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Environmental and Social Soundness Assessment of 700 MW Thermal Power Plant

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ENVIRONMENTAL AND SOCIAL SOUNDNESS ASSESSMENT OF 700 MW THERMAL POWER PLANT

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ABSTRACT

An environmental and social soundness assessment was carried out for a 700 MW oil fired power plant to be located at Khalifa Point in Hub District, Baluchistan. Field survey was conducted to study the environmental and socio-cultural conditions of the area. Pollutant dispersion modelling was used to assess SO_2, NO_x and TSP concentrations resulting from plant operation. Thermal plume modelling was employed to evaluate the impact of hot water discharges from the plant on the marine environment. The impacts of the project on physical and human environment were considered and necessary mitigation measures recommended.

INTRODUCTION

To cope with the increasing energy needs of the nation, the Fauji Foundation of Pakistan proposed the establishment of a 350 MW oil fired power plant at Khalifa Point in Hub District of Baluchistan with the financial support of various international agencies. The plant will be upgraded to 700 MW capacity at a later stage. To this effect, an Environmental and Social Soundness Assessment (ESSA) was conducted during mid 1993 by M/s Engineering General Consultants, EGC, (Pvt) Ltd. Lahore in association with Environmental Technology Consultants (ETC) of U.K. and M/s HR Wallingford Ltd. U.K.

The ESSA study was conducted with the following objectives.

- To identify and evaluate the significant environmental and social impacts.
- To recommend appropriate mitigation measures.
- To propose monitoring plans to ensure compliance with national and the World Bank environmental quality standards.

The ESSA team completed the assessment in four months and consisted of 12 professionals with special inputs on physical resources, air, noise and water pollution control, socioeconomic aspects, agriculture and wild and marine life. The report was prepared in accordance with the format provided by the World Bank (1988). The report was later updated in 1996 in response to comments received from International Finance Corporation (IFC) and revised World Bank Standards.

PROJECT DESCRIPTION

The Fauji Electric Power Co. (FEPCO) plant in proposed to be situated over an area of 328 ha adjacent to HUBCO power plant, some 30 Km west of Karachi. The location of the plant is shown in Fig. 1. The site will accommodate the turbine generator building, fuel oil storage, boiler, stack, cooling

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water intake and outfall structures, switch yard and other facilities. The electricity produced will be sold to WAPDA.

The 700 MW plant manufactured by ANSALDO of Italy will consume 3700 tonnes per day of heavy full oil with a maximum sulphur content of 3.5% and supplied by PSO through a pipeline. A 200 m high stack will dissipate the flue gases from the steam generator. The guaranteed emissions of pollutants will conform to the World Bank guidelines (ANSALDO, 1993). Sea water, screened and chlorinated, will be used at a rate of 16.4 m^3/see in once through cooling system and drawn through an intake channel. The outfall channel will discharge the used cooling water back to the sea. A sea water desalination plant will be constructed at site to provide 960 m^3/day of water for use in plant operation. The power plant will be provided with separate drainage and sewerage systems and wastewater treatment facilities to avoid contamination of sea water.

Pre-construction activities would include widening of the Hub municipality road, on shore and off shore geotechnical investigations at the plant site and hydrographic survey and hydraulic investigations to select suitable sites for intake and outfall channels.

Structural work for the plant will be designed by NESPAK while construction will be undertaken by M/s ANSALDO-Gie of Italy on turn key basis. The plant will be completed within a period of 40 months with 1000 people as the peak force. Water requirements for construction phase are estimated to be 1000 m^3/day and will be provided by truck bowzers.

About 200 Pakistanis will be employed to operate the plant.

LEGISLATIVE AND REGULATORY CONSIDERATIONS

The FEPCO plant is being planned in an area which has no special restrictions imposed by the government and other agencies. The project will address and attain National Environmental Quality Standards, NEQS, (GOP, 1985), the World Bank guidelines and other standards applicable to the preservation of environmental quality, health and safety of the inhabitants and plant workers.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

The existing environment of the project area was studied through field visits, ambient air, noise and water quality monitoring and detailed socioeconomic survey.

