EXECUTIVE SUMMARY

1. INTRODCUTION

The Power Finance Corporation Limited (PFCL) has been entrusted with the task of executing Ultra Mega Power Projects of 4000 MW capacity each through developers under the tariff based competitive route. The Coastal Tamil Nadu Power Limited (CTNPL) is a wholly owned subsidiary of PFCL is identified as SPV and Owner for the Cheyyur Ultra Mega Power Project (UMPP). CTNPL is carrying out preliminary work upto selection of Developer for the 4000 MW Ultra Mega Power Project located at Cheyyur in Kanchipuram district of Tamil Nadu.

The site is located near Cheyyur village in Cheyyur Block of Kanchipuram district in Tamil Nadu Coastal area. The nearest railway station is Melmaruvathur (20 km)/ Maduranthakam (22 km). The railway stations are well connected to Chennai through broad gauge railway system. The nearest airport is at Chennai located at a distance of about 96 km from the site. The site needs to be connected with State Highway (East Coast Road)/National Highway (NH-45). The Vicinity Map of the site for Main Plant and Ash Pond is shown in Figure-1.

2. PROJECT DESCRIPTION

2.1 LAND REQUIREMENT AND AVAILABILITY

The main plant is located in a cluster of four Villages namely Cheyyur B Block, Gangadevankuppam, Chitarkkadu and Vedal. The ash pond is located in a cluster of two villages namely, Vilangadu and Kokkaranthangal. The land required/identified for the Power Plant including Ash Disposal area is 560 ha. The details are given in Table-1.

TABLE-1
Details of land requirement and availability

S. No.	Description	Area	
		Acres	**ha**
A	**Land Requirement**		
i)	Main Plant	840	340
ii)	Ash Disposal area	400	160
iii)	Colony	150	60
	TOTAL	**1390**	**560**
B	**Land Available/identified**		
i)	Main Plant	911.83	369.16
i)	Ash Disposal area	403.81	163.49
iii)	Colony	140.00	56.68
	TOTAL	**1455.64**	**589.33**

Apart from the above-said Land Availability, additional Land required has been identified for Other Services as given in Table 2.

TABLE-2
Land required for other services

S. No.	Description	Area(Ha)	Source
i.	Corridor for Ash Pipe line (3.431kmx25m)	8.58	IRS
ii.	Corridor for Railway Siding from Achrapakkam to Site (22kmx25m)	55.00	RITES
iii.	Corridor for Access Road from National Highway NH-45 (Sothupakkam) to Site (23kmx10m)	23.00	RITES
	TOTAL	**86.58**	

This excludes the land required for providing Corridors for Coal Conveyor from port to site and for sea water intake and discharge system for which studies are being conducted.
In addition to above, additional land needs to be identified for corridors viz: Ash pipe line corridor, Coal Conveyor corridor, water system (Intake/Outfall) corridor, Railway Spur Siding for Fuel Oil and an Access Road.

2.2 SITE CHARACTERISTICS

The site is generally plain with mud flats and salt pans. The area is thinly populated. A small portion of the land (10%) is irrigated agriculture land about 40% of the land to be acquired for the project is government and forest land accounts for about 1.67% of the total area to be acquired for the project. The elevation of site varies between 1.5 m to 15 m. The site is gently sloping in the North West direction and there are no major structures present on the site. The proposed site and adjoining area is essentially a gently sloping land. The variation of the elevation is about 1.5 m to 15 m (Main Plant and Colony area) and 20 m to 48.5 m (Ash Pond Area).

2.3 PROCESS DESCRIPTION

The layout of the power plant has been decided considering the space requirements for the Equipment, Systems, Building and Structures, Coal Handing/ Coal Storage area and Ash Disposal area required for 6x660 MW units of the proposed Power Project. Sea water is proposed for Condenser Cooling in a Recirculation System with Natural Draft Cooling Towers (NDCT). Necessary Plant Drainage system would be provided at the proposed Power Plant site. The layout plan is shown in Figure-2.

2.4 FUEL SOURCE AND TRANSPORTATION TO SITE

The Steam Generators would be designed primarily for Coal firing. However, Heavy Fuel Oil (with Arc Ignitors)/ Light Diesel Oil (LDO) would be used for Start-Up and Flame stabilization at low loads. LDO may also be used for lighting up the Boiler.

- Coal for the Project would be imported by the Power Plant Developer. The imported Coal is expected to have a maximum of 12% Ash content and a Gross Calorific Value (GCV) of over 6000 k Cal / kg.
- The secondary Fuel would be HFO as per IS:1593. The Fuel Oil for the Power Plant would be made available from HPCL/BPCL/IOC and/or Refineries at Chennai.
- The annual Coal consumption for the proposed 4000 MW Power Plant with a GCV of 6000 K Cal / kg and annual Plant Load Factor (PLF) of 90% is estimated to be about 14 million MT. The Daily requirement would be about 38400 MT.

2.5 PLANT WATER REQUIREMENTS

The Water System consists of the various sub-systems is given as below:

- Sea water Intake System.
- Condenser Cooling Water (CW) System.
- Auxiliary Cooling Water (ACW) System.
- Desalinated Water (Fresh Water) System.
- Service and Potable Water System
- Fire Protection System.
- Effluent Treatment System.

The Plant Water requirements including Condenser Cooling through both types of Cooling systems is summarized in Table-3.

TABLE-3

Plant Water Requirements

S. No.	Description	Re-circulation Type Cooling System		Quantity of Water sent back to Sea	Quality of Water
		m^3/hr	m^3/day	(m^3/hr)	
A	**Cooling Water**				
i.	Cooling Water for Condenser and other Auxiliaries	24000	576000	14400	Sea Water
	Total	24000	576000	14400	
B	**Fresh Water**				
i.	Sea Water clarifier Blow- down	720	17280	720	Blow-down
ii.	Lubricating Water required	300	7200		Filtered Water
iii.	Filter backwash	290	7000	290	Filtered Water
iv.	Service Water	1500	36000		Desalinated Water
v.	Plant/Colony potable Water	35	800		Desalinated Water
vi.	DM water for SG Make-up	150	3600		DM water
vii.	Waste Water from Desalination plant	9000	216000	6820	Filtered Water
viii.	Waste from Ion-exchange units	5	120		DM Regeneration waste
	Total	12000	288000	7830	
	TOTAL(A+B)	**36000**	**864000**	**22230**	

Note: (i) The Make-up water required for cooling of Condenser and other Auxiliaries has been computed @ 5% of 4,80,000 cu.m/hr. Another 50% of this shall be required for generating Fresh Water for miscellaneous use.

(ii) The water balance is prepared considering desalinated water generation from Thermal Desalination process only. However, based on the exact process of desalination to be decided by Developer, the Plant water requirements would change.

iii) The used water to be discharged back to Sea shall be max 22230 cm/hr & 5,33,000 cum/day i.e.60% of intake water.This may vary from 55% to 60% depending upon surplus water from Desettlement Pond of Ash Pond.

