KAYAMKULAM CCPP
(400 MW)

EXECUTIVE SUMMARY
OF
ENVIRONMENTAL IMPACT ASSESSMENT

SEPTEMBER 1996

NATIONAL THERMAL POWER CORPORATION LTD
NEW DELHI
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INTRODUCTION:

The National Thermal Power Corporation (NTPC) proposes to construct and operate a Combined Cycle Power Plant (CCPP) of capacity 400 MW (nominal), near Kayamkulam in Alleppey District.

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK:

The principal Environmental Regulatory Agency in India is the Ministry of Environment & Forests (MOEF). MOEF formulates environmental policies and accords environmental clearance for the projects. MOEF have accorded environmental clearance for the combined cycle power plant proposed near Kayamkulam vide letter dtd. 4.1.95. The status of implementation of conditions stipulated by MOEF have been presented in Section 1.1(a) of the main EIA report. Earlier a proposal by NTPC for a 420 KW coal based power plant at the same location was also cleared environmentally by MOEF. No separate NOC is required from Kerala State Pollution Control Board (KSPCB) for the planned fuel unloading facilities at the Cheppad Railway Station. A letter has been issued by KSPCB in this regard.

REGIONAL DEVELOPMENT:

The state government has formulated the regional development plan and is under approval. The plan after approval will be submitted to Ministry of Environment and Forest shortly.

TRANSMISSION LINES:

The necessary transmission system for evacuation of power would be implemented by the Power Grid Corporation of India Limited (Power Grid). It has been decided by Power Grid to retain the transmission system earlier identified with the Kayamkulam Thermal Power Project i.e.,

i) Kayamkulam-Pallam 220 KV D/C 65 Kms.
ii) Kayamkulam-Edamon 220 KV D/C 55 Kms.
iii) Establishment of a 220 KV switchyard at Kayamkulam CCPP.
iv) Extension of 220 KV sub-stations at Pallam and Edamon of Kerala SEB.

Clearance from Central Electricity Authority (CEA) has been obtained for the proposed transmission system. It has also been confirmed by Power Grid that the proposal has the clearance of the Ministry of Environment & Forests.
As the switchyard would be located in the land in possession of NTPC adjacent to the main plant area, no land for this purpose is proposed to be acquired by Power Grid. For the transmission corridors, no land is proposed to be acquired and only right of way would be obtained. As far as extension of sub-stations is concerned, the same would be implemented where space is available for termination of transmission lines.

In view of the fact that no land acquisition is involved for the transmission lines, switchyard and substations, no resettlement or rehabilitation is envisaged. It has also been confirmed by Forest Authorities that the proposed transmission line does not pass through reserve forests.

PROJECT DESCRIPTION:

A) Site and Surrounding:

The proposed site is located on the fringe of the backwaters of Kayamkulam Lake/Kayal at latitude 9 14’N and longitude 76 26’E. Arabian sea is approximately 2 kms west and National Highway NH-47 is about 5 kms east of the proposed site. The nearest railway station is at approximately 10 kms from the site on the Kottayam Quilon section of the Southern Railways. The site is about 110 kms. from Trivandrum and 90 kms. from Cochin. Both Trivandrum and Cochin are linked with the National Air Network.

B) Infrastructure Facilities:

a) Township:

The township is located east of the plant on the western side of the National Highway NH-47 near Chingoli and Cheppad villages.

The township would have 213 quarters for O&M personnel and 77 quarters for CISF along with matching non-residential facilities. Already about 72 quarters have been constructed for the construction staff which would form a part of the permanent township. Facilities like potable water, sanitary, security, etc. will be provided in the labour colony.

b) Approach Road:

Approach road to the plant site from National Highway - 47 shall be constructed which will be a double lane road having a width of 7 m with 2.5 m wide shoulders.
c) Water Requirement and Desilting Basin:

Sweet water requirement for the plant would be met from Achankovil river, with a fall back from PIP canal system. This water would be drawn into a desilting basin (located at river end) by gravity. The desilting basin is proposed to be constructed in 6 acres of land. A reservoir is proposed to be constructed in 33 acres of land adjacent to the plant site. The land for the reservoir is already in possession of NTPC and no additional acquisition is required. A commitment for 3 supply of 3200 m/hr. of fresh water has been accorded by the State Govt. vide letter dated 30.1.89, whereas the requirement for the proposed CCPP is estimated to be only 1015 m/hr. The availability of water has been reconfirmed by State Govt. vide letter dtid. 6.1.1994.

Replacing the desilting basin by sand filters may not be advantageous in view of the following facts:

i) A certain minimum water quality is to be ensured for effective use of sand filters without choking. Generally clarified water limiting turbidity to 30 ppm is supplied to sand filters. In case raw water from the river source is directly treated through sand filters, there is every possibility of sand filters getting choked especially during the monsoon months when the turbidity of river water is expected to be quite high.

ii) There is no significant reduction in land requirements for the same. The land requirement for sand filters is estimated to be 2-6 acres depending on the type of sand filters.

It is proposed that a submerged weir will be constructed on the river to ensure minimum water depth for drawal of water. No overflow or submergence upstream of the water structure is envisaged for the proposed submerged type weir. It may be noted that no dam is proposed to be constructed to raise the water level upstream.

As per the information available, the anticipated minimum flow downstream of the weir would be of the order of 600,000 m3/day. About 2000 people depend upon the river water downstream with an average consumption of 75 litres only. The total requirement, therefore, would be 150 m3/day and hence there would be absolutely no impact on availability due to construction of weir.
The water supply for the project is envisaged from a single intake point on river Achenkovil. Commitment of water supply from state irrigation authorities is also for drawal from a single point on river Achenkovil. No separate water drawal arrangement from PIP canal system to plant is envisaged by NTPC. However, the state irrigation authorities have proposed to link the PIP canal system with Achenkovil river upstream of intake point on the river, to augment the water supplies in the event of water flow in Achenkovil river being inadequate to meet the commitments downstream.

