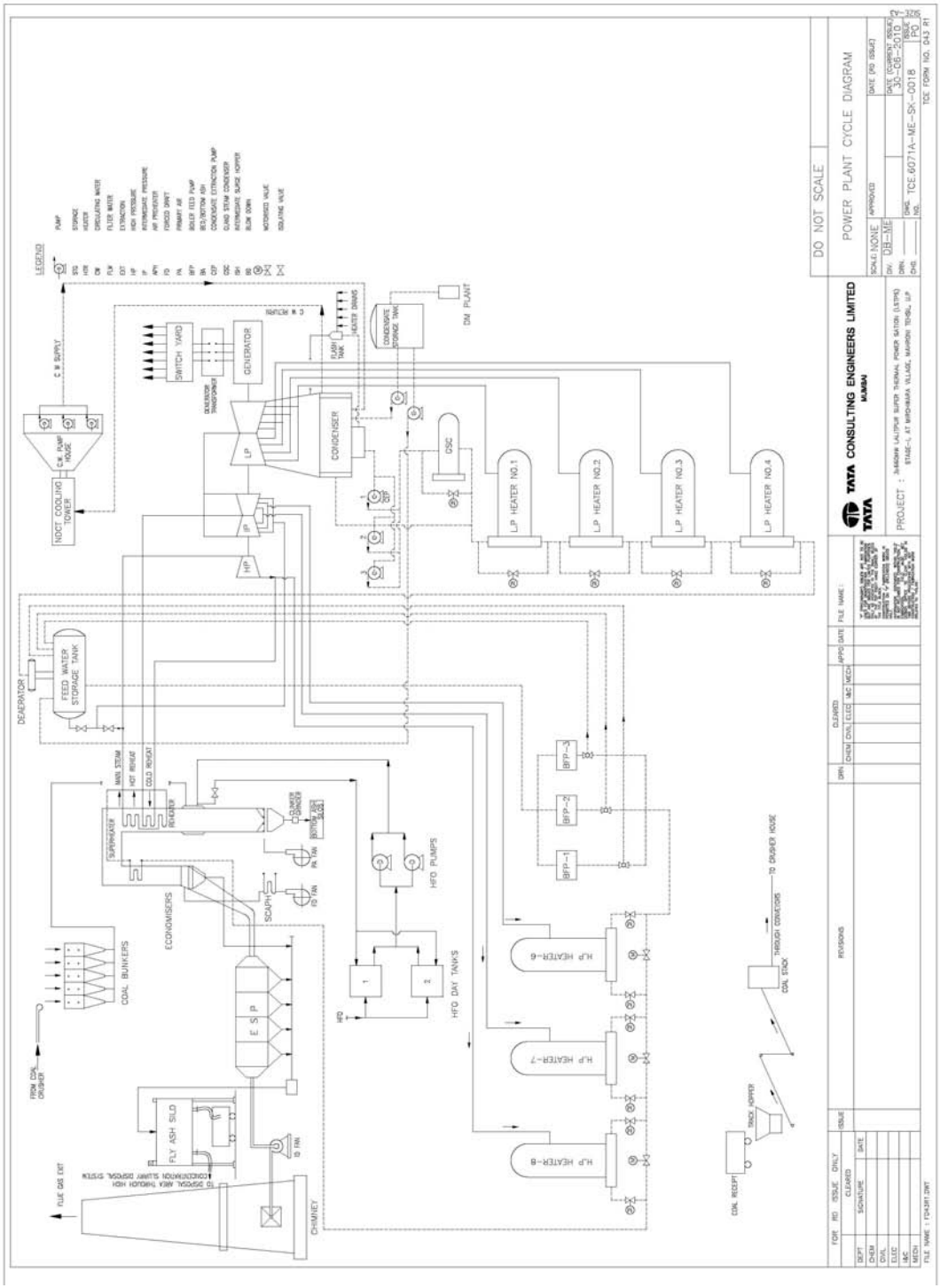

FIGURE 2.3
TYPICAL PROCESS FLOW DIAGRAM

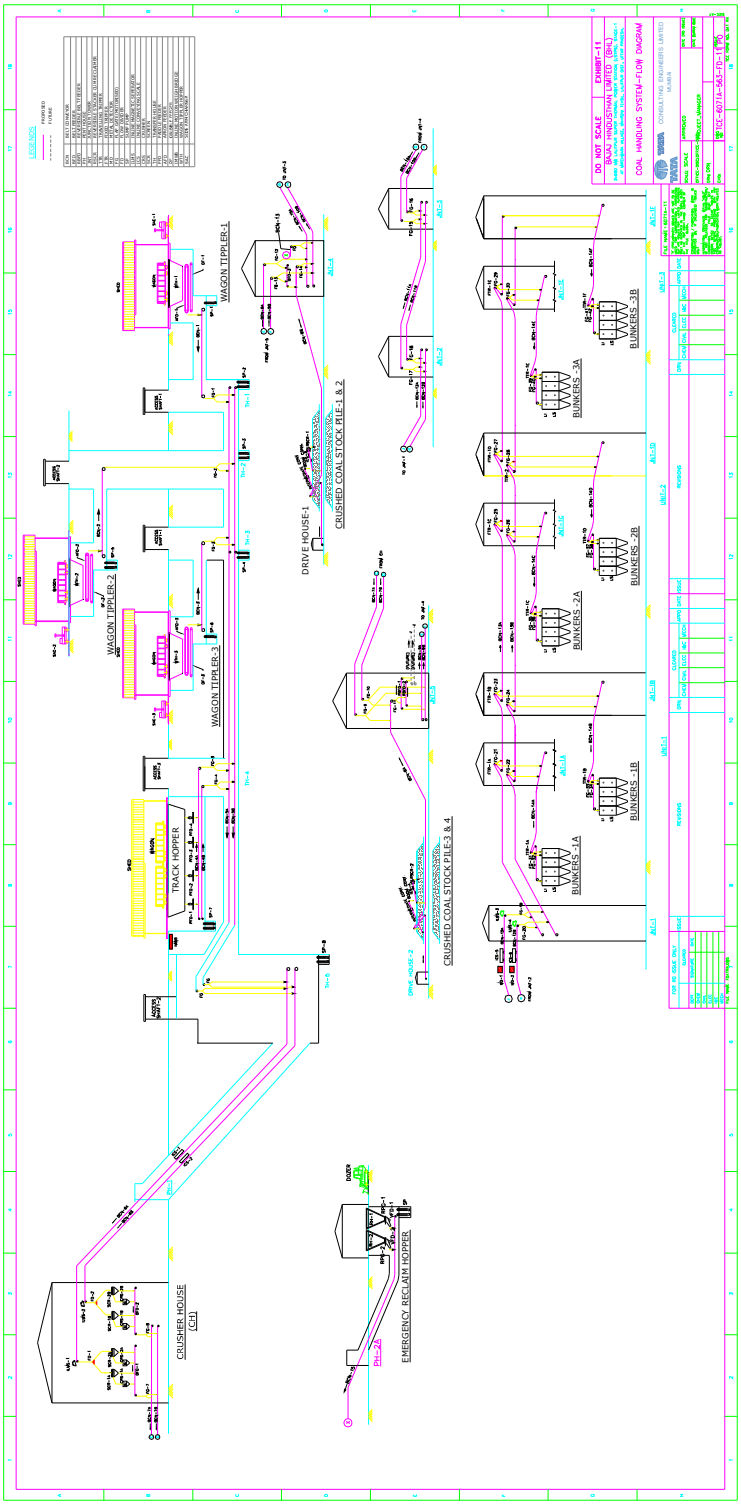

FIGURE 2.4
TYPICAL PROCESS FLOW SCHEME FOR COAL HANDLING PLANT

2.5.2 Fuel Oil System

The fuel oil system will be provided for:

a) Boiler start-up; and
b) Flame stabilization during low load operation with or without coal firing.

Two types of fuel oils are envisaged for use in the proposed power plant: (a) Light Diesel Oil (LDO) and (b) Heavy Fuel Oil (HFO) for low load operation and flame stabilization, as necessary.

Two tanks (2X1500 KL) are envisaged to store HFO in the plant site. Similarly for LDO storage, two storage tank (2X750 KL) will be installed. For each phase, there would be 2x100% numbers of HFO and LDO unloading, transfer and forwarding pumps. Pressurizing and heating units for supplying both HFO and LDO tanks will be provided.

2.5.3 Steam Generator & Auxiliaries

- The steam generator (SG) would be once through type and would be designed for firing blend of Indigenous coal and Imported coal. The SG would be radiant, single /two pass design, single reheat, balanced draught and semi outdoor type.

- The water wall would be spiral wound plain tubes with vertical tubes over the spiral water walls or vertical rifled tubes type.

- Indicative design parameters for the steam generator for the 660 MW unit would be as below:

TABLE-2.9
INDICATIVE PARAMETERS FOR THE STEAM GENERATOR

SI. No.	Parameter	Value
i	Super heater outlet pressure	254 kg/cm^2 (a)
ii	Super heater outlet temperature	568°C
iii	Super heater outlet flow	1983 TPH
iv	Re-heater outlet pressure	53 kg/cm^2 (a)
v	Re-heater outlet temperature	595°C
vi	Feed water inlet temperature to economizer	293°C

- The steam generator would be corner fired or front and rear wall burners mounted type. The furnace would be appropriately sized to avoid slagging in the pendant/platen super heaters and reheaters.

- The coal burners would be of proven advanced design to reduce NOx production and the furnace would also be provided with over fire air ports to further reduce NOx production.

- The SG would be provided with circulation system comprising steam separators to remove water moisture from the evaporator outlet and to recirculate water into economizer inlet for use during startup and shut down. The SG and steam turbine generator (STG) would be designed for sliding pressure operation which would increase turbine cycle efficiency and reduce boiler feed pump power consumption. The load range for sliding pressure operation would be from about 40% STG maximum continuous rating (STG MCR) to 90% STG MCR. This modified sliding pressure operation would be employed to provide facility of temporary load increase even before the fuel handling and firing system can be loaded to support any sustained higher load. The SG would be designed for sustained coal firing without oil support between 40% SGMCR to 100% SGMCR.

- The SG would consist of water cooled furnace radiant and convection super heaters, reheaters, economizer, regenerative air heater, steam coil air preheaters. Smart soot blower system would be provided with soot blowers located at strategic locations for cleaning the slagged and fouled heat transfer surfaces during operation.