2.6 COAL TRANSPORTATION FROM PORT TO POWER PLANT

Considering the PFCCL's present requirement of 12 to 15 MTPA, with 300 operating days per year and an average vessel size of about 150000 DWT, two berths each with a rated unloading capacity of 2500TPH would be required. The proposed belt conveyor routing between the port and plant is planned based on the area available on the ground avoiding the built up- area as much as possible to minimize relocations.

2.7 CONNECTION FROM EAST COAST NATIONAL HIGHWAY TO PROPOSED POWER PLANT

Keeping in view the National Highway - 45 running along side the railway track, the connectivity between National Highway with Plant site has been proposed by strengthening and widening (where ever required) the existing two lane State Highway - 115 connecting Melmaruvathur to Cheyyur and thereafter the road upto plant site. At Cheyyur, road connecting State-Highway and plant area, passes through the densely populated area and has less width of about 5 m as against 10.5 m. The diversion of this road will be required for providing adequate width for movement of heavy traffic carrying plant equipment and materials. It will be better to skirt -the Cheyyur area and this can be acl1ieved by strengthening & widening the existing road connecting plant site to State Highway - 115, which is about 2 kms ahead of Cheyyur towards Chittamar. About 1 km of new two lane road has to be built near plant site. The total length road including strengthening of existing road and construction of new road near plant has been assessed to 23 km.

2.8 TRANSPORTATION OF MATERIAL BY RAIL

Apart from, POL traffic some construction materials and machinery parts are also likely to move by rail. It is estimated to be around 0.50 rakes per month. Thus total traffic comes to a little more than 2 rakes per month or one rake ever 10 – 15 days.
POL traffic will move by rail from Refinery located at Chennai. Rail route will be Chennai Central (MAS) – Chengalpattu Junction (CGL) – Acharapakkam (ACK).

2.9 ASH HANDLING SYSTEM

The following data have been considered for design of Ash Handling system:

S. No.	Description		Rate/Qty
(a)	Hourly Coal firing rate at MCR condition for imported Coal(margin of 5%)	:	1500 MT/Hr
(b)	Ash content in Coal considered for design of Ash Handling system	:	15%
(c)	Distribution of total Ash produced as		
	- Bottom Ash	:	20%
	- Fly Ash	:	80%
(d)	Volume occupied by one MT of Ash in Storage area	:	1 cu.m
(e)	The system adopted for Bottom Ash removal would be Scraper Conveyor system and for Fly Ash removal, Pressure type Pneumatic system		
(f)	Ash disposal would be either in dry form or wet slurry form		

Ash Pond has been provided for storage of Bottom Ash generated for 25 years and Fly Ash over a period of 2-10 years after which 100% utilization of Fly Ash has to be ensured with reduction in phases. Considering Ash content of maximum 15% in the imported coal, following quantity of ash shall be generated at Plant:-

	Bottom Ash	Fly Ash	Total Ash
a) Daily production/Hr	45 MT	180 MT	225 MT
b) Daily production (Total)	1980 MT	4320 MT	5400 MT
c) Annual production	0.39 million MT	1.55 million MT	1.94 million MT

2.10 PROJECT IMPLEMENTATION SCHEDULE

The Unit No.1 is proposed to be synchronized in 57 months and commissioned in 60 months from the date of start of the Project. The subsequent Units shall be synchronized and commissioned, each within 3 months from the respective dates of the previous Unit.

3. ENVIRONMENTAL BASELINE STATUS

3.1 TOPOGRAPHY

The project area district comprises mainly of peneplain with residual hills extending parallel to the coast (N.20-30^{0}E) ranging in elevation between 16 and 230 metres. This forms the zonal of pendiments and buried pediments with maximum number of surface/storage tanks. The coastal track is marked by three beach terraces ranging in elevation between 4 and 12 metres with broad inter terrace depressions.

3.2 SOILS

The major soil types found in district Kancheepuram in order of predominance are as follows:

- Brown soil 53.70 %
- Red loam 14.31 %
- Mixed soils 13.27 %
- Black soil 13.09 %
- Sandy coastal alluvium 5.63 %

In the project area and the study area sandy coastal alluvium type soil is mainly observed. As a part of the REIA study, soil samples were collected from various locations in the project area as well as study area. The soil texture at various stations ranged from clay to sandy. The soil pH ranged from 6.78 to 7.72. The Electrical Conductivity (EC) ranged from 0.123 to 0.403 millimhos/cm. The CEC ranged from 12.35 to 23.36 meq/100 gm. The organic matter was observed in the range of 0.6 to 1.61%. In some of the soil samples, the organic matter was less than moderate productivity range, i.e. <0.8%. In remaining soil samples, the organic matter indicated high soil productivity (>0.8%).

3.3 METEOROLOGY

The project area has a moderate climate with high humidity. Extreme climatic conditions are not prevalent in the project area. Both the monsoons, i.e. south-west and north-east monsoons influence the rainfall pattern in the project area. In summer months, heat is considerably mitigated in the by the sea breeze. The project area is charcterised by an oppressive summer and good seasonal rain fall. Based on average distribution of climatic features the climate of the area can be divided into four distinct seasons, namely summer season (March to May), south-west monsoon season (June to September), post-monsoon or retreating monsoon season (October to November) and north-east monsoon season (December to February), with the associated rains being confined to December.

As a part of the REIA study, a micro-meteorological station was set up close to the project site from 28.03.09 to 30.06.09. The parameters monitored were wind speed, wind direction, temperature, relative humidity, atmospheric pressure. During the study period the maximum temperature observed was 45^{o}C. The minimum temperature observed was 5^{o}C. The wind speed ranged from 1.08 to 93 km/hr. Likewise, the relative humidity ranged from 25 to 90%.

3.4 AMBIENT AIR QUALITY

The ambient air quality is being monitored from one year january 2009. It is proposed to be monitor ambient air quality for a period of one year. In the present report, monitoring results have been reported for a period of 3 months from March to June 2009. The frequency of sampling at each station is twice a week for one year.

The maximum SPM level of 139 µg/m^3 was observed at station located at Cheyyur. The average SPM level at various monitoring stations ranged from 115.6 to 121.2 µg/m^3. The SPM level was lower than permissible limit of 200 µg/m^3, specified for residential, rural and other areas.

The average RPM levels as observed at various stations in the study area ranged from 41.56 to 51.54 µg/m^3. The highest RPM value of 59 µg/m^3 was recorded at sampling stations located at Panaiyur and Kadukallar. The values of RPM monitored during the field survey were well within the permissible limit of 100 µg/m^3 specified for residential, rural and other areas.

The highest SO_2 value observed was 2.9 µg/m^3 . All the valves of SO_2 during field monitoring was below detectable limit. The SO_2 level observed at various sampling stations was much lower than the permissible limit of 80 µg/m^3 specified for residential, rural and other areas.