As clarified earlier, augmentation from PIP canal system is supposed to be from surplus supplies after meeting the irrigation and domestic requirements.

C) Project Components:

The project facilities include:

a) Combined Cycle Power Generation Facility along with township.

b) Associated transmission system of the Power Grid Corporation of India Ltd. (PGIL)

c) Naphtha storage.

D) Fuel:

Naphtha has been considered as basic fuel. The estimated quantity of Naphtha for operating a 400 MW combined cycle power plant is 0.45 MMTA for 6000 hours of operation per year. As Naphtha at present is a decanalised item, no restriction is envisaged in directly importing the same. A confirmation on the availability of 0.6 MMTA of indigenous Naphtha is also available from two Indian fuel suppliers.

It is envisaged to have 4 number of floating roof storage tanks each 10000 m³ at the site and 2 numbers of floating roof tanks of 5000 m³ capacity each at Cheppad siding. A concrete dyke will be provided around the storage tanks to contain spills. The floor of the storage area will also be concreted to avoid any seepage in case of spills. Further, provision for inter tank transfer of fuel will also be made in the tank farm area. Fuel from the handling area near Cheppad will be transported to the site through buried pipelines. The construction of pipeline for transport of naphtha will be in compliance with OISD 141. Apart from wrapping and coating with coal tar enamel, cathodic protection will be provided to prevent corrosion. The pipeline will also be periodically hydrotested. Pressure drop across the
Pipeline will be indicator of any leakage. The pumping of fuel will be stopped and leakage will be promptly attended. Any spill from the pipeline due to minor leaks will get diffused in the soil. The fire fighting system including manually operated medium velocity water spray system along with foam system shall be provided for Naphtha storage tanks. Provision has also been made for firing natural gas as and when gas is available at a later date.

E) Fuel Transportation and Risk Assessment:

Naphtha is to be transported from BPCL storage terminal at Iruppanam near Cochin to storage facilities at Kayamkulam plant. A study was undertaken through M/s Engineers India Ltd, New Delhi to identify the most optimum mode of transportation considering both the techno-economic as well as environmental aspects. Various possible modes of fuel transport were considered. Based on detailed analysis, the following two options were considered for indepth study.

1. Rail option
2. Marine option

Rail Option:

The following three rail options have been considered:

Option-I: Direct by rail upto Haripad and therefore to Kayamkulam site.

Option-II: Unloading near Haripad station transit storage and transfer to Kayamkulam by pipeline.

Option-III: Unloading near Cheppad station transit storage and transfer to Kayamkulam by pipeline.

Marine Options:

The various alternate marine options considered are as follows:

a) Open-sea mooring of ships with submarine and on-shore pipeline. This alternative is further subdivided into two

1. Single point mooring
2. Multibuoy mooring
b) Jetty with pipeline running on approach trestle/road.

c) Jetty inside lagoon near plant site.

It emerged from the study that transportation from Cochin to Chepad by Rail and thereafter to site by pipeline is the most optimum option.

A study of Indian Rail transport practices indicate that transport by rail of hydrocarbon products of all classifications is common and the safety regulations adopted by Indian Railways ensure safe transport of such products.

The details of the study on mode of fuel transportation and risk analysis of the least cost option are covered in Section 2.9.1.1 of the main EIA report. The report of this study has been separately submitted to the Bank.

With a view to ensure international acceptable safety standards, the opinion of an independent international consultant namely M/s Arthur D Little (ADL) have been obtained.

The findings and recommendations of the review consultant are as follows:

FINDINGS

- The risks for loading operations at Irumpamam are negligible.

- The risks to the public living along the railway route from Irumpamam to Cheppad and along the pipeline route from Cheppad to Kayamkulam, are tolerable.

- The risks for unloading operator at Cheppad are intolerable, unless facilities are provided to safely shut off the outlet from a BTPN wagon in the event of unloading hose leak or rupture. It was therefore recommended that such facilities be provided.

- Storage at Cheppad and Kayamkulam fatality risks are minimal.

- Fatality risks are in the As Low As Reasonably Practicable (ALARP) region.
RECOMMENDATIONS

1. **Loading**
   
   No further risk reduction is required.

2. **Rail Transport**
   
   Safety management audits of the rail transport operation could be conducted to check that Indian railways operate naphtha rail transport using best current practices e.g. wagon and track maintenance to avoid derailments, signaling, maintenance and procedures to avoid collisions, etc.

3. **Unloading**
   
   Emergency shut off valve which can be activated in case of a hose rupture should be provided.

4. **Storage at Cheppad and Kayamkulam**
   
   Fatality risks are minimal but to reduce the risk of outages, ensure that:
   
   i) All tanks are fitted with a high level alarm and an independent high-high level alarm which shuts off the inlet feed to the tank.
   
   ii) Safety audits check that the high level alarm and high-high level alarm are not used in practice for normal operations, but are genuine alarms.

   The recommendations under 2,3,4 above will be implemented by NTPC/BPCL/INDIAN RAILWAYS.

5. **Pipeline**
   
   Fatality risks are in the As Low As Reasonably Practicable (ALARP) region and may be minimized by regular patrols of the pipeline (e.g. daily) to observe any signs of unauthorized activity, and very close supervision of any maintenance within the road/pipeline corridor.

   NTPC will also fence off the pipeline/road access corridor and will not permit any building or agricultural activity within it.

   The naphtha and sweet water pipeline will be laid along opposite sides of the roadway. All recommendations suggested by the review consultant will be implemented.
The need for absolute safety during transport and storage of naphtha is well recognised. The transportation, handling and storage of naphtha would be carried out in accordance with prevailing practices and relevant Indian laws.