- The SG would be provided with vertical spindle medium speed coal mills, which would be located in the boiler front or between the boiler and the ESP. The milling system would be designed such that one (1) mill would be standby and other mills would take care of MCR with worst coal. The coal mills would be provided with dynamic/static classifiers to control the fineness of the ground coal thereby controlling the unburnt carbon losses. The coal mills would be provided with gravimetric coal feeders.

- Sampling arrangement at mill outlet would be provided for the purpose of establishing the average gross calorific value of coal as well as coal fineness. The coal mills would be provided with steam blanketing or other system for the purpose of fire protection as per recommendation of mill manufacturer.

- The SG would be designed to handle and burn HFO as secondary fuel up to about 22.5% SG MCR for start up and for flame stabilization during low load operation or during mill changeovers. For unit light up and warm–up purposes, LDO system having 7.5 % SGMCR firing capability would be used with air atomization. The SG would be designed for sustained coal firing without oil support between 40% SGMCR to 100% SGMCR.

- The SG would be provided with fuel oil pumps and fuel oil heating equipment along with high- energy electric arc igniters to ignite the fuel oil guns.

- The draught plant would comprise of primary air fans, forced draught fans and induced draught fans. The primary and forced draught fans would be of axial blade pitch controlled axial type. The induced draught fans would be axial blade pitch controlled axial type or speed controlled (VFD) centrifugal type which would reduce power consumption during power plant operation at TGMCR and part load operations.

- Electrostatic precipitators (ESP) would be provided for the collection of fly ash. The ESP would be provided with microprocessor control system to optimize

and for minimum electric power consumption. The ESP would be so designed that for worst coal firing with an ash content of 35%, an outlet dust concentration of 50 mg/Nm^3 would be achieved.

2.5.4 Steam Turbine Unit

The Steam turbine generator (STG) would be rated for about 660 MW maximum continuous output at generator terminals, with throttle steam condition of 250 kg/cm^2 at 565°C/593°C reheat, 0.1 kg/cm^2 (abs) condenser back pressure with 0% make up. The STG output at valve wide-open (VWO) condition would be about 693 MW which is 5% above the maximum continuous rating of 660 MW to enable increased output required during low frequency operation and drop in efficiencies over years of operation.

The steam turbine would be a multi cylinder, reheat extraction and condensing turbine.

The turbine generator would be complete with all accessories such as protection system, lube and control oil system, seal oil system, jacking oil system, seal steam system, turbine drain system, electro-hydraulic control system, automatic turbine run up system, on-line automatic turbine test system and turbine supervisory instrumentation. A continuous bypass (20% capacity) method of lube oil purification is proposed to be adopted for purification of lubricating oil.