The area is dominated by Gadani sand and unstable sand dunes. The land is generally flat except for a few ridges and partly used for agricultural purposes. The coast is open and dominated by waves. There are a number of sandy beaches and rocky shores. Two small, barren and uninhabited islands, named Churna and Kaio, are situated in the vicinity of the plant site. The project area falls in an active seismic region and thus calls for special considerations in structural design of the plant.

The 30 years meteorological data obtained from Pakistan Meteorological Department, Karachi was used in air pollution computer modelling for predicting the ground level impact of air borne pollutants from the plant.

Ambient air quality and noise measurements were carried out at four locations namely Khaifa point, coast guard post, Goth Abbas and Goth Ghulam Muhammad. The results of the samplings are shown in Table 1.

The SO_2 and NO_x levels indicate that the area is generally free from the influence of anthropogenic pollution sources. However, TSP concentrations are very high which are due to the arid nature of the area.

The Hub river is the only prominant surface water source in the area and was found inadequate to meet the FEPCO plant water requirements. Hub river water is chemically fit for drinking purposes and supplied to the communities through tankers. Small irrigation canals bring water from the Hub dam to scarcely meet the requirements of the area. The groundwater is brackish and used for irrigation, washing and bathining purposes.

The quality characteristics of the sea water at plant site are suitable for shellfish propagation and indicate that the open coast in undisturbed by any pollution. At present no industry except HUBCO power plant is situated near the proposed plant site. A ship breaking industry and some other industries are, however, located at Gadani, about 16 Km north of plant site.

The vegetation of the area is of thorn scrub type and forage grasses. With brackish water, many farms with fruit trees have been raised. The limited terrestrial wildlife includes lizards, snakes and hedge hogs. The river estuary supports edible oysters, migratory and off shore birds. Along the coast line some crab species are found and the area is not considered important for sea turtle nesting and egg laying.

Socioeconomic survey of the project area revealed a total population of 5800 in the nearby three main villages i.e. Goth Allana, Goth Abbas and Goth Ghulam. Houses are generally made from straw mats and tin sheets. The inhabitants are poor and lack the basic facilities of water, gas, electricity, education and health. Fishing is the predominant activity followed by farming and construction. Most villagers have some sort of livestock. The three villages are accessible by road. There are no historical and cultural sites in the vicinity of the project area.

The survey team interviewed a number of people in the villages regarding the proposed project. Most of the people favoured setting up the plant for better employment opportunities. Relevant agencies and organizations were also consulted for their response towards the establishment of the power plant. Their views were duly considered while recommending the mitigation measures in the report.

ENVIRONMENTAL IMPACTS OF THE PROJECT

Various impacts can be addressed separately with respect to construction and operation phases.

Impacts During Construction:

a) Topography and Soil

Approximately 16 ha of land at the plant site will be cleared and graded before erection of the plant. The excavation activities will give rise to fugitive dust. A spoil management and disposal programme will be required for safe handling of the surplus material.

b) Air Pollution

Dust emissions of short duration and localized nature may be caused due to excavated and construction material and from vehicular traffic. Measures may be adopted by the contractor to minimize dust pollution and if implemented the impact will be minimal.

c) Water Pollution

Careful planning of domestic and chemical wastewater disposal will be needed. On the other hand, accidental spills of petroleum and other chemicals may result in adverse impact of temporary nature on groundwater.

d) Drainage

The provision of an effective drainage system at the site will ensure that no significant adverse impacts are associated with the construction of the plant.

e) Land Use

Construction of the plant will change the landuse from no activity to industrial and commercial development, resulting in more beneficial use.

f) Solid Wastes

The construction phase will significantly increase the volume of solid wastes in the area and require disposal in a suitably engineered and properly managed landfill.

g) Noise

Construction work will result in significant but temporary increase in noise levels. However, it will not have any significant impact on the people living in nearby villages provided all reasonable noise control measures are adopted.

h) Vegetation, Ecology and Wildlife

Increased dust levels will have a minimal effect on vegetation as it is adapted to dusty and arid environment. The construction of inlet and outlet channels will result in some destruction of the

benthic fauna. The impact will, however, be insignificant due to relatively small section of the affected beach. A little wildlife at the plant site may be disturbed due to construction activities.