F) The Power plant:

The total land required for plant, township and associated facilities like intake structure for water, water pipe corridor, fuel storage facility near the Chepad Station etc. is as follows:

a) Main Plant 100 Acres.
b) Township 60 Acres.
c) Labour Colony 6 Acres.
d) Resettlement Colony 20 Acres.
e) Green belt 40 Acres.
f) Approach road, sweet water corridor etc. 38 Acres.
g) Pump, desilting basin & intake structures. 6 Acres.
h) Main reservoir at plant site 33 Acres.
i) Fuel storage facility near Chepad station 10 Acres.

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Total 313.00 Acres.

An area of 180 acres required for the main plant, green belt and labour colony and reservoir earlier owned by the State Agricultural Department has now been taken over by NTPC. The balance 133 acres land is primarily private owned land out of which 80 acres is already in the possession of NTPC. About 53 acres required for water corridor, pump, desilting basin and water intake structures, approach road and fuel storage facility near Chepad Station is under acquisition.

PLANT FORMATION LEVEL

The proposed plant site is surrounded all round by the backwaters (known as kayals). A strip of land of about 500 m wide between the outer kayal and the Arabian sea, protects it from direct exposure to sea. The water level in the adjoining backwaters undergoes tidal variation and maximum and minimum water level as observed is stated to be RL (+) 0.81 m and RL (+) 0.05 m respectively.
The high water level of (+) 1.2m in 1991 was not because of storm or typhoon. It was due to delay in clearance of bar formation at the confluence of Kayal with sea approximately 10 kms. south of plant site which is done annually in a routine way. It is to be noted that for most part of the year, the Kayal waters are open to sea at the confluence. However, in summer months before the monsoon when inflows to the Kayal from upstream water bodies is low, generally a sand bar forms at the confluence point. In extreme conditions, as happened in 1991, the sand bar is normally cleared as a routine exercise by local state authorities at the onset of monsoon, so that the increased flows in Kayal during the monsoon can flow out into the sea. In case this sand bar clearance is delayed, as was stated to be the case in 1991, the Kayal water levels may rise. However, the possibility of Kayal water levels exceeding (+) 1.2 m is not anticipated, because if the Kayal water level rises and even before it reaches (+) 1.2 m, it tends to flood the adjoining land areas which are occupied by local people. The sand bar is, therefore, necessarily to be cleared as is done each year before it floods the occupied areas.

The existing ground level in the plant area varies from RL (-) 1.5 m to RL (-) 2.0 m. To protect the plant facilities against flooding from surrounding backwaters, plant area is proposed to be filled up to a formation level of RL (+) 2.0 m. The storm water drainage from the plant area is envisaged to be achieved by gravity through suitably sized open lined drains which will finally discharge into the adjoining outer Kayal. With proposed formation level of RL (+) 2.0 m and suitable drainage arrangements for rain water, plant site is protected against flooding.

Site levelling shall entirely be in the form of filling. Since no burrow areas are available in the vicinity of the plant site, which can meet the full requirement, the levelling is proposed to be achieved by dredging and hydraulic filling with bed material obtained from outer Kayal. Permission to dredge the bed of outer Kayal has been obtained from the State Authorities.

The dredged material will be directly pumped to the filling site. From the borelog investigation done in the outer kayal, it is seen that the soil in the bed of outer kayal adjoining plant area generally consists of very loose to loose, fine to medium sand up to a depth of 10 m and is quite suitable for dredging and hydraulic
filling. The pumped material which generally will contain 15-20% solids, will be allowed to get hydraulically compacted and the excess water will be drained back into the outer kayal. For containing the fill material at the filling site, earthen bunds all round the filling areas shall be made with earth burrowed within the filling site or with dredged material. The bunds shall be made in stages as per the requirement as the filling progresses. Necessary drainage arrangements like temporary weirs shall be provided to drain out the excess water.

The available draft in the outer kayal is about 1.5 m only. Accordingly, it is proposed that portable cutter suction dredger(s) which will pump the dredged material with approx. 80:20 water sediment ratio shall be deployed for the dredging. Total sediments required to fill the plant area is estimated to be 1.8 million cu.m. and it is proposed to be completed within a period of 12 months. Suitable floating pipeline shall be used for transport of dredged material across the water.

Dredging shall be restricted to a depth of 7 m leaving a clear width of 75 m on the sides of the kayal for ensuring the stability of structures on the banks of the kayal, as per the requirements of state authority.

The dredging is generally undertaken to a slope of IV:5H to IV:6H which itself is a stable slope for the sandy bed material of kayal and will ensure stability of bank in the dredged portion. In view of above and dredging being restricted to a maximum depth of 7.0 m only no potential threat to the stability of the land strip between the kayal and the sea is envisaged. However, to assess the impact of dredging of the kayal on the prevailing hydrostatic conditions in kayal and suggest possible measures, a study has been undertaken by National Institute of Hydrology, Roorkee, India, a premier National Institute in the field of research in hydrology, at the behest of NTPC. The scope of study specifically covers the study of hydrostatic pressure distribution for stability of land strip between kayal and the sea. The study has since been completed. The major findings are presented in Section 2.3.3 of the main EIA report.

It is envisaged to dredge only a length of about 1700m of the kayal bordering the proposed project site to extract the required filling material. The pumped material containing 15-20% solids will be allowed to get hydraulically compacted and the excess water will be drained back into the outer kayal. An environmental management plan for dredging has been incorporated in the main EIA report.
BASELINE ENVIRONMENTAL CONDITION:

a) The study area for Environmental Impact Assessment (EIA) covers an area of 10 km. radius around the project site covering four (4) districts. The baseline environmental status in the salient disciplines is presented in Table I.

i) Land Use: Sixty percent of the land in the study area is categorized as unirrigated land whereas the balance forty percent is irrigated land. Acquisition of forest land is not involved.

ii) Demography and Socio-economics: The study area has a high density of population and has been experiencing a higher growth rate compared to the average growth rate of Alleppey district. The economy of the area is predominantly agricultural. Although about 84% of the area is under cultivation, workers in agricultural activity comprise about 44% of the workforce. The scope of bringing more land under agriculture is limited.