The turbine generator would also have all necessary indicating and control devices to permit the unit to be placed on turning gear, rolled, accelerated and synchronized automatically from the control room. Other accessories of the turbine generator would include an external oil purification unit with transfer pumps and oil storage tank of adequate capacity.

2.5.5 Condenser

Number of condensers will be same as the LP turbines. Single pass or double pass condenser with tubes of welded type will be provided. The condenser will be of divided water box construction. Condenser will be horizontal, surface type with integral air-cooling section. Condenser hot well will be sized for three (3) minutes storage capacity (between normal and low-low level) of total design flow with the turbine operating at VWO condition, 3% make-up, and design backpressure. The condenser will be adequately sized to cater to all the conditions of turbine operation including abnormal operating conditions and Boiler Feed Pressure turbine. Tube plugging margin of 5% will be considered for sizing of the heat transfer surface of the condenser. The exact condenser parameters will be optimized on the basis of site data and the most economical combination of cooling surface and circulating water quantity will be selected. Stainless Steel tubes will be used in the condenser. Tubes plates will be carbon steel. The condenser will be designed, manufactured and tested in accordance with the latest applicable requirements of the Heat Exchange Institute (HEI), USA. Provision of separate sponge rubber ball type condenser on-load tube cleaning system for each half of the condenser including ball circulation pumps, strainer, ball monitoring system etc. will be made.

The air evacuation system will comprise of (2 x 100%) vacuum pumps along with all accessories and instrumentation for condenser air evacuation.

2.5.6 Boiler Feed Pumps

It is proposed to have 2 x 50% turbine driven feed pumps (normally working) and 1x30% motor driven boiler feed pump for the unit with the booster pumps mounted on the common shaft. Each pump will be designed with parameters to suit the steam generator requirements such that two feed pumps will be capable of meeting the full requirements of the boiler turbine unit with the third pump as a standby. Turbine Driven Boiler Feed Pumps (TDBFPs) will be located at operating floor and the motor driven pump will be located on ground floor and will be accessible to turbine house EOT crane for erection and maintenance. The feed pump will be able to handle feed water of pH 8.5 to 9.5 and of temperature up to 185 °C.

The feed flow will be controlled by controlling the speed of the drive turbine by throttling the steam control valve in case of turbine driven pumps, whereas hydraulic coupling will be utilized to achieve speed control of motor driven pumps. Provisions will be made for warm-up arrangement of standby pump, if required.

2.5.7 Condenser Feed Pumps

The unit will have 3x50% capacity or 2X100% motor driven Condensate Extraction Pumps (two operating and one standby). The condensate pumps will be vertical canister type, multistage, centrifugal diffuser design with a double suction first stage designed for condensate extraction service having low suction head requirement. The pumps will be capable of handling the condensate from the condenser together with feed heater drains when the machine is operating at maximum unit output with HP heaters out with 3% make up and discharging this quantity through the gland steam condenser and condensate polishing unit to the deaerator.

Auxiliary steam

Auxiliary steam header shall be maintained at 13 ata and 350°c. Sources of auxiliary steam shall be:

- Auxiliary boiler initial start up
- Cold reheat live for start up in low load operation
- Suitable turbine extraction for higher loads

Auxiliary steam header of each unit shall be interconnected. Auxiliary steam shall be conditioned through Auxiliary pressure reducing and de-superheating (PRDS) station unit wise and spray water shall be drawn from CEP/BFP discharge.

2.5.8 Condensate and Feed Water Heating System

Regenerative feed heating system is envisaged for the turbine cycle to improve the efficiency. While, exact number of heaters will be based on the optimization to be carried out during detailing engineering, typical feed heating system with four (3) numbers of Low Pressure (LP) heaters, one number direct contact type

deaerating heater and three (3) numbers of High Pressure (HP) heaters are foreseen for this type of unit as discussed below.

The main steam flows from final super heater through main steam line to the HP turbine inlet valves into the HP blading. HP turbine first extraction will be connected with the HP-feed heater No. 8. The HP exhaust will be connected with the reheater. A part of the HP exhaust steam flow will be led from the HP exhaust to the No. 7 HP-feed heater. The steam from the reheater will be led via the reheat steam line to the intercept valves and the IP-turbine. The extraction no. 6 from the IP-turbine will be sent to HP-feed heater No. 6, Steam from IP-turbine extraction No. 5 will be connected with Deaerator and the Boiler Feed Pump turbine. After expansion in the IP turbine blading, the steam will be led via a cross over pipes to the LP-turbine. LP-turbine extraction Nos. 4, 3, 2, and 1 will be connected with LP-feed heaters Nos. 4, 3, 2 and 1 respectively. After expansion in the LP blading the steam flows through the exhaust necks of the LP turbine into the condenser, which will be rigidly welded to the LP turbine casing and spring mounted onto the foundation at the ground floor.

- ***Feed Water Heaters***

Direct contact spray or spray cum tray type Deaerator with a feed water storage tank of about 10 min. storage capacity will be provided. The Deaerator storage tank capacity will be selected to receive drains from boiler start-up system, if applicable. The Deaerator will be capable of deaerating all the incoming condensate and HP heater drains. It will effectively remove the dissolved oxygen in condensate and completely remove the traces of carbon dioxide. The Deaerator will operate without any vibration and water hammer during any transients resulting from loss of full load followed by HP-LP bypass coming into operation and at any steady load from 0% to 110% of rated capacity. The Deaerator will be designed such that the dissolved oxygen content is not greater than 0.005 ppm at the deaerator feed water outlet, under all operating conditions. All pressure parts like shell, heads and nozzles shall be of carbon steel as per ASTM A-515 Gr. 70. Shell will be of welded construction. Hardened 400 series stainless steel impingement plates will be provided for flashed drain inlet from HP heaters, BFP recirculation, boiler startup drains etc.

HP heaters will be of U-tube type with integral desuperheating, condensing and drain cooling sections. Shell will be of carbon steel as per ASTM-516 Gr. 70 and water box channel as per ASTM A-266 class-II and shall be welded to tube sheet. Tubes shall be welded to tube sheets and then roller expanded.

During start up and low loads seal steam will be supplied to the turbine glands from the auxiliary steam header or cold reheat line through a seal steam regulating valve. During normal operation the HP and IP glands will be used for sealing the LP glands. The excess leak-off steam will led to the condenser. A gland steam condenser will be provided to condense, and return to the cycle, all gland leak-off steam from TG set and from BFP turbines. 2x100% capacity exhausters will be provided to remove non-condensable gases from the gland steam condenser. The exhaust gases will be vented above the TG hall roof level.

