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THE ARAB REPUBLIC OF EGYPT
Ministry of Electricity & Energy
New and Renewable Energy Authority (NREA)

150MWe KURAYMAT INTEGRATED SOLAR COMBINED CYCLE POWER PLANT PROJECT

Environmental Impact Assessment

FINAL

December 2006

Energy & Environment Consultant (E&E)

150 MWe KURAYMAT INTEGRATED SOLAR COMBINED CYCLE POWER PLANT PROJECT

Environmental Impact Assessment

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LIST OF ABBREVIATIONS

AADT	Average Annual Daily Traffic
BOD	Biochemical Oxygen Demand
BPIP	Building Profile Input Program
CAA	Competent Administrative Authority
CAPMAS	Central Agency for Public Mobilization and Statistics
CEDC	Cairo Electricity Distribution Company
CEPC	Cairo Electricity Production Company
CTG	Combustion Turbine Generator
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DS	Dissolved Solids
EAAQLs	Egyptian Ambient Air Quality Limits
EAP	Environmental Action Plan
EEAA	Egyptian Environmental Affairs Agency
EEHC	Egyptian Electricity Holding Company
EGSMA	Egyptian Geological Survey and Mining Authority
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
ENIT	Egyptian National Institute of Transport
EUPS	Egyptian Unified Power System
FHWA	Federal Highway Administration, (US)
GARBLT	General Authority for Roads, Bridges and Land Transport
GEP	Good Engineering Practice
GDP	Gross Domestic Product

HCM	Highway Capacity Manual
HGVs	Heavy Goods Vehicles
HRSG	Heat Recovery Steam Generator
HTF	Heat Transfer Fluid
IFC	International Finance Corporation
ISC-Prime	Industrial Source Complex/Plume Rise Model Enhancements
ISCC-KPP	Integrated Solar Combined Cycle Kuraymat Power Plant
KPP	Kuraymat Power Plant
LFO	Light Fuel Oil
LOS	Level of Service
MEEDC	Middle Egypt Electricity Distribution Company
MSDSs	Material Safety Data Sheets
MWe	Mega-Watt electrical
NFRA	National Fire Protection Authority
NRIAG	National Research Institute of Astronomy and Geophysic
OSHA	Occupational Safety and Health Administration, (US)
PCBs	Polychlorinated Biphenyls
PCDP	Public Consultation and Disclosure Plan
PCU	Passenger Car Units
pcph	passenger car per hour
RIGW	Research Institute for Ground Water
SS	Suspended Solids
STG	Steam Turbine Generator
TDS	Total Dissolved Solids
TOC	Total Organic Carbon

TSS	Total Suspended Solids
TWA	Time-Weighted Average
UEEPC	Upper Egypt Electricity Production Company
vph	vehicle per hour
WB	World Bank

NON-TECHNICAL SUMMARY

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Non-Technical Summary

1. INTRODUCTION

1.1 Background

Energy and Environment Consultant (E&E) was commissioned by the New and Renewable Energy Authority (NREA) to prepare the technical documents and procedures required by the Global Environmental Facility (GEF), and the World Bank (WB)/IFC as well as the Egyptian Environmental Affairs Agency (EEAA) concerning the environmental and social assessment of the proposed Integrated Solar Combined Cycle Power Plant at the Kuarymat location. NREA is seeking financial assistance from the GEF/WB for the construction and operation of this 150 MWe power plant.

The proposed facility has been designated as a Category B project under World Bank/IFC rules and as a black listed project under EEAA regulations and therefore requires a full Environmental Impact Assessment (EIA). Financing from any other international/regional investors is conditional upon obtaining the environmental clearance from both the Egyptian regulatory authorities and the WB.

1.2 Project Overview

New and Renewable Energy Authority (NREA), an organization incorporated in Egypt and affiliated to the Minsitry of Electricity and Energy (MEE), proposes to build, and operate the power plant at within an existing fenced area of uncultivated land in the eastern desert about 2 km distant from the Nile river at the kuraymat area in the southern part of Giza Governorate, approximately 95 km south of Cairo and 30 km north of Beni-sueif and about 750 m east of the existing residential community of the present Kuraymat thermal power plant. The overall proposed site area is 660 Feddans. Construction of the plant is due to commence in 2005 and will last approximately 34 months. Operation of the power plant will begin in 2007.

The proposed power facility will consist of an integrated solar combined cycle power plant consists of a solar field and a combined cycle power block. Solar field basically composed of parabolic trough collectors and Heat Transfer Fluid (HTF) heat exchangers to generate steam. Combined cycle block mainly consist of two industrial heavy-duty type gas turbines (GT) each with a nominal electricity generation capacity of around 43 MWe at ISO conditions, unfired Heat Recovery Steam Generators (HRSGs) and steam turbine generator (STG) sized to match the maximum steam output from HRSGs and solar steam generator with capacity rated at about 67 MWe. The overall generating capacity of the power plant will be 150MWe.