The highest NOx values of 3.9 µg/m^3 were observed at stations located at Vidal Panchayattu Union Office building. The NOx level observed at various sampling stations was much lower than the permissible limit of 80 µg/m^3 specified for residential, rural and other areas.

3.5 AMBIENT NOISE LEVEL

The noise level at various sampling stations ranged from 32 to 48 dB(A). the day time and night time equivalent noise levels were very well within permissible limits specified for residential area.

3.6 WATER QUALITY

As a part of the REIA study, surface and ground water quality monitoring was conducted at various locations in the study area, with an objective to ascertain the quality of water, which at present is the major source for meeting domestic water requirements in the study area.

The pH in groundwater samples ranged from 6.70 to 7.19, indicating that the pH in neutral range. The Electrical Conductivity (EC) in various ground water samples ranged from 116 to 700 µs/cm. The TDS level at various sampling locations ranged from 86 to 548 mg/l. The TDS level in various ground water samples in some of the water samples was below the permissible limit of 500 mg/l specified for drinking water purposes. However, TDS level was much below the cause for rejection limit of 1500 mg/l. The BOD and COD levels in surface and ground water samples were observed to be quite low, indicating the absence of pollution sources. The concentration of various heavy metals e.g. Copper, Cadmium, Zinc, Chromium and Lead was observed to be below the detectable limits. The concentration level of various heavy metals and toxic compounds indicates the absence of chemical pollution sources in the area. This is expected because there are no industries or sources of chemical pollution in the study area.

3.7 LAND USE PATTERN

The land use pattern of the study area, i.e. area within 10 km radius has been studied using satellite data. The raw digital satellite data has been procured from National Remote Sensing Agency (NRSA), Hyderabad. The land use pattern based on the classified imagery is given in Table-4.

TABLE-4
Land use pattern of the study area as per satellite data

Category	Area(ha)	Percentage of study area
Vegetation	6313	13.48
Agriculture	22744	48.58
Barren	4808	10.27
Saltpan	3833	8.19
Water body	9035	19.30
Settlements	87	0.19
Total	**46820**	**100.00**

It is observed from 4.13, that as per satellite data, the major portion in the study area is under agriculture land as it accounts for about 48.58% of the total study area. The next dominant landuse category is water body (19.30%), followed area under vegetation (13.48%). Salt pans account for about 8.19% of the study area. Area under barren land accounts for about 10.27% of the study area.

3.8 VEGETATION

As per Champion and Seth Classification, the following forest types are observed in the Study Aarea are listed as below:

- Tropical dry evergreen (Group 7G) : Climatic Climax forests
- Tropical dry evergreen scrub (Group7-ds1): Degraded forests
- Southern Tropical Thorn forests :(Group 6 AC1)

The land to be acquired for the proposed project have a few area under reserve forest land. This reserve forest land comprises mainly of Eucalyptus plantation.

3.9 WILDLIFE

In the project area, dense forests are generally absent. The major landuse in study area is agriculture land interspersed with settlements villages. Normally in such settings, wildlife is not observed. The faunal species reported in the study area include. Jackal, hare, common mongoose amongst mammals. Amongst birds, species reported are Shrew, Pangolin, Kite, Partridge, Koel, etc. are commonly observed. Amongst reptiles, commonly reported species are Rat snake, Cobra, Green Whip snake, etc.

Vedanthangal bird sanctuary

Vedanthagal bird sanctuary which is spread in area of about 30 hectare attracts a variety of birds resident and migratory, which breed and disperse. Vedanthagal is one of the oldest bird sancturies. Some of the birds that can be seen in the sanctuary are Cormorants, Egrets, Grey heron and Open - billed stork. 112 species of birds were observed in the area. In all these observed birds, includes 33 species of water dependent birds and 79 Species of land birds. Most of the Aquatic birds were observed in the Reservoir in Cheyur called Periya yari, Yekyari and Odapari. Herons, Egrets, Storks and Spoonbills are the most conspicuous

group of birds that are found in the saltpans area of Cheyyur, function as the feeding ground for Wading birds since two thirds of these species feed almost exclusively on fishes.

3.10 FISHERIES

Fisheries are important not only for its high nutrient value but also for improving the rural economy and for providing employment to a large section of the rural population. The project area district has a coastline of 87.2 km. The inland fresh water area spreads over about 75006 ha and estuaries and brackish water area are 14841 ha. In Kanchipuram there are 44 Fishing villages and 39 Fish landing centres, of which only 2 are major fish landing centres. The Marine and Inland fish production in the project area district is about 12.825 MT and 12013 Tonnes respectively.

4. ASSESSMENT OF IMPACTS

4.1 IMPACTS ON LAND ENVIRONMENT

a) Construction phase

Impacts due to land acquisition

The preparatory activities like the use of existing of access roads, construction of storage sheds, staff quarters, etc. being spread over a large area would have no significant impact, except that as soon as the land is acquired, its use changes and the land ceases to be a productive unit. The land to be diverted for the proposed thermal power project is 1455.64 acres or 589.1 ha. The To this an area of 10% is added as the edge effect, which brings the total area to about 650 ha, out of a total study area of about 31,416 ha. The area likely to be affected is around 2% of the study area. The land to be acquired or affected due to the project includes agriculture, forest and government land. The site preparation activities like clearing, stripping, leveling, construction of bunds, for protection from flooding and impounding of ash dump, altering slopes for transmission towers each filling and excavation for foundation, will result in loss of local plants and other biota and change of existing land use pattern. Since, only a small portion of the area is affected and no rare, endangered or threatened species is observed. Hence, no major impact is envisaged as a result of acquisition of land for the proposed thermal power plant.

b) Operation phase

Impacts due to coal handling

Coal would be received at plant site through surface conveyor system. Coal handling system would be designed to cater for the requirements of the proposed Ultra Mega Power Project. The coal received by conveyor belts from the port, would be stored in the stock-yard near the power plant Normally, for imported coal of (-) 50 mm size will be received, after which screening and crushing is done. Crushers shall be installed to reduce the coal from (-) 50 mm size to (-) 25 mm size. Two crushers (one working + one standby) of adequate capacity need to be commissioned. Each crusher will be provided with eccentric disc type screens. The coal would then be fed to the bunkers from conveyors through motorized traveling tippers. In the proposed project the coal bunker would be covered with bunker sealing belt to avoid dust nuisance. The bunker would be adequately ventilated so as to keep the bunkers free from accumulation of volatile gases, thereby eliminating fire hazard and also avoiding dust nuisance on the tipper floor. The dust laden air sucked from bunkers would be passed through bag filters before being let out to atmosphere. Thus, it is clear that adequate measures will be implemented to prevent air pollution due to entrainment of coal dust during coal handling operations.

IMPACTS ON LAND USE PATTERN OF THE AREA

The construction and operation of the project will provide an impetus to the industrialization and urbanization in the area. Thus, some of the agricultural or barren lands are likely to be put to non-agricultural use. The power station would require lot of ancillary developments like shops, restaurant, workshops, etc. which will have a significant impact on the existing land use of the area. Thus, a part of existing agricultural or barren land would be diverted for the above referred use.