2.5.9 Electrostatic Precipitators and Stack

It is proposed to install high efficiency electrostatic precipitators having an efficiency that will limit the outlet emission to 50-mg/Nm^3 while the boiler is operating at its BMCR, firing worst coal having maximum ash content.

Electrostatic Precipitator shall be supported by steel structure designed & supplied by ESP manufacturer. ESP columns shall be supported by RCC pedestal resting on RCC strip/raft foundation. Area below the ESP shall be paved.

ESP Control Room shall be a two storied reinforced concrete portal frame structure with RCC beams, slab and columns. The building columns shall be supported by RCC strip/ isolated foundation. The building shall have dimensions in accordance with functional requirements.

ESP Control Room shall be on the first floor and cable cellar with other facilities on the ground floor of the building. Control Room shall be provided with false ceiling. External walls shall be in masonry construction.

2.5.10 Ash Handling System

For each unit, Bottom ash will be collected in wet form, while fly ash will be collected in dry form to facilitate utilization and the un-utilized fly ash will be disposed in wet form combined with bottom ash to the ash pond. Ash extraction system is unitized basis and ash disposal system will be common for set of 3 units.

Scheme for proposed Bottom Ash handling system is shown in **Figure-2.5** and Fly Ash handling system is shown in **Figure-2.6.** For the design of the Ash Handling System, the following data has been considered for each Unit.

2.5.11 Ash Disposal System

Ash Handling Plant (AHP) design is based on the BMCR generation. The system proposed is for semi dry/wet disposal of the bottom ash and dry extraction of the fly ash. Disposal of fly ash will be by truck or pneumatic conveyor to emergency ash storage area.

The quantum of ash generation would depend on the plant load factor and the quality of coal being fed. Considering average ash content of < 35% for Indian coal, the generation of ash is given in **Table-2.10**.

TABLE-2.10
ASH GENERATION FOR INDIAN COAL FOR 3X660 MW PLANT

Sr. No	Particulars	Unit	Quantity
1	Ash content	%	<35
2	Total ash generation at full load	TPH	345.6
3	Bottom ash generated	TPH	69
4	Coarse ash generated	TPH	58
5	Fly ash generated	TPH	276.6

- ***Bottom Ash System***

Scraper Chain Conveyor (SCC) will be provided below the refractory lined Bottom Ash Hopper (BAH) of each boiler. The BAH will be of dry type and will have storage capacity of about 8 hours. Normally the bottom ash at the rate of 37 TPH from the boiler furnace will be directly discharged onto the submerged SCC provided below the BAH. The capacity of the SCC will be 37 TPH.

The bottom ash discharged onto the SCC in the water trough will be quenched and fed to single / double roll type heavy duty clinker grinders provided at the head end of SCC. In the clinker grinders, the bottom ash will be crushed to (-) 25 mm size. The crushed bottom ash from the clinker grinders will be conveyed to the bottom ash silo by belt conveyors. This system will be a continuous type of system.

The BAH gates would be closed during the maintenance of SCC. Two (2) (1 working + 1 standby) SCCs would be provided with long travel wheels and associated electro-mechanical drives for shifting during maintenance. Long travel rails would be provided for the purpose.

- ***Fly Ash Handling System***

The fly ash handling system would be designed to collect fly ash in dry form in silo using two stage pressure type dense phase pneumatic conveying system. FA from ESP hoppers, APH hoppers and Economiser hoppers of each unit would be conveyed upto Intermediate Surge Hopper (ISH) by first stage pressure type dense phase pneumatic conveying system and from ISH upto the fly ash silos by second stage pressure type dense phase pneumatic conveying system.

The removal of fly ash from any particular hopper would be initiated whenever the level in the hopper reaches predetermined level and this would continue cycle after cycle till the level in the hopper reaches low level. Therefore, the removal and transfer of the fly ash to the intermediate surge hopper would be done in cyclic manner on a continuous basis.

Generally, the fly ash conveying system would operate continuously but with time gaps between cycles. The fly ash removal system would be designed on a continuous basis with 20 cycles of operation per hour and during emergency with 30 cycles of operation per hour. The level probe would be provided in each hopper in such a way that the ash collected in the hopper would be equal to the volume of the ash transmitter vessel. There would be one (1) manually operated isolation valve (knife gate type) below each fly ash hopper which would be used during maintenance of the ash transmitter vessel.