Impacts During Operation:

a) Topography and Soil

Nearby sand dunes, if not stabilized, will shift on to the site and might cause operational problems. Such an impact would be quite significant and thus concerted efforts for stabilization of the dunes are required.

b) Air Pollution

'SCREEN' model was used to predict the impact of the plant operation with a stack height of 200m on the ambient air quality of the area. The results of the modelling carried out for 700 MW capacity operation for SO_2, NO_2 and TSP are shown in Tables 2,3 and 4 respectively.

It was predicted that maximum average ground level SO_2 concentrations of 346 ug/M^3 will be achieved against the prescribed World Bank guideline value of 500 ug/M^3 (World Bank, 1988). Nevertheless SO_2 emissions will amount to 260 tonnes per day and thus would exceed the revised World Bank limit of 100 tonnes per day. It would therefore be necessary to install Flue Gas Desulphurization (FGD) unit to make the SO_2 emissions conform with the prescribed limits. Alternatively, the use of fuel with low sulphur content of 2% may be considered.

As indicated there is likely to be no significant impact with regard to NO_2 and TSP levels.

c) Water Pollution

A well planned sewerage and treatment facility in the form of activated sludge process will be provided for safe disposal of treated effluent into the sea. Oily waste from the plant will be treated separately to recover oil before disposal. This will be done in a pool where a skimmer will periodically remove the oil skin from the pool top.

d) Thermal Plume

Thermal plume modelling was conducted to predict the layouts and temperatures of the cooling water plume. The cooling water will receive a temperature rise of 6.5°C in cooling process. The sea surface water temperatures at the plant site vary between 19° to 31°C. The World Bank guidelines (1988) for the situation stipulate that the effluent temperature should not be more than 3°C higher than the ambient temperature of the receiving water.

The modelling study concluded that the plume from FEPCO plant will have an insignificant impact upon its intake. Similarly the plume will not affect the temperature at the HUBCO plant intake. A small portion of thermal plume will exceed World Bank guideline for thermal discharge. However, the impact being confined to a very small area is not considered to be significant on marine life.

e) Marine Pollution

During operation of the plant slight sedimentation may occur in the intake channel requiring periodic desludging. Chlorine will be used to prevent biofouling in the cooling water and result in a residual concentration of 0.2 mg/l. The impact of chlorine was assessed by processing the thermal plume modelling results. It was concluded that the levels of residual chlorine in excess of 10 ug/l would occur in a very small area around the out fall and as such will have insignificant impact on the mobile species.

f) Solid Wastes

Operation of the plant is envisaged to generate around two tonnes of solid wastes mostly in the form of oil ash and sludges. All of these if properly disposed through landfill will not pose any environmental hazard.

g) Noise

With all the appropriate mitigating.measures, the impact of noise on the nearby communities is envisaged to be negligible.

h) Vegetation, Ecology and Wildlife

Emission of SO_2 may have impacts on vegetation in the form of reduced yield. Nevertheless it is highly unlikely that the native vegetation will be subject to acute damage. As the area around intake channel is biologically unproductive, the water withdrawal operation will have minimum impact on aquatic population. Some adverse impacts on wildlife may be experienced due to accidental spills of hazardous materials. However, such impact are expected to be minimal.