4.2 WATER ENVIRONMENT

a) Construction Phase

Impacts due to effluents from labour camps

During construction phase, about 1500 persons are likely to be employed. The number of company's and contractor's employees would be 300 and 1200 respectively. Most of the employees are likely to come from nearby areas, and only a very few labour or company's employees along with their families are likely to stay near the project site. It is assumed that about 10% of the total company's and contractor's employees (150) would be staying near the construction site for which small labour camp/colony needs to be constructed. Considering family size as 5, the increase in the population is expected to be of the order of 750. The balance (90%), of the employees involved in the construction phase would come from the nearby villages or towns. The total water requirement has been estimated as about 113.25 m^3/day. The sewage generated is normally taken as 80% of the total water requirement. Thus, the sewage generated would be of the order of (0.8 x 113.25) 91 m^3/day. The disposal of sewage without treatment can cause problems of odour and water pollution. It is important to provide appropriate sewage treatment facilities at the labour camp and at the construction site prior to disposal on land or in water body.

b) Operation phase

The following types of liquid wastes are expected in the project operation phase.

- cooling water and boiler blow down
- effluent from water treatment plant
- waters for hydraulic ash disposal.
- sewage generation.
- runoff from coal stack sites.

COOLING WATER AND BOILER BLOW DOWN

Sea water shall be used for meeting condenser cooling water requirements. The cooling water carries an enormous amount of heat Boiler blow down water would be led to the guard pond for storage prior to further utilization.

EFFLUENT FROM WATER TREATMENT PLANTS

Waste water from water treatment plant contains various neutral salts, acids and alkalis, which are not toxic but can substantially increase the salt content and change the pH of the receiving water body. Further more, waste water from DM plant will contain high concentration of chlorides and sulphate ions. The waste water from DM plant combined with filter backwater would be neutralized, and will be led into the ash water tank.

FROM HYDRAULIC ASH DISPOSAL

The dry fly ash from ESP would be collected and conveyed to the fly ash silo. The fly ash will then be conveyed in wet for to ash slurry sump using associated set of wetting unit, jet pumps and piping. The fly ash in the slurry sump would be conveyed to the ash pond using slurry pumps and pipelines. The ash settles in the ash pond and the slurry water

accumulates in the low lying area and reaches the ash recovery system. This effluent is likely to contain suspended solids which can be removed in a clarifier. The treated effluent from clarifier can be reused either for sprinkling in coal dump area, or other uses.

SEWAGE GENERATION

The water requirement for domestic use includes requirement for drinking, cleaning, etc. in the project area. The sewage generated from domestic sources in the proposed thermal power station shall be treated before disposal.

EFFLUENT FROM COAL STACK PILE AREA

The stock pile area is assumed to be about 25 ha and it is proposed to commission 200 no. of spray guns to spray water for prevention of entrainment of fugitive dust. The effluent generation shall be about 90-100 m^3/hr. The effluent shall contains high suspended solids and shall be mildly acidic. The same needs to be treated before disposal.

4.3 IMPACTS ON NOISE ENVIRONMENT

(a) Construction phase

The major sources of noise during construction phase are due to operation of various construction equipment. Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that equipment required during construction phase is operating at a common point. Likewise, to predict the worst case scenario, attenuation due to various factors too have not been considered during noise modeling At a distance of 1 km from the construction site, the increase in noise levels will be only 1 dB(A). Hence, no adverse impacts are anticipated on noise levels in the construction phase of the proposed project.

b) Operation phase

The noise generated by various machineries are of a broad based variety with strong component in low frequency range. The power house building would be made of RCC structure with adequate sound insulation. The expected resultant noise level emanating from the power house building will be about 70 dB(A). At a distance of 500 m power plant from the site, the increase in noise levels will be only 1 dB(A). There are no residential areas within 500 m of proposed project site. Hence, no adverse impacts are anticipated on noise levels in the due to operation of the proposed project.

4.4 IMPACTS ON AIR ENVIRONMENT

(a) Construction phase

The major pollutant in the construction phase is SPM being air-borne due to various construction activities. The vehicular movement generates pollutants such as NOx, CO and HC. But, the vehicular pollution is not expected to lead to any major impacts. The fugitive emissions due to vehicular movement will be 8 to 12 kg/km travelled by the vehicle. The soils in the project area are sandy in texture, and are likely to generate substantial quantities of dust. However, the fugitive emissions generated due to vehicular movement are not expected to travel beyond a distance of 200 to 300 m from the point of their origin. The wind blown dust is also likely to be substantial, especially during the summer months. Since, there is no habitation within 200 to 300 m, of the project site the impact on air environment during the construction phase is not expected to be significant as far as air pollution is concerned.

b) Operation phase

On the basis of process emission characteristics coal analysis and theoretical estimates from fuel being used in boilers or furnaces, the emission characteristics were calculated. The ambient air quality modeling has been conducted using industrial source complex model. The meteorological data collected as a part the study was alos used to assess the predict the ambient air quality. The increase in concentration of SPM, SO2, and NOx at various sampling sites is given in Tables-5 to 7 respectively**.**

TABLE-5
Short term increase in SPM level at various ampling sites

S.No	Name of station	Base Line Level ($\mu g/m^3$)	Increase in concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
1	Chitharkadu	115.96	0.01795	115.978
2	Cheyyur	119.13	0.01421	119.1442
3	Panaiyur	115.60	0.04669	115.6467
4	Gengadvankuppam	120.83	0.07517	120.9052
5	Vedal	117.04	0.00000	117.04
6	Kadukalur	121.20	0.11004	121.31

TABLE-6
Short term increase in SO_2 level at various ampling sites

S.No	Name of station	Base Line Level ($\mu g/m^3$)	Increase in concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
1	Chitharkadu	1.57	2.10	3.67
2	Cheyyur	1.93	1.66	3.59
3	Panaiyur	1.99	5.47	7.46
4	Gengadvankuppam	2.03	8.81	10.84
5	Vedal	1.28	0.0004	1.2804
6	Kadukalur	2.26	12.89	15.15

TABLE-7
Short term increase in NOx level at various ampling sites

S.No	Name of station	Base Line Level ($\mu g/m^3$)	Increase in concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
1	Chitharkadu	2.43	0.9974	3.4274
2	Cheyyur	2.11	0.7914	2.9014
3	Panaiyur	2.60	2.6030	5.203
4	Gengadvankuppam	2.25	4.1921	6.4421
5	Vedal	2.98	0.0002	2.9802
6	Kadukalur	2.30	6.1326	8.4326

IMPACTS DUE TO COAL HANDLING

In the proposed project, the coal from the port will be unloaded through unloaders which will be sent through closed conveyor belt. Thus, entrainment of coal dust during unloading shall be minimal.