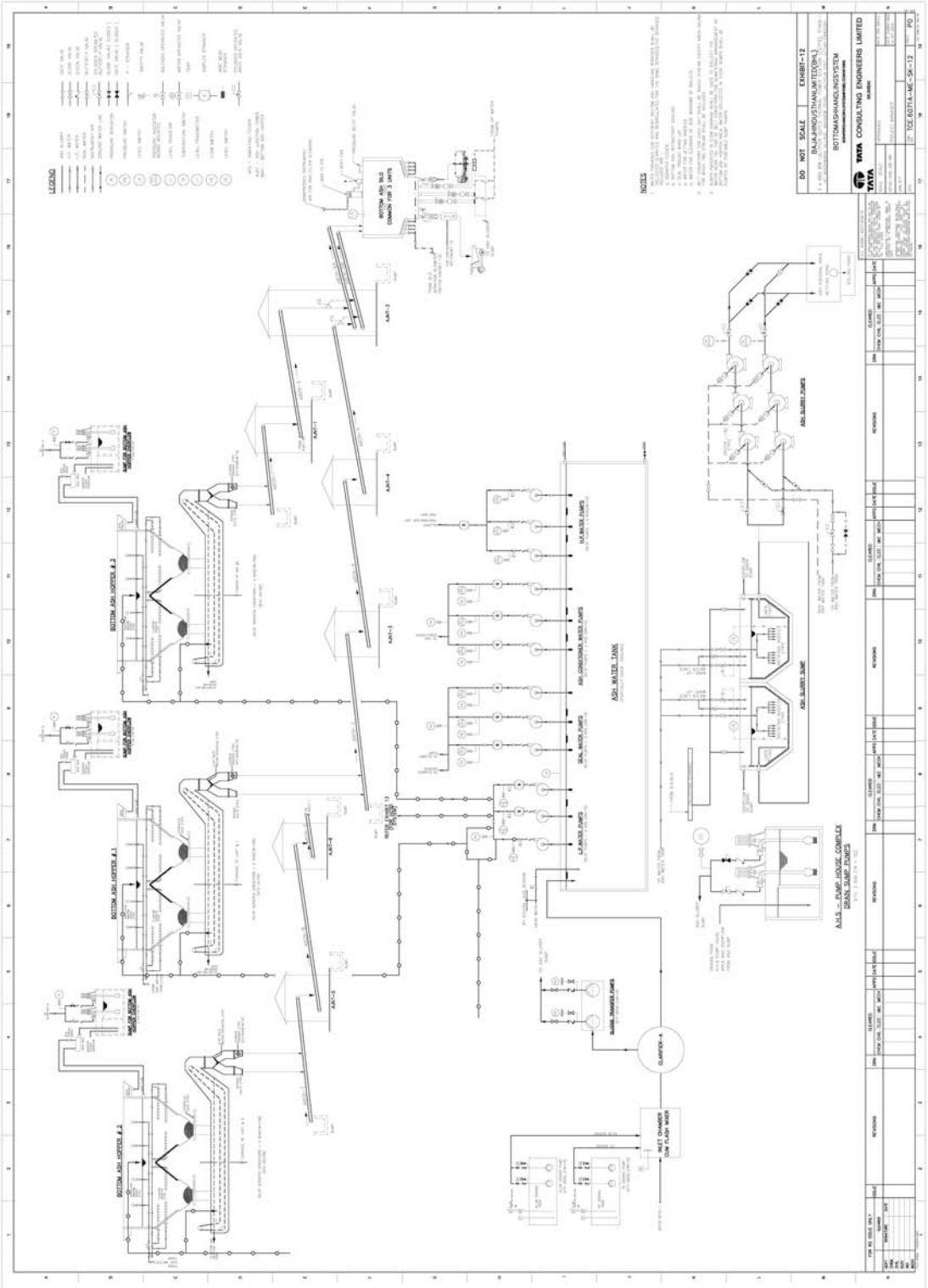

FIGURE-2.5
BOTTOM ASH HANDLING SYSTEM

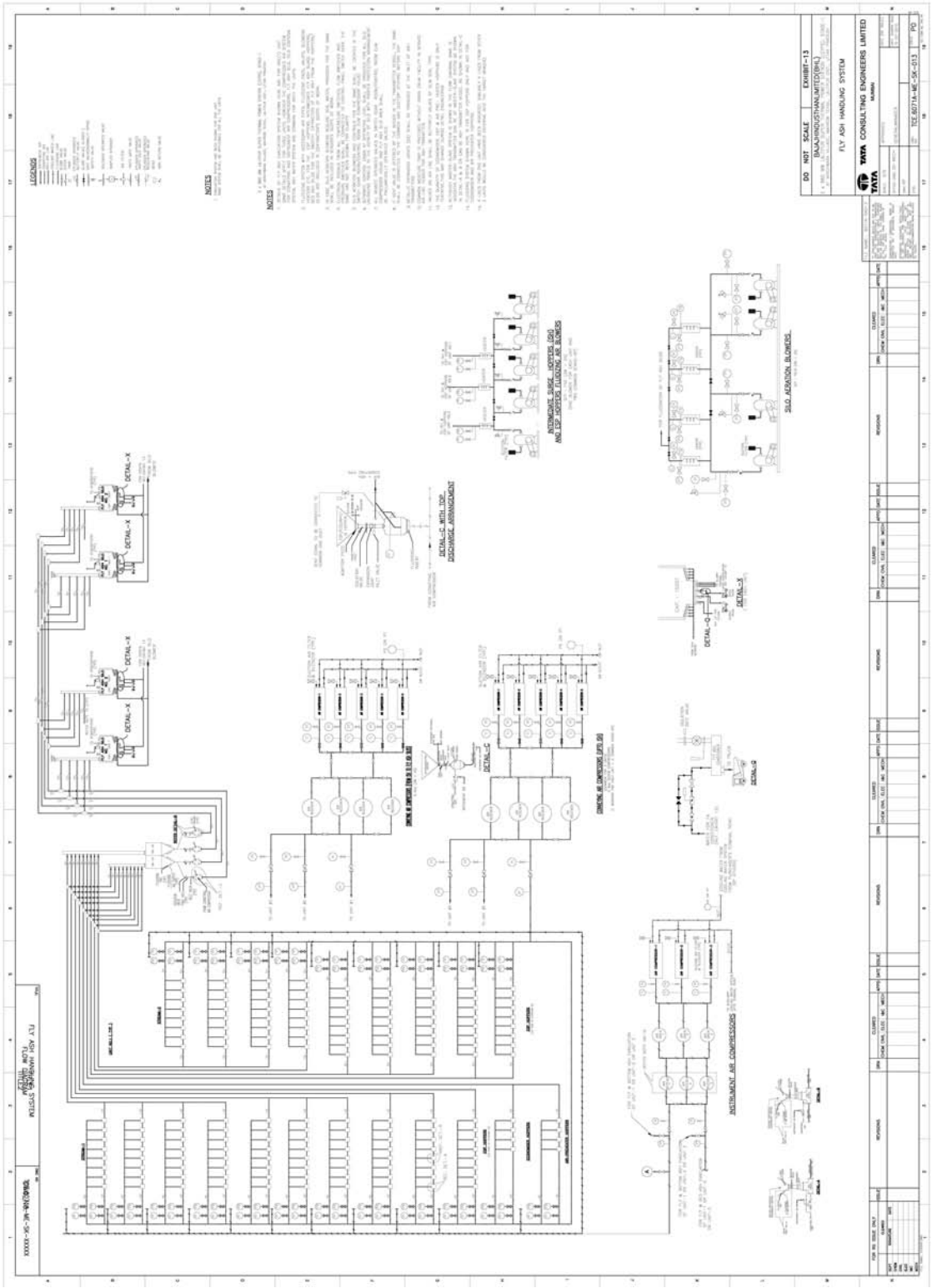

FIGURE-2.6
FLY ASH HANDLING SYSTEM

- **Ash Pond**

All efforts will be made to promote utilization of ash to the fullest extent. The ash pond with green belt is envisaged to be around 411 acre of which ash pond (storage) with dyke wall and restricted to 102 acres. In the event not enough utilization is found, other means of disposal of ash such as high concentration slurry disposal will be explored. The ash slurry will be discharged into the Ash Pond where the ash particles will settle and the decanted water will be recovered. This ash water is clarified and reused for ash disposal.