SOCIAL AND INSTITUTIONAL CONSIDERATIONS

During construction phase, around 400 unskilled labourers are expected to be hired locally. The others will be brought in from outside. Labour requirements will result in a shift from fishing to other activists. Commercial activities in the area will get a boost. Some people may migrate to the area to strain the existing infrastructural facilities. Local people have a particular lifestyle and cultural values. The influx of outsiders may cause social problems and conflicts. On completion of the construction phase, the unskilled labourers will be jobless and may be subjected to sufferings.

A conservative estimate indicates a total influx of 450-600 people due to plant operation and secondary business. Some residential colonies may develop near the plant site. Fauji Foundation will need to draw the attention of the government departments for the improvement of the infrastructural facilities. FEPCO management will, however, be responsible for providing health care facilities to the staff and their families. FEPCO management would also need to initiate training programme to ensure the utilization of local people as labourers effectively bridging the social gap between locals and outsiders. In this context local contractors may be used for hiring workers for the plant.

A favourable change in the lifestyle of the local people is expected as a result of changes in the local economy. The proposed activity will lead to enhancement of community awareness, economic development and improvement in infrastructural facilities in the area. As a consequence land prices will increase.

The major economic benefit will come in the form of 700 MW of generated electricity to encourage industrial and agricultural growth. Some adverse impacts such as inflation in the prices of goods and services and a setback to fishing and agricultural industry may also be faced. It is anticipated, however, that the overall impact of the proposed activity will be positive and beneficial.

MITIGATING MEASURES

The plant design incorporates major mitigating measures necessary for thermal plant operation. The following additional measures were recommended:

- Creation of planted buffer strip around the plant site.
- Upgradation of approach roads to accommodate increased traffic.
- Stabilization of sand dunes.
- Adoption of adequate techniques to minimize noise and vibrations and control of spillage during construction.
- Development of a suitable landfill for solid waste disposal.
- Development of emergency response plans for handling accidental spillage of hazardous materials and cleaning oil spills.
- Launching of public awareness programme in the community.
- Establishment of a residential colony.
- Compliance of spill control plan as recommended by EGC to effectively deal with oil and chemical storage.

MONITORING

To undertake environmental monitoring programme, FEPCO will establish an Environmental Management Unit (EMU) at the power plant. EMU will monitor stack emissions (TSP, SO_2, NO_x) and ambient air quality and noise at sensitive locations, collect meteorological data from Gadani tower, undertake water quality monitoring and siltation measurements to formulate dredging schedule for intake and outfall channels. EMU will also monitor treated effluent quality to ensure compliance with NEQS and cooling water temperature and chlorine content to check compliance with the World Bank (1988) standards.

EMU will also publish annual environmental report.

CONCLUDING REMARKS

The project will cause no unwarranted losses of irreplaceable resources in the area and will bring economic benefit to the region. Provided that the recommended mitigation measures are implemented and the monitoring programme launched, there is no factor which would preclude the attainment of satisfactory environmental and social conditions in the area.

The ESSA report has been accepted by the EPA, Baluchistan.

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TABLE-1 CONCENTRATIONS OF SO_2 AT AND AROUND PROPOSED FEPCO SITE

Sampling Date	Site	Number of Hourly Observations	Concentrations (ppb) Max.	Min.	Mean
06-08 Nov.93	Khalifa Point	39	2	1	1.18
08-09 Nov.93	Coast Guard Post	22	2	1	1.36
09-10 Nov.93	Goath Abbas	22	2	1	1.45
10-11 Nov.93	Goth Ghulam Muhammad	25	2	2	1.32

TABLE 2: CONCENTRATIONS OF NO_X AT AND AROUND PROPOSED FEPCO STIE

Sampling Date	Site	Number of Hourly Observations	Concentrations (ppb) Max.	Min.	Mean
06-08 Nov.93	Khalifa Point	39	6	2	4.21
08-09 Nov.93	Coast Guard Post	22	8	4	5.82
09-10 Nov.93	Goth Abbas	22	8	4	6.23
10-11 Nov.93	Goth Ghulam Muhammad	33	8	4	5.97