Also, the high levels of outward migration from the region owing to economic reasons is a sharp pointer to the paucity of employment opportunities.

The average family size is found to be 4.92 persons. There are 1061 females per 1000 males.

Fishing is an important occupation in the coastal belt. A characteristic of the occupational pattern in the region is the prevalence of seasonal unemployment especially in agriculture and fishing due to dependence on seasonality in cropping and fish breeding.

iii) Meteorology and Air Quality: The area experiences a typical tropical monsoon climate.

A 24 hours sampling programme with a 8 hours cycle to establish the ambient levels of pollutants in ambient air was undertaken using high volume samplers. Sampling frequency was twice a month for one year at three sampling locations for SPM, SO2 and NOx. The maximum level of pollutants observed in the study area given at Table - I.

iv) Hydrology & Water Quality:

Ground Water: The major abstraction of ground water is through deep tubewell tapping the workkalai formation although shallow ground water is also harvested to a limited extent through dug wells and hand pumps.
<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th>MAIN PROBLEMS</th>
<th>PROBABLE SOURCES</th>
<th>MAXIMUM LEVEL OBSERVED DURING THE STUDY</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality</td>
<td>NOx</td>
<td>Emission from vehicular traffic</td>
<td>79.65 µg/m³</td>
<td>120 µg/m³ (Indian standard)</td>
</tr>
<tr>
<td></td>
<td>SPM</td>
<td>Agricultural activity</td>
<td>88.12 µg/m³</td>
<td>500 µg/m³ (Indian standard)</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Fecal contamination of Achankovil river</td>
<td>Human settlement along the canal</td>
<td>18000 MPN/100 ml</td>
<td>No standard for agricultural water.</td>
</tr>
<tr>
<td></td>
<td>Cynide in river water</td>
<td>Source cannot be identified.</td>
<td>MIL</td>
<td>0.05 mg/l</td>
</tr>
<tr>
<td></td>
<td>Mineral oil in river water</td>
<td>Source cannot be identified.</td>
<td>1.6 mg/l</td>
<td>0.01 mg/l</td>
</tr>
<tr>
<td></td>
<td>Phenolic compounds in river water</td>
<td>Source cannot be identified.</td>
<td>MIL</td>
<td>Max. 0.002 mg/l</td>
</tr>
</tbody>
</table>

- 8 hourly monitored value converted to 24 hourly average by a factor 0.72.
The total ground water resources have been estimated as 864.25 mcm.

**Kaval Water:** The kaval has an approximate surface area of 14 Sq.km. and the average depth varies from 1m in summer to about 3 to 5m in monsoon. The back water quality varies greatly with fresh water inflow. Since the Kayal is connected to both rivers and the sea, the salinity distribution varies widely. The use is presently confined to navigation and fishing.

No ground water or Kayal water is proposed to be drawn for the plant operation.

**Surface Water:** The Pamba is the main river controlling the drainage of the area. Achankovil river joins the Pamba from the south in the western part of Kerala. The mean annual run off at Erapuzha gauging station on Pamba is 3892.5 mcm (1970-86), while the same for Kollakadavu gauging station on Achankovil river is 1735.0 mcm. The water for plant use is proposed to be drawn from the Achankovil river.

**v) Terrestrial Ecology:**

The tropical conditions in Kerala support luxurious vegetation with a diversity of species. Changes in the vegetation stem mainly from conversion into agricultural land or due to monoculture practices. The main vegetation of the area is in the form of plantation. Paddy is the most important field crop. Next to paddy is Tapioca. The other crops grown are pepper, coconut and cardamum. Higher proportions of the area surveyed are under cultivation of commercial plantation (43.35%), followed by food crop (33.5%). The important commercial field crops are spices (12.5%). No ecologically sensitive areas or forest exist in the study area.

**vi) Aquatic Ecology:**

The area has three interconnected major water bodies. These are fresh water, the brackish water and marine. Consequently, the eco-systems together exhibit a high level of diversity.

Within the study area, Kayamkulam Kayal, the rivers Pamba and Achankovil are of importance in addition to coastal waters.

The distribution of micro and macro flora and fauna in the Kayal closely follows the pattern of salin-
ity gradient. The monsoon influx is associated with a predominance of fresh water forms whereas the dry season shows a conspicuous dominance of the salt water varieties. The distribution of species within the Kayal at a given time shows strong affinity to the salinity gradient. The Kayal harbours a variety of fish and prawn such as Mugil cephalus, Hemiramphus limbatus, Glossogobius giuris, Caridinia propinqua. The benthic fauna in the backwaters consists of ilogochaetes, polychalites, bivalves and crustacean. The main fauna found in the Achankovil river are corps, murrel, catfishes, prawns and molluscs. The aquatic ecosystem of the adjoining coast is highly productive.

REHABILITATION AND RESETTLEMENT:

The land for plant and township have already been acquired. The land required (53 acres) for raw water reservoir, pipeline corridor, approach road and fuel storage facility is under acquisition.

Socio-Economic Survey:

A socio-economic survey for the project affected families due to land acquisition for the earlier proposed coal based power plant at Kayamkulam was undertaken through Loyala College of Social Sciences, Trivandrum in 1990.

Complementary Socio-Economic Survey:

In view of the reduction in the requirement of land, the time gap between the completion of the Demographic and Socio-economic studies by Loyala College of Social Sciences, Trivandrum and the implementation of RAP, and also due to the fact that the NTPCs R&R Policy had undergone a major change, a complementary Socio-economic study has been undertaken through Loyala College of Social Sciences, Trivandrum in January 1995. The study has since been completed.