2.5.12 Fuel Oil Handling System

Warm-up and low load operation (up to 40%) will be carried out by HFO / LSHS for which storage tanks (2x 1500 kl) and unloading facilities have been envisaged for the plant. HFO will be brought to the plant by rail and unloaded to the storage tanks by means of 5 nos. (3working + 1 standby) unloading pumps. Two (2) nos (1 working + 1 standby) pressurising pumps (for each set of 2 units) will be used to supply oil from storage tanks to boilers. Necessary filters and tanker heating arrangement will be provided.

The storage tanks will be provided with floor coil heaters and outflow heaters, to maintain the oil temperature suitable for pumping and feeding to the shell and tube heaters in the pressurizing and heating (P&H) system, which feeds the boiler burners at the required pressure and temperature. Two (2) numbers of P&H units will be provided (1 working + 1 standby) common for feeding boilers of set of 2 units. The unloading pumps will be located in a pump house near the tanker unloading header. The pressuring pumps will be located adjacent to storage tanks. Recirculation will be provided at the outlet of P&H unit and near the burner front in the boiler, to ensure availability of fuel oil at the required pressure and temperature. The fuel oil heaters will be of steam heating type and all HFO lines will be steam traced or electrically traced.

To facilitate cold start of the units, LDO firing system will be provided. The LDO unloading and storage system will comprise of road tanker unloading station and 2x750 KL capacity storage tank. LDO will be brought to the plant by road tankers and filled in the storage tank by 2 x 50 m^3/hr unloading pumps. The unloading pump capacity has been selected to unload three (3) no road tankers at a time completely in less than an hour. Two (2) Nos. (1 working + 1 standby) pressurizing pumps will be used to supply oil from storage tanks to the boilers.

The pressuring pumps will be located adjacent to oil tanks. Recirculation will be provided at the outlet of pumping unit and near the burner front in the boiler, to ensure availability of fuel oil at the required pressure and temperature. Necessary piping, valves and strainers provided in the system.

2.5.13 Chlorination Plant

A chlorination plant will be utilized for chlorine dosing in the Pre-treatment plant and CW system to avoid the growth of algae and bacteria.

Chlorination plant will be provided for Gas chlorine dosing in the CW system and pre-treatment plant. The chlorination system will be designed for:

1) Shock dosing to circulating water system @ 5 ppm for 30 minutes, every 8 hours.

2) Continuous dosing in Pre-treatment plant @ 8 ppm

2.5.14 Service Water & Potable Water System

Drinking water requirement for the plant will be met from the output of filters after treatment. There will be 2x100% drinking water pumps, which will supply drinking water to various facility area overhead tanks. Plant service water requirement will be met from the Overhead Service water tank and 2x100% Service water pumps, which will supply service water to various facility areas.

2.5.15 Effluent Treatment Plant

The Plant is designed to treat all effluent except for the cooling Tower blow down. The effluent generated from cooling Tower blow down will be used for ash handling system to the extent possible. The following are the different type of effluent to be treated before reuse.

a. The Cooling tower (CT) blow down will be used for Ash handling system to the extent possible.

b. Effluent from clarifiers and filters will be fed to ash handling plant.

c. All chemical area drains and demineralization waste are directed to the neutralization basin. Once the pH of the wastewater has been adjusted to acceptable limit, the neutralization basin effluent will be transferred to CMB.

d. Effluent from Boiler, Turbine and other areas, which may contain oil traces, will be sent to oil/water separator. The oil will be pumped out periodically and trucked out for offsite disposal. Then the water will be directed to CMB.

e. The wastewater in transformer area may contain oil. Disposal of wastewater from transformer yard will be directed to Oil/water separator. Then the water will be directed to common effluent treatment plant.

f. Effluent generation is dependent, to some extent, on the operating practices in the plant. Any residual effluent will be used for dust suppression (for coal handling plant and open areas) and green belt. Flow scheme for waste water system is given in **Figure-2.7.**