4.5 IMPACTS ON ECOLOGY

a) Impacts on terrestrial flora

The direct impact of construction activity for any project is generally limited in the vicinity of the construction sites only. The construction sites include berthing, storage and infrastructure facilities. The total land requirement for this project is about 590 ha. About 24.29 ha of forest land is proposed to be acquired for the project. The forest land to be acquired has mainly plantations of consuarina, and dense forest is not observed. There is no forest with tree cover in the vicinity of the project site. Hence, no significant impacts due to land acquisition are anticipated in the proposed project. As a part of the project, greenbelt will be developed, which will improve the vegetal cover in the area. The emissions of SPM and SO_2 from the thermal power station can lead to harmful effects on plants. If proper air pollution control measures, are not undertaken, then the diversity of plant life will be adversely affected.

4.6 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

(a) Construction phase

The construction stage will last for 3 years for the proposed project. The peak labour force, skilled and unskilled labourers, is estimated at about 1500. The construction phase of any project of this size is rather an unsettled stage characterized by uncertainities and often disorders. The basic problem relates to provision of infrastructural facilities to the labour population which migrate to the construction area in search of jobs. During project construction phase, a large number of labour population and other professionals will migrate to this area in search of work. Unless infrastructure is improved, the existing resources will fall short and a larger number of persons would be using the existing resources. This could lead to guest-host friction. The construction and operation of the project will open a large labour market. The agricultural labour working in the construction sites, are more permanent in nature. This could lead to marginal paucity of agricultural labour, especially during the project construction phase.

b) Operation Phase

The following impacts are envisaged in the project operation phase:

- In the operation stage the project would lead to monitoring of various allied activities. This will lead to marginal improvement in the employment scenario, which is a positive impact.
- Improvement in communications and transportation facilities.
- As a part of Area Development Activities, the project proponents will upgrade the existing facilities for education and health. This will be a positive impact

5. ENVIRONMENTAL MANAGEMENT PLAN

5.1 ENVIRONMENTAL MANAGEMENT PLAN FOR IMPLEMENTATION IN CONSTRUCTION PHASE

Water Quality

It is proposed to construct 40 community toilets within the labour camps and close to construction sites itself. The sewage can be treated in septic tank and disposed off through absorption trenches. It is proposed to construct two septic tanks for treatment of sewage generated during construction phase. One septic tank each at construction site and the other near the labour camp close to the construction site needs to be constructed. An amount of Rs. 2.0 million can be earmarked for this purpose.

Solid waste management from labour camps

The solid waste likely to be generated from labour camps shall be of the order of 0.16 tonnes/day. Adequate facilities for collection, conveyance and disposal of solid waste needs to be developed. For solid waste collection, 10 number of masonry storage vats, each of 2 m^3 capacity shall be constructed at appropriate locations in various labour camps. These vats shall be emptied at regular intervals and the waste so collected can then be transported to the nearest landfill site. One covered truck to collect the solid waste from common collection point and transfer it to the disposal site shall be put to service. The truck can collect the solid waste from the construction site to the designated land fill sites where city's solid waste is being discharged. An amount of Rs.2.0 million can be earmarked for purchase of a truck for conveyance of solid waste to the landfill site.

Provision of free fuel

The project proponent in association with the state government of Tamil Nadu shall make necessary arrangements for distribution of LPG to families of labour and technical staff involved in construction activities. The total cost required for provision of fuel has been estimated as Rs.2.16 million.

Restoration and landscaping of project site

The construction of the proposed project, would lead to minor disturbance the existing topography and physiography. Although, no major alteration of the area is expected as the layout has been so conceived that no major impacts on this account are anticipated. It is proposed to landscape the area, so that it integrates with the natural surroundings. It is proposed to clear construction waste material from entire area. It should be made mandatory for the contractor involved in construction activities to remove all the construction waste and restore the original topography of the area.

Health facilities during construction phase

A first-aid post is proposed shall be commissioned at the construction site for providing immediate health care. The first aid post will have the following facilities:

* First-aid box with essential medicines using ORS packets
* First-aid appliances, splints and dressing materials
* Stretcher, wheel chair, etc.

For serious injuries, the patient will be immediately reached to the nearby hospital for which a van will be kept at the construction site. The total expenditure for implementation of public health measures shall be Rs. 2.56 million.

Air pollution control measures

All vehicles delivering materials of the site will be covered to avoid spillage of materials. All existing highways and roads which are part of the project site used by vehicles and road use by vehicles of the contractor shall be kept clean and clear of all dust found and other extraneous materials dropped by such vehicles. The unloading of trucks/vehicles used for transport of construction material shall be done only during day time.

Unpaved haul roads near/passing through residential and commercial areas to be watered thrice a day. Trucks carrying construction material to be adequately covered. All earthwork will be protected in a manner acceptable to the Engineer to minimise generation of dust. The contractor will take every precaution to reduce the level of dust along construction sites involving earthworks, by frequent application of water.

Noise control measures

Noise pollution can be mitigated at the source itself. As discussed in Chapter-5, the ambient noise levels would have marginal increase up to about 1 km from the major construction site. The increased level of noise will, however, not have any significant adverse impact. The effect of high noise levels on the construction labour is to be considered. It is known that continuous exposure to high noise levels above 90 dB(A) affects the hearing acuity of the workers/operators and hence has to be avoided. Other physiological and psychological effects have also been reported in literature, but the effect on hearing acuity has been specially stressed. To prevent these effects, it has been recommended by international specialist organisations that the exposure period of affected persons shall be limited as specified in Table 8.

TABLE-8

Maximum exposure periods as specified by OSHA

Maximum equivalent continuous noise level (dBA)	**Unprotected exposure period (hrs) per day for an 8 hr/day and t days week**
90	8
95	4
100	2
105	1
110	½
115	¼
120	No exposure permitted at or above this level

Alternatively, they shall be provided with effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure.

All vehicles, equipment and machinery to be procured for construction will conform to the relevant Bureau of Indian Standard (BIS) norms. Noise limits for construction equipments to be procured such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB(A), measured at one metre from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986.

Disposal of runoff from construction sites

Fencing will be provided around stockpiles. Construction materials containing fine particles will be stored in an enclosure such that sediment-laden water does not drain into nearby watercourses. All discharge standards promulgated under Environmental Protection Act, 1986, will be adhered to.

Prevention of soil contamination

Vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refueling areas within the construction camps. Fuel storage will be in proper bunded areas. All spills and collected petroleum products will be disposed off in accordance with MoEF and SPCB guidelines.

Fuel storage and refilling areas will be located at least 1000 m from rivers and other water bodies or as directed by the Site Engineer. In all fuel storage and refueling areas, if located on agricultural land or areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage and refueling activities.

5.2 ENVIRONMENTAL MANAGEMENT DURING OPERATION PHASE

Water Environment

Cooling water

The total cooling water discharge shall be stored in a guard pond for storage prior to disposal. As per the norms specified for disposal of effluents, the temperature shall not exceed 7^{o}C above the temperature of the receiving water temperature.