Rehabilitation Action plan:

The RAP for the project affected people is presented below:
BUDGET SUMMARY AND EMPLOYMENT

<table>
<thead>
<tr>
<th>Scheme</th>
<th>No. of person covered</th>
<th>Total cost of scheme (Rs. in lakhs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut farming</td>
<td>50</td>
<td>60.00</td>
</tr>
<tr>
<td>Fish farming</td>
<td>500</td>
<td>70.00</td>
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<tr>
<td>Coir</td>
<td>400</td>
<td>720.00</td>
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<td>Labour Cooperative</td>
<td>500</td>
<td>79.00</td>
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<tr>
<td>Shrimp feed</td>
<td>300</td>
<td>33.00</td>
</tr>
<tr>
<td>Poultry Farm</td>
<td>100</td>
<td>30.00</td>
</tr>
<tr>
<td>Dairy Farm</td>
<td>100</td>
<td>26.00</td>
</tr>
<tr>
<td>Self employment</td>
<td>300</td>
<td>45.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2250</strong></td>
<td><strong>1063.00</strong></td>
</tr>
</tbody>
</table>

A comprehensive document on the RAP has been separately submitted to the bank.

Public Awareness on the Proposed Project:

During the complementary study presently in progress, the views of the people regarding the Kayamkulam CCPP were ascertained. Of the families surveyed 93.5% opined that the Kayamkulam CCPP is the need of State since Kerala is industrially backward. Other reasons were that the availability of power will create job opportunities, which in turn will reduce unemployment problem in general and educated unemployment problem in particular. Among those who are unfavourably disposed, include 4.62 per cent of families who are concerned about the delay in executing the project and acquisition of private cultivable land for the project. The balance 1.78 per cent were neutral.

Regarding land already acquired for the project, 91.81 per cent of the respondents opined that the land acquired is in order as any developmental work need such facilities, and they are willing to cooperate with the Govt. in that aspect. But 8.18 per cent members were against the acquisition of their land because their main source of income was from the land acquired and the compensation was not sufficient and the land acquired by NTPC has not yet utilised and the place look almost deserted which was prime cultivable land earlier.

Regarding land under acquisition, 50.17 per cent of the families felt that for the development of the State and for the well being, some sacrifices have to
be made, 12.45 per cent of the families felt that though the place is one of the good sites, their land was not an urgent requirement for the project. The objection of these people were mainly on the ground that there is a time lag in executing the project.

Public Consultation:

No effort was spared in involving the whole community in reaching a reasonable level of understanding on the need for land acquisition and also a degree of understanding in the resettlement & rehabilitation measure to be adopted. Community level discussions were held number of times to dissipate maximum information to the host population about the project and its requirement. An elaborate Public Consultation involving majority of the land owners giving land to NTPC and the retrenched Kayal farm labourers were held during the Socio-Economic and Demographic Survey. The recording of the same is available at site.

The trouble free land acquisition and the agitation by the local population for the early implementation of the project itself is a clear indication of the acceptance of the project by the community.

On the clearance of the project for implementation by Govt. of India, a truly representative Village Development Advisory Committee (VDAC) has been formed. The members were selected first by short listing names from the land and homestead oustees. Their names were discussed among a cross section of PAPs for their acceptance among them and to know about the Social standing of these persons in the respective communities. From their names, few were deleted and again went through the above process for finalising the names. These persons are acceptable to the PAPs. To these names, representatives of bodies representing traditional fishermen and Kayal farm labourers are also included. The representative body of Kayal farm is having the written acceptance of 806 labourers out of the 827 retrenched by the State Govt. The representative of Traditional fishermen have the acceptability of all the traditional fishermen staying in and around the plant site. The draft RAP, has been discussed in the VDAC and their acceptance is there for the RAP. During the course of implementation of RAP, the suggestions still emerging in the VDAC will be included for implementation. The RAP will be implemented through the VDAC and to its full satisfaction. The general acceptance of RAP by VDAC could be obtained during the meeting of VDAC on 14th and 17th October, 1995. The Chair Person of VDAC is Dy.Collector, Alappuzha District and is a person who can assist/direct the VDAC in successful implementation of the RAP.
Public Consultation process was initiated along with commence of after the Land acquisition activities at the site, through meetings with interested groups, individuals, etc.

All decision affecting the PAPs and the population in the neighbourhood of the project are taken only by consultative mechanisms. For instance:

a) the dispute of communication facility to traditional fishermen was resolved in 1990, by mutual discussions along with representatives of Govt. of Kerala, in the presence of Hon'ble Ministers of Govt. of Kerala.

b) recently when the approach road to the plant site was to be formed, the road had to cross the water route used by the traditional fishermen. The details of the crossing were finalised by the tripartite consultative committee chaired by the District Collector on 29.4.95.

c) any issues raised by any group or individual is discussed in PIC (Public Information Centre) and whenever detailed discussions are specifically required, the same is carried out until the matter is resolved finally. A meeting was held on 25.8.1995 with representatives of Traditional Fishermen at the office of R&R Cell on a charter of demands raised by them for which they had announced an action plan of agitation. By this process of discussion, we could convince them to call of the agitation programme based on the decision taken in the first VDAC meeting on 14th October, 1995.

As mentioned earlier, a register has been maintained in the public information center. The residents in the area have been regularly recording their views recorded in this register. Some of the salient views recorded in the register highlighted in Section 1.3.11.3 of the main EIA report.

A copy of the extracts of register wherein the above comments have been recorded is enclosed as Annexure - 1.3.11.3 of the EIA Report.
SECTION 29 NOTIFICATION

Notification under Section 29 of the Electricity (Supply) Act as is required under the law in the country has already been issued in the Official State Gazette. Several local newspapers in January, 1995 informing on the intent of implementing the project at the proposed location.

Public Information Centre

A Public Information Centre has already been established. Further, the EIA report and Executive Summary have been made available for information to the public. For details please refer section 1.3.9 of the main EIA report.