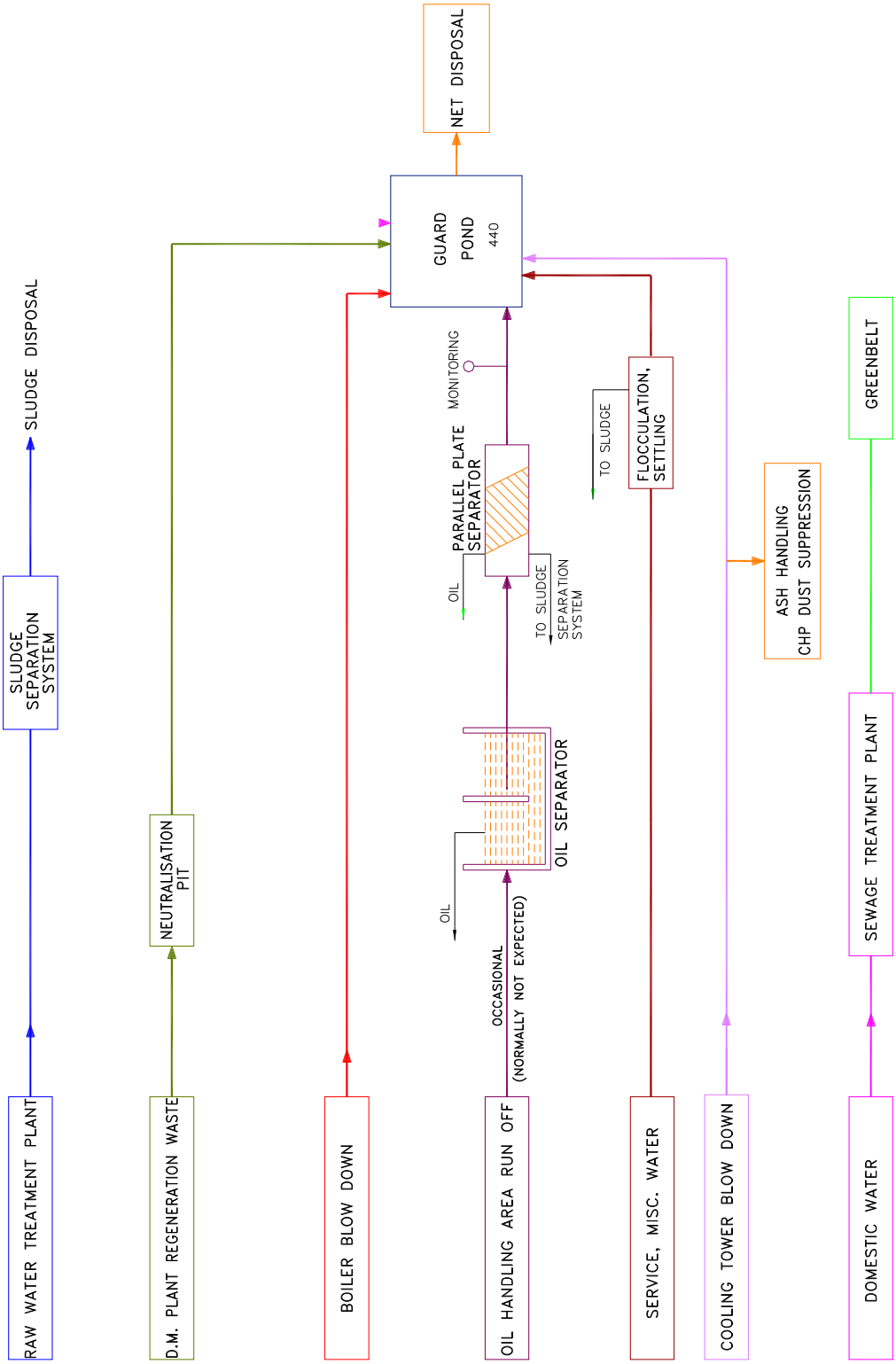

FIGURE-2.7
SCHEMATIC DIAGRAM OF EFFLUENT TREATMENT PLANT

2.5.16 Ash Water

Most of the cooling tower blow down will be used for Ash handling plant. Ash slurry will be directed to ash pond from where clear water after clarification will return to AHP system.

2.5.17 Rain Water

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

ii) The rain water will be collected in the rain water harvesting pits from the storm water drain running all around the project. Rain water harvesting pits are connected at regular interval to the storm water drain. Thus the rain water will recharge the ground water.

Excess rain water will flow to common collection pit from where water can be pumped for use in the ash handling system.

2.5.18 Air Conditioning System

- It is proposed to air-condition the unit control room, electronic cubicle room, shift charge engineer's room, printer room, maintenance engineer's room, UPS room, ESP control room, static excitation cubicle room, analyser panel room, coal handling control room, DM plant control room and switchyard control room. Inside design conditions of 24.5 ± 1.5^{0}C dry bulb temperature and relative humidity not exceeding 60% would be maintained in all air-conditioned areas.

- An independent centralised chilled water system is envisaged for air-conditioning the unit control room / electronic cubicle rooms and ESP control rooms. The centralised system would consist of three (two working and one standby) water chilling units. The system also consists of chilled water pumps, condenser cooling water pumps, induced draught FRP cooling towers, adequate number of air handling units for circulating the conditioned air through air distribution system to the room.

For air conditioning of all other rooms, packaged air conditioners or room air conditioners of suitable capacity would be provided.

2.5.19 Ventilation system

- For the ventilation of the station building, evaporative cooling system (Air washer type) is envisaged. This system consists of air washers, supply air fans, air washer circulating water pumps, centrifugal fans and air distribution system for distributing the supply air inside the station building. The exhaust of hot air out of the station building would be achieved by provision of roof extractors and wall mounted exhaust fans.

- For ventilation of other buildings, supply air fans or louvers, exhaust air fans, roof extractors or a suitable combination of these complete with louvers, filters, ducting grilles would be provided.

2.5.20 Fire Protection System

For protection of the plant against fire, all yards and plant will be protected by any one or a combination of the following systems:

- Hydrant system;
- Automatic high velocity and medium velocity sprinkler system;
- Water spray (emulsifier system);
- Foam system;
- Portable and mobile chemical extinguishers; and
- Auto modular CO_2 system.

The system will be designed as per the recommendation of Tariff Advisory Committee (TAC) of the Insurance Association of India. Applicable codes and standards of National Fire Prevention Association (NFPA), USA would also be followed.

Fire detection & Alarm system complete would be provided for efficient, safe and trouble free operation of plant. Areas for fire alarm detection will include main control room, local control rooms, control equipment room, electrical equipment rooms, cable cellar room, oil tank room, coal conveyers and coal stockpiles.

2.5.21 Power Evacuation System

Evacuation of power from the proposed power plant will be done at 400 kV level. The generation voltage is envisaged as 22-27 kV or will be as per the standard design of manufacturer. For evacuation of power, three (3) nos. single phase 260 MVA, 22 / 400/√3 kV generator transformers are envisaged for each unit will be connected to the 400 kV switchyard of the proposed power plant. The power would be excavated to the nearest 400 kV line to the UPPTCL grid substation at Parichha which is about 45-km from the proposed site.

2.5.22 Instrumentation and Control System

The proposed plant instrumentation and control system for 3 X 660 MW thermal power plant has been envisaged for control and monitoring of all equipments of the main plant, auxiliaries and offsite plants from the unit control room. The C & I system shall provide control and monitoring of all major system and equipments and related subsystems so that the status of all parameters of the plant is made available to the Unit Control Room (UCR). The implementation of C&I system shall be based on the state of the art Instrumentation and Distributed Control System (DCS) with functional distribution and geographical distribution of inputs and outputs for some sections of the plant at different locations for optimization of the scope of cabling from the field of electronic equipment room. Integration of all major systems has been envisaged through software link.

The design of the control and monitoring system envisaged shall be based on the following basic requirements;

- Complete operation and monitoring facility of the main plant, auxiliary systems, offsite plants and electrical systems from unit control room with the help of DCS and Human Machine Interface (HMI) through VDU and key board/ mouse based operator's console;
- Software integration of different control system of the plant with DCS;
- Energy management for electrical systems;
- Online optimization, display and report generation of all relevant parameters of the power plant in operator's guidance mode. The system shall facility for efficiency, performance evaluation of all major equipment of the power plant; and
- Back up operation and Indications are envisaged for essential trip operations of the power and electrical system from control desk, which will be located on one side of operator's control desk. Direct indications such as boiler drum level etc. and any other emergency operation facility have been envisaged from control desk.

2.6 Sources of Pollution

The various types of pollution from the proposed power plant are categorized under the following types:

- Air pollution;
- Water pollution;
- Solid waste; and
- Noise pollution.

The major type of pollution from the power plant is gaseous emissions. In addition, wastewater and solid waste will also be generated. The quantities and the composition of the gaseous, liquid and solid waste that are likely to be generated in the plant will be managed and treated such that their final disposal into the environment meets all the statutory requirements and thus the environmental impacts are minimized.

2.6.1 Air Emissions

The major pollutants emitted from the power plant stack will be SO_2, NOx and particulate matter. Proper control measures as described below will be installed to minimize the stack emissions within the stipulated/permissible limits prescribed by National Ambient Air Quality Standards.