Steam generator blow down

Boiler blow down water would be led into guard pond for storage before utilization.

Plant wash down water and Miscellaneous drains

The wastewater along with process drain would be led to an oil water separator for separation of oil. The clear water would be led to the guard pond. The dirty oil would be recovered separately in a drum and disposed at regular interval.

Rain (Storm) Water Drainage

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. The storm water from the storm water drainage piping discharges outside the plant boundary. 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.

Effluent from Water Treatment Plant

The acidic and alkaline effluents from DM plant and the filter backwash would be led to the neutralising pit of water treatment plant, which is in two (2) compartments to facilitate maintenance and cleaning. Acid or alkali would be added to the neutralising pit depending on nature of effluents from DM plant to neutralise the effluent collected in the neutralising pit. Two (2) nos. neutralising pumps, (one working + one standby) are proposed to be commissioned to re-circulate and transport the neutralised effluents to the guard pond and aeration.

Effluent from coal stock yard

The coal and clinker stock yard shall be cleaned immediately once a phase of coal handling operations is completed. The water can be channeled from various area, and can then be settled in a settling tank. It is likely that considerable quantity of coal slurry settles within the drain, before reaching the settling pond. Thus, at regular intervals of drain length sumps can be installed adjacent to the drain to allow the bulk of the solids to settle in these sumps with overflow water being channeled to the settling pond. The solids which settle out in the sumps can be cleaned out by a front end loader or back hoe and the material can be returned to the respective stock pile area.

Effluent from ash disposal area

The dry fly ash from ESP would be collected and conveyed to the fly ash silo. The fly ash will then be conveyed in wet for to ash slurry sump using associated set of wetting unit, jet pumps and piping. The fly ash in the slurry sump would be conveyed to the ash pond using slurry pumps and pipelines. The ash settles in the ash pond and the slurry water accumulates in the low lying area and reaches the ash recovery system. This effluent is

likely to contain suspended solids which can be removed in a clarifier. The treated effluent from clarifier can be reused either for sprinkling in coal dump area, or other uses.

Sewage from Various Buildings in the Plant

Sewage from various buildings in the power plant area would be conveyed through separate drains and treated in a sewage treatment plant (STP). The treated effluent shall be reused or recycled depending on the quality.

Noise Control Measures

The adverse impacts due to high noise could be controlled by implementing various control measures listed as below:

- Noise generated at higher elevations like, turbines, generators, compressors, can be mitigated by developing greenbelt comprising of trees and shrubs around the proposed thermal power station.
- The exposure to workers operating in high noise areas be limited to the exposure period specified by Occupational Safety and Health Administration (OSHA). The maximum exposure periods as specified by OSHA for various noise levels is given in Table-8.
- Workers operating in high noise areas be provided with ear muffs or ear plugs.
- It would be ensured that in the surrounding area, the noise level does not exceed 75 dB(A) in day time and 70 dB(A) in night time to meet the Indian Standard regulations.
- All the steam safety valves that are likely to be operated often would be provided with silencers to reduce the noise level during steam release.

Land Environment

For the proposed 4,000 MW thermal power plant, total ash production is 4,320 tonnes per day. The percentage of bottom ash and fly ash generated is 20% and 80% respectively. About 3,456 tonnes/day shall be generated as fly ash and the balance (864 tonnes/day) will be bottom ash. The ash will be beneficially utilized to the maximum extent as per government of India guidelines, and remaining ash will be sent to the ash pond.

Bottom ash handling

A maximum of 20% of the total ash produced by the steam generator would be collected in the dry refractory lined hopper below the furnace as bottom ash. The bottom ash hopper would have a capacity to store about four hours collection of bottom ash generated. The bottom ash hopper would have two outlets fitted with hydraulically operated feed gates. Scraper feeder common to both the outlets would be provided below bottom ash hopper. Ash discharged in the scraper feeder would be conveyed to the single / double roll heavy duty clinker grinder to reduce the size to (-) 25 mm. Crushed ash clinker would be conveyed to bottom ash silo through series of belt conveyors.

Fly ash handling system

The fly ash collected at various hoppers would be gravity fed into individual transmitter vessels provided below each hopper. On initiation of fly ash removal cycle, fly ash would be fed into the transmitter vessel for pre-determined time after which the inlet valve would close. The compressed air would then be allowed to flow into the transmitter vessel by opening the air inlet valve. Once the desired conveying pressure is reached inside the vessel, the fly ash would be conveyed to the silo with the help of compressed air through transport piping. The conveying air would be vented through the bag filter mounted on top of the silo in order to limit the dust concentration in the vented air below 100 mg/m^3.

Disposal of Bottom Ash from Bottom Ash Silo

Bottom ash generated from various units would be conveyed to one bottom ash silo through a series of belt conveyors. Silo would be sized to store 24 hours bottom ash generated from all the units. The bottom ash collected in the silo would be disposed off in dry form by trucks. Bottom ash being in lump form is not expected to cause pollution after disposing in to the disposal area.

Disposal of fly ash from fly ash silo

Dry fly ash from various hoppers would be collected and conveyed to the fly ash silo. The fly ash silos for each of unit would be designed to have capacity to store fly ash generated during 24 hours operation. The fly ash collected in the fly ash silo would be unloaded into the trucks or into the railway wagons after conditioning if required for utilisation or conveyed in wet form to ash slurry sump using associated set of wetting units, jet pumps and piping. The fly ash slurry in the sump would be conveyed to the ash disposal area using ash slurry pumps and pipelines. Two series of slurry pumps (One operating + One Standby) are proposed for disposal of the ash slurry.

Air Pollution Control

Dust control during coal handling

The following measures are recommended to control air pollution during coal handling:

- The conveyors would be provided with completely enclosed galleries with GI sheeting on sides.
- Seal plates will be provided on the bottom run off these galleries at road crossing, plant area and in areas where these conveyors cross buildings to present coal for from falling down the conveyor gallery.
- Ring granulation type crushers would be provided to reduce coal from 50 mm size to 25 mm size. The crusher house would be made of structural steel and shall have RCC floors. Sides and roofs will be covered with GI sheets. A partition wall would be provided in the crusher house in between the operating and the standby crusher to reduce the dust.
- The crusher house and junction towers would be provided with dry type dust extraction system with bag filters.
- Water will be sprayed around the stockpile to suppress the dust generated and to reduce the dust nuisance.
- Plain water type dust suppression system would also be provided at the locations whether the dry dust extraction system are proposed.

Dust control during fly ash handling

The following measures would be implemented to prevent entrainment of fugitive emissions during fly ash disposal:

- To reduce the dust nuisance while loading the ash into the trucks from fly ash silos, the fly ash is conditioned with water spray.
- It is proposed to cover the ash in the open trucks with tarpaulin to prevent flying of fine ash during transportation.
- Vegetation would be provided on the disposed ash to restrain flying of fine ash.
- The ash disposal area would be lined with impervious lining to prevent seepage of rain water from the disposal area in to the ground and pollute ground water.