It is further interesting to note that an opinion survey has been conducted by Malayalam Manorama, a local newspaper in July, 1993 to assess the views of the population of the State as to which development projects in their opinion should be implemented on priority in Kerala. The survey indicated that about 81.5% of the respondents favoured the implementation of the Kayakulam Power Project.

A circular intimating the people in the surrounding area on the availability of the EIA report and the ES for information of the public has already been issued both in English and local languages in February, 1995. Any clarifications sought by the people are promptly furnished so that they are satisfied on the environmental issues related to this project.

Monitoring & Evaluation:

Monitoring & evaluation has been established as a permanent, continuous responsibility. Monitoring will be done by the R&R Unit established in the Kayamkulam project. Evaluation will also be carried out by Corporate R&R Group on annual basis till the measures provided in the plan are implemented. Head of the project will take a monthly review on the progress of the R&R plan.

To ensure proper implementation of RAP Quarterly review meeting are be held at the Regional Executive Director level.

IMPACTS AND MITIGATORY MEASURES:

Impacts and mitigatory measures and waste management scheme are presented in Table II and III, respectively.
TABLE - II

IMPACTS AND MITIGATION

<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th>POTENTIAL NEGATIVE IMPACTS</th>
<th>PROBABLE SOURCE</th>
<th>MITIGATIVE MEASURES</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTRUCTION IMPACT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Quality</td>
<td>Increase in suspended solids due to soil run off during heavy precipitation.</td>
<td>Soil Erosion.</td>
<td>Temporary sedimentation Tank.</td>
<td></td>
</tr>
<tr>
<td>Air Quality</td>
<td>Increase in dust concentration.</td>
<td>Heavy vehicular movement.</td>
<td>Regular sprinkling of water in the construction area.</td>
<td>The impact will be low as the main approach road is tarred.</td>
</tr>
<tr>
<td>Sediment</td>
<td>-</td>
<td>Dredging of the Koyal.</td>
<td>) No significant impact.</td>
<td>)</td>
</tr>
<tr>
<td>Aquatic Life</td>
<td>-</td>
<td>Dredging of the Koyal.</td>
<td>)</td>
<td>)</td>
</tr>
<tr>
<td>Noise</td>
<td>Higher noise level.</td>
<td>Construction equipments.</td>
<td>Equipments will be kept in good condition to keep the noise level within 90 dBA.</td>
<td>Workers will be provided necessary protective equipment e.g. ear plug, ear-muffs.</td>
</tr>
<tr>
<td>Socio-economics</td>
<td>Population displacement.</td>
<td>Land Acquisition.</td>
<td>Proper A/R measures.</td>
<td>Refer Section 1.1.4 of the report.</td>
</tr>
<tr>
<td>OPERATION IMPACT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Quality</td>
<td>Deterioration of water quality of surface water.</td>
<td>Discharge of Main Plant, Cooling Tower, Water Treatment Plant waste, boiler blow down and Township Effluents.</td>
<td>Adequate treatment facilities like neutralisation pit, settling ponds, biological treatment system etc. will be</td>
<td>All effluents after accord treatment will be led to a central monitoring basin and finally discharge into the Koyal. Analysis</td>
</tr>
</tbody>
</table>
provided so that the treated effluents conform to the regulatory standards.

of all relevant parameters on heavy metals in the effluent is included in the monitoring programme. STP effluents will be disinfected, if required.

Condenser Cooling Water Discharge.

A closed cycle cooling system with cooling towers is proposed with blowdown from the cold side.

No temp. increase in discharge hence no impact on aquatic life anticipated.

Coliform contamination of ground water in shallow aquifers.

Human settlements.

Adequate drainage and sanitation system in township and treatment for sanitary effluent shall be provided.

Coliform contamination of ground water in shallow aquifers.

Air Quality. Increase in NOx levels in ambient air.

Power Plant.

Gas turbines would be designed to keep the NOx emission level to 100 ppm. A 70 m stack would be provided to ensure wider dispersal of pollutants.

Low NOx burners or steam/water injection will be used depending on the vendor chosen for the main plant.

Maximum short term Ground Level Concentration (GLC) of NOx and SOx due to operation of CPP would be of the order of 10 ug/m3 and 3 ug/m3 respectively.
Superimposing the maximum background levels the total NOx and SOx levels in ambient air due to operation of ECCP will be about 89 ug/m³ and 26ug/m³ respectively which are well below the stipulated norms of 120 ug/m³.

Increased SPM in ambient air. Vehicular traffic. All motorable roads in the plant area will be paved to reduce dust emission.

Afforestation programmes will be undertaken around the Plant and Township Areas.

Ecology:

a) Terrestrial

Impact on plant specifications. Emissions from stack. Emission will be controlled through appropriate design. As emissions will be within limits, no active injury to the vegetation is expected.

b) Aquatic

Impact on kayal. Waste water from CMB. All the waste water will be provided adequate treatment. As all the effluents will be treated to conform to prescribed limits, no significant impact on aquatic life of kayal is expected.

Noise

Increase in noise levels in the area. Equipment in main plant and auxiliaries. Equipment are being designed to conform to noise levels prescribed by regulatory agencies.