The power plant will utilize natural gas as its primary fuel, and also have the capability to operate using sollar (fuel oil # 2). The ability to "dual-fuel" the power plant (with natural gas or sollar) will provide security of electricity supply in the event that gas supplies are unavailable for any reason.

The power plant will incorporate a closed circuit cooling system using water abstracted from either the Nile river or the underground aquifer. The abstracted water will also be used following pre-treatment demineralization. to provide process water make-up in the HRSG systems. Potable water supplies as well as other service waters will also be drawn from this water after treatment to support the plant water requirements.

The main demand for water is due to the closed circuit system. The use of a closed circuit cooling system minimizes the capital cost and maintains the electrical efficiency of the power plant at a good level. Only make-up water will be required to compensate water losses. Evaporative cooling towers are required; hence there is opportunity for water drift and the formation of visible plumes of water vapor and ground fogging.

To provide the make-up and service water, a pumping facility will be constructed either on the Nile intake or on the proposed site. In case of abstracting water from the Nile river underground pipelines will be extended from the site across the bank line and out into the Nile river.

The location of the proposed site is shown in *Figure 1.*

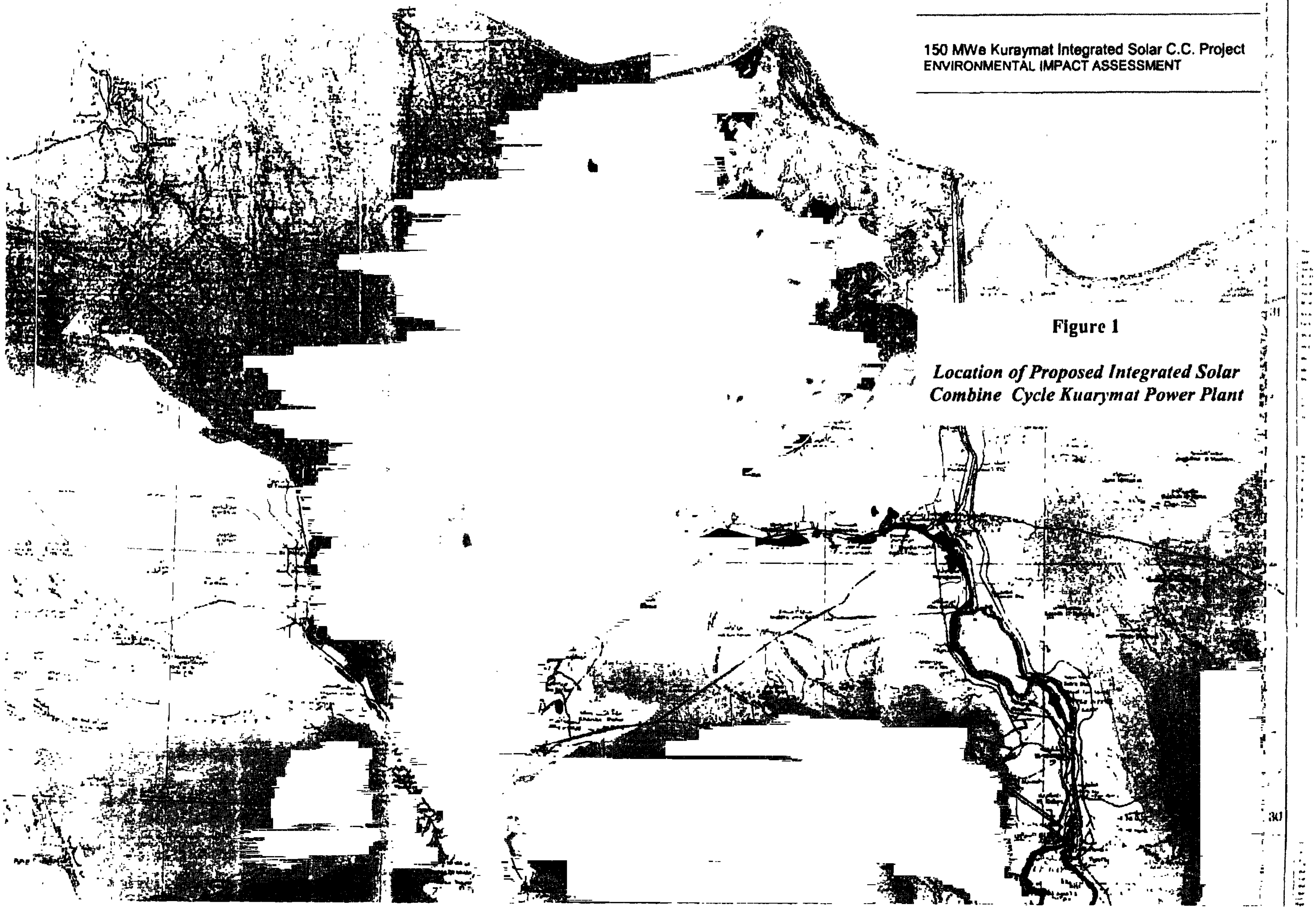


Figure 1

Location of Proposed Integrated Solar Combine Cycle Kuarymat Power Plant

2. THE ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Contributors to the EIA Report

The Environmental Impact Assessment (EIA) report is prepared by E&E, based on information provided by NREA and their sub-contractors. Public consultation activities are being undertaken by E&E and NREA. The EIA report draws heavily on the environmental assessment documentation prepared by group of local and international multidisciplinary consultants and submitted to E&E, for preparing the EIA report for local permitting and GEF or international financing purposes. Most of the relevant local permits for the construction of the power plant have now been received.

2.2 Scope of the EIA Report

The EIA has been carried out in accordance with IFC "Thermal Power – Guidelines for New Plants" (July 1, 1998), Egyptian "Law 4 of 1994, Law for the Environment" and the Egyptian Environmental Affairs Agency's "Guidelines for Egyptian Environmental Impact Assessment".

The EIA has assessed the impacts of the construction and operation of the Kuarymat ISCC power plant and has also considered the cumulative impacts of the plant and other existing sources, particularly the existing Kuraymat thermal power plant, in the project area. Permits will be required from the relevant Competent Administrative Authorities.

The EIA report presents the full assessment of the environmental, health and safety impacts of the Kuarymat ISCC power plant. This Non-Technical Summary presents a short resume of the findings of the EIA report. For further details, reference should be made to the full EIA report.