Dust Particulate From Fly Ash in Flue Gas

As per the Pollution Control Board norms, the standard for particulate emission applicable to this project is 100 mg / Nm^3. The electrostatic precipitators (ESP) proposed for this project would be designed to limit the emission level of the particulate matter to this limit.

Sulphur Di-Oxide (SO_2) in Flue Gas

As per the norms of minimum stack height for 500 MW unit would be 275 metres. A single multi flue stack of 275 m would meet the norms for the power plant has been proposed for effective dispersal of sulphur di-oxide.

Nitrogen Oxides (NO_x) in Flue Gas

To reduce NO_x emissions, over-fire air system equipment with airports would be installed for the furnace. Further, the steam generators would be fitted with advanced low NO_x burners.

Control of fugitive dust from stock piles

The Dry Fog Dust Suppression System controls fine dust in the form of respirable and fugitive dust. The system utilizes water and air to create an ultra fine droplet sized fog that achieves dust suppression through agglomeration. No chemical is required and the water addition to the process is restricted to 0.1% by weight of material being handled. The Dry Fog Dust Suppression system controls virtually all types of respirable and larger airborne dust and mists. Momentum and coverage of the water spray is adjusted to optimize penetration and enshrouding of the dust, while droplet size and turbulence is adjusted to allow contact and removal of particulate with a minimum of water.

Other measures for control of pollution from stock piles

- The stackers can operate from a distance with brooms to keep the stack pile surface to a minimum. This reduces the area contributing to dust entrainment. The stackers can be provided with face masks to minimize their exposure to coal dust.
- All regularly used roadways around the site must be swept daily with a tank mounted road sweeper and washed by a trunk mounted cart.
- All transport shall be properly covered at the bottom and top with perfect sealing of plastic/tarpaulin sheets, so that no coal dust spills and spreads out during present operation.
- The coal stack yard should be covered with screens/walls. The screens should be made of a permanent brick wall of height of at least 7 to 8 m, covering the entire threes sides of coal stock yard.
- Regular cleaning of roads.
- Removal of the accumulated dust from roadsides.

Ways to avoid self ignition

- Cooling by ventilation or by water spraying to avoid increase of coal stack temperature.
- Storing the coal in smaller lots.
- Reducing access to air, i.e by storage in compressed piles (packing coal tightly by impacting by running dozer / loader compactor over stock pile) or storage in closely covered air tight enclosure.
- Reducing the fine powder content in coal.
- Getting coal which was mined at least 6 months back.
- The storage location shall be such that any external source of heat is to be avoided.
- Water hydrant points to be provided near to the pile. When fire is noticed in pile with small emanation of smoke, large volume of water shall be sprayed.

Compensatory Afforestation

The Indian Forest Conservation Act (1980) stipulates:

- If non-forest land is not available, compensatory afforestation are to be established on degraded forest lands, which must be twice the forest area affected or lost, and
- If non- forest land is available, compensatory forest are to be raised over an area equivalent to the forest area affected or lost.

The total forest loss in the land acquired for the project is 24.29 ha. It is proposed to afforest double the amount of forest land being acquired for the project. Thus, a total of 49 ha of land needs to be afforested. The afforestation work is to be done by Forest Department. The cost of afforestation is Rs. 2.94 million. The unit cost for afforestation has been taken as Rs.60,000/ha. In addition, project proponents shall pay cost towards NPV and cost of trees, which is to be decided by the Forest Department as a part of Forestry Clearance.

Rain water harvesting

There are two main techniques of rain water harvesting;

- Storage of rainwater on surface for future use.
- Recharge to ground water

In the proposed project, storage of rainwater on surface for future use is envisaged. It is one of the methods where rain water falling on the paved surface can be harvested and used directly either by directing in to a sump / tank for future use This can supplement the demand for fresh water. Since the rain water thus harvested (through a filter) is free from contamination, low in dissolved solid and fit for direct consumption.

Greenbelt Development

It is proposed to develop greenbelt around various project appurtenances, which will go a long way to achieve environmental protection and mitigation of pollution levels in the area. Taking into consideration the above parameters, the greenbelt development plan has been evolved for the proposed alternatives to reduce the pollution levels to the maximum possible extent. The maintenance of the plantation area will also be done by the project proponents. The cost of plantation per hectare is estimated at Rs.40,000. About 100 ha of land is proposed to be afforested as a part of Greenbelt Development Plan in either of the project alternatives. The total cost of afforestation works out to Rs..4.0 million.

Socio-economic Environment

The construction and commissioning of the power plant could lead to mushrooming of various allied activities, where largely local population would be involved. The development of various activities, would not improve the cash flow in the area, but would also provide an impetus to improvement in infrastructure at the local level. During project operation phase, local employment is not expected to be high, as power plant requires manpower with specific skill and expertise. However, for unskilled posts, local population needs to be given priority.

Fire protection system

An elaborate fire protection system covering all the buildings of the proposed power plant including coal stockyard would be provided. The water would be drawn from the desalinated water storage tank in which reserve capacity of 2000 cu.m would be provided.

The following fire protection systems are proposed:

- Hydrant system for plant area and foam system for HFO & LDO tanks.
- Automatic High velocity water spray (HVWS) system for the protection of transformer and manual HVWS system for the protection of turbine oil tanks.
- Automatic deluge (Medium velocity water spray) system for the protection of cable vaults and coal conveyors.

- Clean gas agents for the protection of control rooms.
- Portable fire extinguishers for different areas.

The system would be designed to conform to the Rules and Regulations of Fire Safety standards as per TAC.

6. DISASTER MANAGEMENT PLAN

As a part of the risk analysis study, a detailed Risk Analysis was conducted. Based on the finding s of the study, a Comprehensive Disaster Management Plan has been formulated.

7. RESETTLEMENT AND REHABILITATION PLAN

About 411.5239 ha of private land is proposed to be acquired for construction of the thermal power project. The land for the proposed thermal power project is envisaged to be acquired for 6 villages. However, private land is to be acquired for 5 villages. The details are given in Table-9.

TABLE-9
Villages in which private land is to be acquired

S.No.	Village Name	Private land to be acquired	Remarks
1.	Chithor Kadu	Yes	-
2.	Gangadevankuppan	Yes	-
3.	Kokkaranthangal	Yes	-
4.	Vedal	Yes	-
5.	Vilangadu	Yes	-
6.	Cheyyur (Town Panchayat)	No	Only government land is to be acquired

Based on the details of the khasras identified for land acquisition, the family details of the revenue records were corroborated to identify the persons/ families owning/ in procession of these land plots. A total of 549 PAFs would be affected due to the process of land acquisition and the village wise no. of PAFs are given in Table-10. No PAFS are likely to lose homestead.