 Provision of green belt and plantation would further help in reducing noise.
### Demography & Socio-economics

<p>| Strain on existing amenities like housing, water sources and sanitation, medical and infrastructure facilities. | Influx of people - NTPC's employees as well as contractor's employees/labourers. | NTPC proposes to built its own township equipped with all infrastructural facilities for its employees. Population in surrounding area will also be benefitted from some of these facilities like shopping complex, medical camps, etc. |</p>
<table>
<thead>
<tr>
<th>S.NO.</th>
<th>WASTE</th>
<th>SOURCE</th>
<th>ANNUAL QUANTITY</th>
<th>ANALYSIS</th>
<th>TREATMENT AND DISPOSAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Plant drains</td>
<td>Main plant area</td>
<td>265 m³/hr</td>
<td>Oil/grease/TSS</td>
<td>Oil separation and treatment to less than 10 ppm. Oily sludge to be sold for recycling.</td>
</tr>
<tr>
<td>2.</td>
<td>Cooling tower blowdown</td>
<td>Cooling tower</td>
<td>240 m³/hr</td>
<td>Dissolved solids and chlorine.</td>
<td>C12 will be monitored to control excess chlorine.</td>
</tr>
<tr>
<td>3.</td>
<td>DM Plant regeneration waste, filter backwash and clarifier sludge</td>
<td>Water treatment plant</td>
<td>65 m³/hr</td>
<td>Dissolved solids and pH variation</td>
<td>pH adjustment for regeneration waste and backwash sludge to be dried and disposed in an environmentally secure landfill.</td>
</tr>
<tr>
<td>4.</td>
<td>Boiler blowdown</td>
<td>Boiler</td>
<td>50 m³/hr</td>
<td>Alkalinity</td>
<td>Dilution</td>
</tr>
<tr>
<td>5.</td>
<td>Plant/township sewage</td>
<td>Township</td>
<td>50 m³/hr</td>
<td>BOD, suspended solids</td>
<td>Biological treatment sludge to be dried and provided to farmers for fertilizer or disposed in an environmentally secure sanitary landfill.</td>
</tr>
<tr>
<td>6.</td>
<td>Township/domestic solid waste</td>
<td>Township</td>
<td>91.05 ton/yr</td>
<td>Characteristic of solid waste</td>
<td>To be disposed in an environmentally secure sanitary landfill.</td>
</tr>
</tbody>
</table>
Environmental parameter of concern:

a) Impact on Kayal aquatic life due to dredging: The impact of dredging on Kayal aquatic life would be marginal. State Irrigation Department has clarified that State Govt. have taken into consideration the environmental aspect also while permitting NTPC to undertake the dredging operation.

A study was also undertaken through Department of Aquatic Biology and Fisheries, University of Kerala, to assess the aquatic (biology) of the Kayal. The study also covered the possible adverse impacts due to dredging on the aquatic eco-system of the Kayal. The findings of the study indicate that:

"The dredging activity is stated to be a one time activity covering largely, the area of the Kayal adjacent to the proposed plant. If this is so, the impact would be minimal. Flood waters of the Pamba and the Achankovil rivers joining the Kayal at its northern extremity through a net work of canals would be depositing huge quantities of land borne sediments in the dredged area and would replenish the sediment extracted from the basin.

The fauna of the Kayal sediments would be destroyed in the area proposed to be dredged. The lifecycle of benthic organisms would be able to resettle in the dredged basin once the dredging activity is over."

The report has suggested the following:

1. The area proposed for dredging may be limited to a maximum length of 6 kms. covering areas adjacent to the project site. NTPC proposes to dredge a length of only 1.7 km.

2. The dredging should be completed within the shortest time possible. NTPC expects to complete this operation in a year’s time.

3. All measures may be taken to ensure the stability of the land strip between the sea and the Kayal.

b) Impact on Kayal aquatic life due to hot water discharge: A closed cycle system with cooling towers is proposed for CCPP and blow down from cold side will be discharged. Therefore, no impact on aquatic eco-system is envisaged due to hot water discharge from CCPP.
c) Impact of emissions on coconut trees: The levels of NOx and SOx in ambient air after operation of CCPP are expected to be within the levels stipulated by regulatory agencies and hence no active injury to the vegetation is expected.

d) Compliance to Coastal Regulation Zone: Ministry of Environment & Forests in the environmental clearance for coal based thermal power project have stipulated that a minimum of 100 m of distance must be left on the front side from the Kayal and on the remaining three sides, the distance equivalent to the width of the Kayal should also be left as per the provisions of the Coastal Regulation Zone. The area so left all around the Kayal should not be used for any other purposes except for raising green belt*. Filling operation in CRZ zones is not prohibited. This will be complied with.

SITE SELECTION:

The site for the power station was selected by the Kerala State Electricity Board (KSEB) from seven alternatives considered by them. Kerala State is densely populated and Government land free from habitation is extremely scarce. The present site offers a distinct advantage that the entire area for the power plant is Govt. owned land involving no displacement of persons. Some private land is, however, required for the township and corridors for approach road and sweet water transportation. Assured availability of sweet water in the nearby vicinity makes this site the ideal choice from all considerations and was, therefore, finally selected for putting up the power project.

ANALYSIS OF ALTERNATIVES:

i) Site Alternatives:

Following alternative sites were considered:

a) Brahmapuram Site: This site is near Ambalamugal in Ernakulam District. It was not pursued because of environmental constraints in the area.

b) Allepey Jetty Site: The site is located at a distance of 3 kms. from the proposed railway station. It was rejected as the area is densely populated and would pose problems of major displacement of persons.

c) Karinugapally Site: The site is located at a distance of approx. 15 kms. from Karunagapally Railway
Station. It was found to be densely populated and hence not pursued.

d) **Site near proposed fishing harbour at Kayamkulam:** The site is approx. 12 kms. from Kayamkulam Railway Station and involves major displacement of families as well as uncertainty regarding availability of land. The site was, therefore, not considered.

e) **Nilambur site near Manjeri:** The site is located at a distance of approx. 12 kms. from Nilambur Railway Station. The land belongs to private cultivators and could involve major displacement of persons.

f) **Malampuza near Palghat:** The site is located at a distance of approx. 3 kms. from Kanjivode Railway Station. It was rejected as no water was available for the plant and colony requirements.

g) **Kayamkulam site in Kaval Reclaimed area (selected site):** This site is located at a distance of approx. 10 kms. from Kayamkulam Railway Station. The entire land for the main plant area is Govt. land which is readily available and involves no displacement of persons.