- ***Suspended Particulate Matter***

Suspended Particulate Matter (SPM) is one of the important pollutants from the proposed power plant. High efficiency (>99.9%) electrostatic precipitators are proposed to be installed to limit the particulate matter emissions to below 50 mg/Nm^3.

- ***Sulphur dioxide***

The sulphur content in coal is about 0.7 %. One stack with three flues of 275-m height will be provided, as per CPCB/MoEF norms, to disperse the gaseous emissions.

- ***Oxides of Nitrogen***

To reduce the NOx emissions from the steam generator, all provisions in the steam generator design and fuel firing system will be made. Necessary confirmation from the boiler manufacturers regarding concentration from stack will be less than 750 mg/Nm^3 generation of NOx would be taken as a measure to control production of this pollutant right at the source. The details of stacks and emission rates are presented in **Table-2.11.** The emission rate calculations are given in **Annexure-IV**.

TABLE-2.11
STACK DETAILS AND EMISSION RATES

Sr. No.	Parameters	Unit	Stack#1		Stack#2
			Flue-1	Flue-2	
1	Flue (Stack) Height	M	275	275	275
1	Top diameter of each flue	m.	7.35	7.35	7.35
2	Flue gas velocity in each flue	m/s	22	22	22
3	Flue gas temperature	^oK	413	413	413
4	Flow rate of gas in each flue	Nm^3/s	617	617	617
5	Coal Consumption in each boiler	TPH	360	360	360
A]	Sulphur dioxide (SO_2) emission (0.7% sulphur content)	g/s	1400	1400	1400
B]	Particulate matter (PM) emission rate in each flue based on design limit of 50 mg/Nm^3	g/s	30.8	30.8	30.8
C]	Oxides of Nitrogen (NOx) (based on design limit of 9 kg/ton)	g/s	900	900	900
D]	Mercury emission rate based on 0.12 mg/kg	g/s	0.01	0.01	0.01

- ***Thermal Pollution***

Heat loss through the stack represents only about 8% to 10% of the total heat input to the furnace. The quantum of heat so lost to the atmosphere is not significant. It may further be noted that the area is subjected to moderate wind speed and good rainfall.

The effect of tall chimneys, which are being installed primarily to take care of the gaseous discharges, would also indirectly help in diffusing the thermal pollution. Due to the high kinetic energy gained by the flue gases issuing from the stack, the effective rise of the plume would ensure discharge of flue gas at a considerably higher stratum ensuring dilution of the gas dispersed leaving the local environment virtually unaffected.

2.6.2 Liquid Waste Generation

Effluents will be generated from cooling tower blow down, wash water and wastewater from sanitary facilities. Sanitary effluent will be treated in sewage treatment plant. The cooling water blow down will be reused in ash conditioning and disposal system and dust suppression system. Blow down from cooling towers will be the main sources of the wastewater. Besides this, DM plant waste, domestic waste from canteen and toilets will be the other wastes generated. The cooling tower blow down will be reused in dust suppression, ash/coal handling, fly ash conditioning, ash disposal and service water. The treated wastewater from sewage & effluent treatment plant will be used in greenbelt development. The waste water generated from proposed project is given in **Table-2.12**.

TABLE-2.12
WASTE WATER GENERATION FROM THE PROPOSED POWER PLANT

All Values are given in m^3/hr

Sr. No.	Units	Water Requirement	Loses/Uses	Waste Water Generated	Usage/ Disposal
1	Cooling tower make up	4815	4011	804	Used in AHS
2	Potable Water	41	10	31	Treated in STP & used for Greenbelt
3	Service water	291	272	19	To Guard Pond
4	Sludge Treatment	276	0	276	Disposal to Ash pond
5	Filtration & DM plant	98	65	33	Disposal to guard pond
7	Fire water make-up	1	1	0	-
8	Transmission losses	34	34	0	-
Total		**5556**	**4393**	**1163**	52 - guard pond 804 - AHS 276- Ash Pond 31 – Greenbelt
Note: 52 m^3/hr (1248 m^3/day) will go to guard pond as waste water. Remaining will be consumed in various usages					

Adequate storm drains will be constructed along the boundary of the plant area and within the plant area to drain off the storm water during monsoon period.

2.6.3 Solid Waste Generation in Power Plant

Ash is the main solid waste generated in the coal based thermal power plant. Considering the coal for the proposed power plant, the coal requirement would be 25920 TPD (8.51 MTPA). Ash content of coal would be less than 35%. Considering above, about 2.75 MTPA ash will be generated for the worst quality blended coal. In this total ash 80% will be fly ash (2.2 MTPA) and 20% will be bottom ash (0.549 MTPA).

Major portion of the ash will be utilized by supplying to potential users. Efforts will be made to utilize 100% fly ash as per the Fly Ash Notification, 1999 and as amended later.

The ash which is not lifted by the potential users will be disposed off in the ash dyke using High Concentration Slurry Disposal (HCSD) method. In this method of ash disposal, the slurry is highly viscous and non-Newtonian fluid requiring less water compared to conventional low concentration slurry disposal. The ash pond will be provided with trenches to collect the storm water during rainy days. Greenbelt will be provided enveloping the ash pond to arrest the fugitive dust emissions. Ash pond will also be provided with HDPE liner to prevent leaching of contaminants to groundwater.

2.6.4 Noise Pollution

The noise levels expected from various noise generating sources in the proposed plant are given in **Table-2.13**.

TABLE-2.13
SOURCE NOISE LEVELS IN THE PROPOSED PLANT

Sr. No.	Unit	Expected Noise Level dB(A) [1m away]
1	Turbine unit	80-85
2	Cooling tower	65-70
3	Air compressors	80-85
4	Transformer	70-75
5	Boilers	80-85

- *Noise Control*

Acoustic enclosures will be provided wherever required to control the noise level below 85 dB(A). Anywhere not possible technically to meet the required noise levels, personal protection equipment will be provided to the workers. The wide greenbelt around the plant will work as green mufflers to attenuate the noise level dissemination outside the plant boundary.

2.7 Infrastructure for Labours

The basic amenities for the labour force during construction and operation phase are proposed. The facilities comprises of the following;

- Separate shelters will be provided for male and female labours for resting;
- Separate wash rooms (sanitary facilities)will be provided for male and female labours;
- The contractors will be directed to provide fuel to labours for cooking;
- The first aid facilities will be made available; and
- Drinking water will be provided.