TABLE 10
PAFs likely to be affected due to the process of land acquisition

S. No.	Village Name	Number of PAFs
1.	Chitharkadu	259
2.	Gangadevankuppam	130
3.	Kokkaranthangal	8
4.	Vedal	139
5.	Vilangadu	15
Total		**549**

Various measures outlined under Rehabiliation Plan is given as below:

- Each PAF shall get a one time financial assistance of Rs. 15,000/- per hectare towards land development.
- A provision of Rs. 10,000 per PAF has been earmarked for provision of financial assistance to PAFs towards loss of agricultural produce.
- In case affected families who have not been provided agricultural land or employment shall be entitled to a rehabilitation grant. A provision of Rs. 41.18 million (549 PAFs x 750 days x Rs. 100 MAW x 10^{-6}) is being kept for this purpose.

- It is proposed to offer scholarships to the children of the PAFs scholarships for continuing their education. Two scholarships per PAF is being suggested, for an amount of Rs. 500 per month per child, for a period of 2 years.
- For the purpose of providing necessary training facilities for development of entrepreneurship, technical and professional skills, it is suggested that project developer identify agencies/ institutions to impart such training facilities. It is suggested to offer this facility to one person from each of the PAFs. It is recommended that an amount of Rs. 1000 for a period of 6 months may be earmarked for providing this training facility.

8. AREA DRAINAGE STUDY

Based on the detailed Area Drainage study carried out, following conclusions are drawn.

- The project area which is Cheyyur has an average annual rainfall of 1263.5 mm.
- The historical 24 hr 25 year return period rainfall of 247 mm is taken as design rainfall. The design of drains would be carried out considering a peak rainfall intensity of 9.5 cm/hr with a recurrence period of 25 years.
- Rational method with regression method (Ryve's method) used for estimation of flood in present study. The value calculated by Rational formula is higher. Hence runoff values calculated from Rational formula should be taken for designing purpose.
- The internal drainage network needs to be connected to this network at key locations and finally by storm water drain shall be connected to Bay of Bengal.
- The area drainage system will provide diversion of storm water run off from the site. The formation levels of site are such that the storm water will be directed to the proper outfall. On site run off from the plant roofs, roads, parking areas, rail road beds, coal pile run off etc. will be directed to the waste water collection pond or settling pond. Run off from the coal and ash-handling areas will be collected and no discharge shall be appear out from it. Slope protection will be provided wherever required to protect earth slopes from storm water erosion.
- The wastewater collection pond will be designed to contain general site drainage, coal pile run off, neutralization pit flows, oil/ water separator flows, and reservoir water system flows.
- Based on the area drainage study and topographic study rainfall and drainage pattern, it is perceived that there is no serious threat of floods in the proposed project area due to rainfall.

9. ENVIRONMENTAL MONITORING PROGRAMME

Marine water & sediment quality

The chemical characteristics of marine water quality should be monitored once in three months and biological parameters once a year. Both surface and bottom waters should be sampled and analysed. Physio-chemical parameters in sediments could be monitored once in 3 months whereas biological parameters in sediments could be monitored once a year. The marine water and sediment sampling and analysis be conducted by an external agency. An amount of Rs. 0.8 million per year can be earmarked for this purpose.

Ground water quality

The ground water quality needs to be monitored at six locations in the study area. The frequency of monitoring should be once in three months. The analysis can be done by an external agency approved by Tamil Nadu Pollution Control Board. A total of 18 samples need to be monitored for which an amount of Rs. 0.11 million/year can be earmarked.

Surface Water Quality

The surface water quality needs to be monitored at six locations in the study area. The frequency of monitoring should be once in three months. The analysis can be done by an external agency approved by Tamil Nadu Pollution Control Board. A total of 18 samples need to be monitored for which an amount of Rs. 0.11 million/year can be earmarked.

Micro-meteorology

An essential part of air quality monitoring would be to establish a small automatic meteorological observation station to record daily continuous synoptic data. Arrangements for recording temperature, humidity, visibility, wind direction and speed, cloud cover, rainfall and meteorological phenomena like storms would be required to be established at the project site. An amount of Rs. 1.0 million can be earmarked for purchase of micro-meteorological instruments.

Stack Gas Emissions

The parameters to be monitored are SPM, RPM, CO, SO_2 and NOx. It is also proposed to monitor particulate emission using continuous particulate stack monitoring system. The stack monitoring data would be utilised to keep a continuous check on the performance of the ESP's. The monitoring can be conducted by Tamil Nadu Pollution Control Board. An amount of Rs. 1.0 million can be earmarked for purchase of continuous particulate stack monitoring system. An amount of Rs. 0.1 million/year has been earmarked for purchase of inventory for stack monitoring.

Ambient Air Quality

Ambient air quality monitoring will have to be conducted at four locations within the study area. Air quality could be monitored for three seasons in a year. The frequency of monitoring shall be twice a week for 24 hours for twelve consecutive weeks. The parameters to be monitored are SPM, RPM, SO_2 and NOx. The post-project ambient air quality monitoring work can be carried out by the project staff. A provision of Rs. 0.15 million has been earmarked for purchase of monitoring of ambient air quality instruments and equipment. The monitoring can be done inhouse. An amount of Rs. 0.1 million/year can be earmarked for purchase of inventory for ambient air quality monitoring.

Noise

Personnel involved in work on in-plant noise producing equipment are likely to be exposed to high level of noise. For such in-plant personnel, audiometric examination should be arranged at least once a year. The noise level should be monitored once in 3 months at major sources of noise. The post-project noise level monitoring will be carried out by the project staff and a noise meter shall be purchased. An amount of Rs. 0.1 million has been earmarked for purchase of noise meter.

Greenbelt Development

Sites of greenbelt development should be monitored once in 6 months to study the growth of various species and to identify the needs if any, such as for irrigation, fertilizer dosing, pesticides, etc.

10. COST ESTIMATES

10.1 Cost for implementing Environmental Management Plan

The total amount to be spent for implementation of Environmental Management Plan (EMP) is Rs. 81.0 million. The details are given in Table-11.

TABLE-11
Cost for Implementing Environmental Management Plan

S. No.	Item	Cost (Rs. million)
1.	Sanitation facilities in labour camp	2.00
2.	Solid waste management facilities in labour camps	2.00
3.	Cost estimate for LPG distribution	2.16
4.	Public health delivery system	2.56
5.	Compensatory Afforestation	2.94
6.	Greenbelt Development	4.00
7.	Resettlement and Rehabilitation Plan	63.75
8.	Purchase of equipment of stack monitoring	1.00
9.	Purchase of equipment of ambient air quality monitoring	0.10
10.	Purchase of noise meter	0.10
	Total	**80.61 Say Rs. 81 million**

10.2 Cost for implementing Environmental Monitoring Programme

The cost required for implementation of the Environmental Monitoring Programme is of the order of Rs.1.02 million/year. The details are given in Table-12.

TABLE-12
Cost for Implementing Environmental Monitoring Programme during operation phase

S. No.	Item	Cost (Rs. million/year)
1.	Marine Ecological monitoring	0.80
2	Ground Water quality monitoring	0.11
3	Surface Water quality monitoring	0.11
	Total	**1.02**