**Least Cost Options:**

In order to establish the economic viability of Kayamkulam CCPP, a least cost system study was conducted by CEA. The report has been submitted to the World Bank by NTPC. The study establishes that Kayamkulam CCPP fits in the Least cost system expansion programme in the Southern region.

**MONITORING PROGRAMME:**

In order to follow the evolution of critical parameters and to check or assess the efficiency of mitigative measures, a regular environmental monitoring programme is proposed. The proposed monitoring programme is presented in Table IV. The list of equipment needed for monitoring is presented in Table V.

**INSTITUTIONAL NEEDS:**

The NTPC has a full fledged Environmental Engineering Department, consisting of a number of qualified scientists and engineers from various disciplines. This department is the nodal agency to coordinate and provide
<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th>LOCATIONS</th>
<th>PARAMETERS</th>
<th>FREQUENCY</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Air Quality</td>
<td>Three (to be finalized in consultation with State Pollution Control Board)</td>
<td>SPM, NOx, SO2 &amp; RPM</td>
<td>24 hrs twice a week</td>
<td>In line with notification of CPCB</td>
</tr>
<tr>
<td>Stack emissions</td>
<td>Each unit</td>
<td>NOx</td>
<td>Continuous</td>
<td>Monthly</td>
</tr>
<tr>
<td>Main plant effluent</td>
<td></td>
<td>a) pH, Temperature, Conductivity, TDS, TSS, BOD, DO, Oil &amp; grease</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Heavy metals (Hg, Pb, Zn, As, Cu and Phenolic compounds)</td>
<td>Quarterly</td>
<td></td>
</tr>
<tr>
<td>Sanitary effluents</td>
<td></td>
<td>pH, TSS &amp; BOD</td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td>CT Blowdown</td>
<td></td>
<td>Cl2</td>
<td>Daily</td>
<td></td>
</tr>
<tr>
<td>Ambient water quality</td>
<td>At least two locations in the Kayal and one ground water well near township</td>
<td>a) pH, Temp., Coliform, Conductivity, TSS, TDS, BOD and DO, RPM.</td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td>Ecology of Kayal</td>
<td>Two locations</td>
<td>Phytoplankton, Zooplankton, Fishes</td>
<td>Once in two years</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Macroinvertibrates</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# TABLE V

LIST OF EQUIPMENTS FOR ENVIRONMENTAL MONITORING

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>DISCIPLINE</th>
<th>EQUIPMENT</th>
<th>PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>Air Quality (Ambient)</td>
<td>a) High volume sampler with impingers.</td>
<td>Monitor SO2, NOx, RPM and SPM in ambient air.</td>
</tr>
<tr>
<td>B)</td>
<td>Stack monitoring</td>
<td>a) Online monitoring instrument for NOx.</td>
<td>To monitor NOx emissions.</td>
</tr>
<tr>
<td>C)</td>
<td>Effluent and ambient water quality monitoring</td>
<td>a) pH meter</td>
<td>To measure pH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Conductivity meter</td>
<td>To measure conductivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Spectrophotometer (UV visible range) with accessories.</td>
<td>Chemical analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d) Atomic Absorption Spectrophotometer with cold vapour attachment, GET and accessories.</td>
<td>For analysis of metals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e) Ion selective electrodes</td>
<td>Analysis of specific anions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>f) Incubator</td>
<td>BOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>g) Laminar flow hood and autoclave, counter</td>
<td>Bacteriological analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>h) Total Organic carbon analyser</td>
<td>Organic matter in effluent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>i) Plankton and fishing nets, Microscope</td>
<td>For ecological monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>j) Supporting equipment: oven, muffle furnace, balances, thermometer, glassware, distillation unit, etc.</td>
<td>For gravimetric and volumetric analysis and general laboratory work.</td>
</tr>
</tbody>
</table>
necessary services on environmental issues during planning, construction and operation of the project. This group is responsible for preparation of Environmental Impact Assessment report, interaction with the environmental regulatory agencies, reviewing draft policy, notification, framing environmental policy and planning for NTPC projects. Further, an R&D group at the Corporate Centre has been created which is responsible for field work related to air quality, water quality, soil etc.

NTPC has also established Environmental Management Group at the corporate level and will establish environmental monitoring and management cell, with dedicated staff at Kayamkulam power plant site. NTPC has also established Environmental Management Group in Operations Division at Corporate Centre. This Group has constituted in September 1991 with basic objectives of:

a) Co-ordinate with Stations, Regions, Corporate Centre Engg. Division on all environmental matters.

b) To carry out trend analysis of pollution monitoring data and prepare exception reports.

c) Providing operational feedback to Engg. for carrying out necessary modifications in existing/future systems.

d) Providing corporate support to stations.

Environmental monitoring data will be submitted directly to the Corporate Environmental Management Group. The Corporate Environmental staff will conduct periodic environmental management and safety audits of the power plant.

A separate group under Director (Personnel) has been established at the Corporate Centre to implement the Rehabilitation and Resettlement (R&R) plan for people affected due to land acquisition. Separate groups at each project have also been established to address this matter and report to Head of Personnel. A R&R cell shall be established at the Kayamkulam site.

NTPC has a safety group at Corporate Centre to manage, develop and administer safety policies of NTPC. At the Kayamkulam project, a safety group with the requisite number of personnel would be instituted. The Safety Department of the project would provide routine training to the plant personnel to make them aware of safety needs. All personnel will be involved in train-
ing and drills. The Safety Department would also be responsible to conduct safety audits and analysis of data relating to safety and health.

SAFETY AND EMERGENCY PLAN:

The major areas in the project which could be potential hazard are main plant, fuel handling plant, switchyard etc. The hazards could be due to fire explosion, pipe bursting, release of gases/liquids, etc.

The project will be carefully designed and protected by sophisticated instrumentation controls and inter-locks, thus reducing the risk. Details of safety and emergency plan are presented in section 6.2 of the main EIA Report.