TABLE 3: CONCENTRATIONS OF TOTAL SUSPENDED PARTICULATES (TSP) AT VARIOUS SITES

Date	Site	Concentration of TSP ug/m^3
06.11.93	Khalifa Point	305.74
07.11.93		
08.11.93	Goast Guard Post	314.96
09.11.93	Goth Abbas	209.52
10.11.93		
11.11.93	Goth Ghulam Muhammad	321.28

TABLE 2 – MAXIMUM AVERAGE GROUND LEVEL CONCENTARATIONS OF SO2 DUE TO THE FEPCO PLANT FOR 200 AND 120 METER STACK OPTIONS AND NO TERRIAN AND TERRAIN CONSIDERATIONS FOR 700 MW CAPACITY

AVERAGING PERIOD	MAXIMUM AVERAGE GROUND LEVEL CONCENTRATIONS (ug/m3)	DISTANCE FROM PLANT (km)	WINDSPEED (m/s)	STABILITY CATEGORY	WLD BANK GUIDELINE UG/M3 (ug/m3)
1. 200m Stack					
a. No. Terrain					
1–HOUR	1728	1.2	2.5	A	NA
3–hour	1382				NA
8–hour	864				NA
24–hour	346				500
Annual	43				100
b. Terrain					
24–hour	340	9.6			500
2. 120m Stack					
a. No. Terrain					
1–hour	1948	1.2	2.4	A	NA
3–hour	1558				NA
8–hour	974				NA
24–hour	390				500
ANNUAL	49				100
b. Terrain					
24–hour	734	9.6			500

TABLE 3 – MAXIMUM AVERAGE GROUND LEVEL CONCENTARATIONS OF NO2 DUE TO THE FEPCO PLANT FOR 200 AND 120 METER STACK OPTIONS AND NO TERRIAN AND TERRAIN CONSIDERATIONS FOR 700 MW CAPACITY

AVERAGING PERIOD	MAXIMUM AVERAGE GROUND LEVEL CONCENTRATIONS (ug/m3)	DISTANCE FROM PLANT (km)	WINDSPEED (m/s)	STABILITY CATEGORY	WLD BANK GUIDELINE (ug/m3)
1. 200m Stack					
a. No. Terrain					
1–HOUR	161	1.2	2.5	A	NA
3–hour	145				NA
8–hour	113				NA
24–hour	64				NA
Annual	16				100
b. Terrain					
24–hour	62	9.6			NA
2. 120m Stack					
a. No. Terrain					
1–hour	183	1.2	2.4	A	NA
3–hour	165				NA
8–hour	128				NA
24–hour	73				NA
ANNUAL	18				100
b. Terrain					
24–hour	73	9.6			NA

TABLE 4 – MAXIMUM AVERAGE GROUND LEVEL CONCENTARATIONS TOTAL SUSPENDED PARTICULATES DUE TO THE FEPCO PLANT FOR 200 AND 120 METER STACK OPTION AND NO TERRAIN AND TERRAIN CONSIDERATIONS FOR 700 MW CAPACITY

AVERAGING PERIOD	MAXIMUM AVERAGE GROUND LEVEL CONCENTRATIONS (ug/m3)	DISTANCE FROM PLANT (km)	WINDSPEED (m/s)	STABILITY CATEGORY	WLD BANK GUIDELINE UG/M3 (ug/m3)
1. 200m Stack					
a. No. Terrain					
1–HOUR	32	1.2	2.5	A	NA
3–HOUR	29				N/A
8–HOUR	22				N/A
24–HOUR	13				500
ANNUAL	3				100
B.TERRAIN					
24–HOUR	12	9.6			500
2. 120m Stack					
a. No. Terrain					
1–hour	37	1.2	2.4	A	NA
3–hour	33				NA
8–hour	26				NA
24–hour	15				500
ANNUAL	4				100
b. Terrain					
24–hour	15	9.6			500

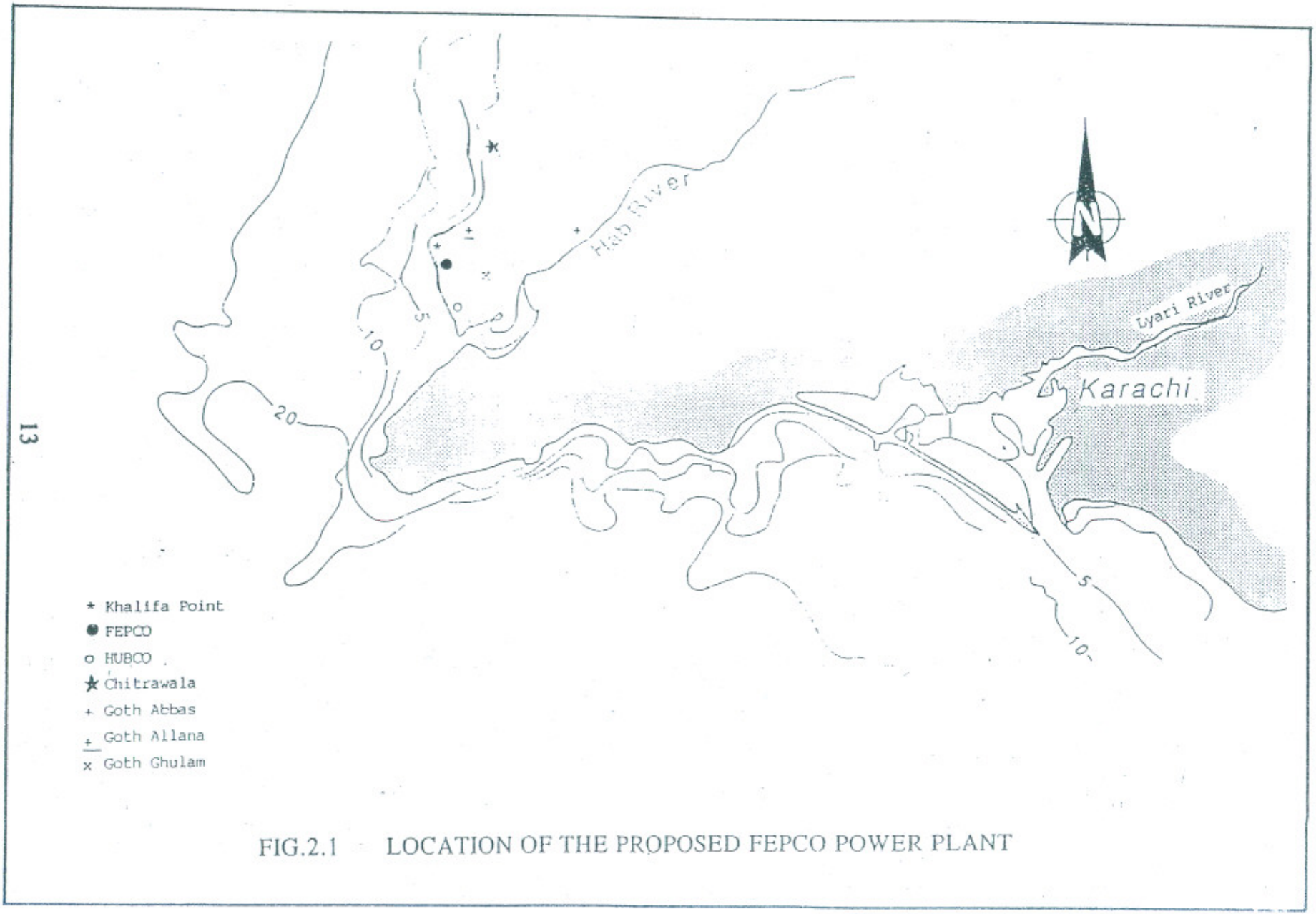

FIG.2.1 LOCATION OF THE PROPOSED FEPCO POWER PLANT