3. PROJECT DESCRIPTION

3.1 Overview of the Power Plant

The power plant site will occupy an area of approximately 2,772,000 m^2 irregular-shaped piece of land and will include the following main elements:

- Solar-thermal-electric system (STES) collects solar radiation, throughout collector field comprising parabolic trough-shaped mirrors used to focus sunlight on thermal efficient receiver tubes containing heat transfer fluid (HTF), convert it to thermal energy first and then to mechanical energy via a thermodynamic cycle to drive an electromechanical energy conversion device to generate electrical energy.

- conventional combined cycle power plant, comprising two combustion turbine generators capable of delivering an output of about 2x43 MWe (ISO), two Heat Recovery Steam Generators (HRSGs) and one steam turine generator capable of delivering an output of 67 MWe, which will be fed into the Egyptian unified grid system. Two gas turbines, fired by natural gas or light fuel oil in emergencies, will feed the generators and exhaust gases will be expelled through a stack 35 m high;

- cooling and process water intake structures, with buried pipelines across the Nile river bank or groundwater intake structures, with demineralization and storage facilities; and

- supporting site infrastructure, switchyard, offices and workshops.

The layout for the power plant is presented in *Figure 2*.

3.2 Process Description

The key steps of the generating process of the proposed power plant are as follows:

- The HTF passing from one end of the SCA to the other collects the heat absorbed by the heat collecting elements (HCEs). Header pipelines at the cold and hot ends of the SCAs connect these to the HTF-boiler integrated into the power block. The HTF-boiler is a conventional steam generating heat exchanger similar in design to boilers used for industrial process heat applications. Depending on the integration design of solar steam supply into the power block, the HTF-boiler may generate saturated steam or superheated steam. The common HTF in parabolic trough solar fields is a thermal oil. The operation pressure is below 20 bar and temperature of the HTF is limited to 400°C to avoid cracking. Typically the upper temperature in the HTF circuit is 390°C.

- Natural gas (or light fuel oil (sollar) in emergencies) will be mixed with air and combusted using low NOx technology, to generate power and hot exhaust gas, which will be used to generate steam from demineralized water to drive one turbine serving electrical generator. The process results in the generation of electricity and also produces hot exhaust gases.

- The steam is cycled from Heat Recovery Steam Generators (HRSGs) through the turbine to condenser. The condenser is cooled by a closed circuit system using cooling towers, abstracting water from the Nile river or the underlying aquifer via a ground well to be digged at site, and discharging the used effluent to, a nearby drainage basin/wadi or a ground well. The condensate is then returned for recirculation within the HRSGs.

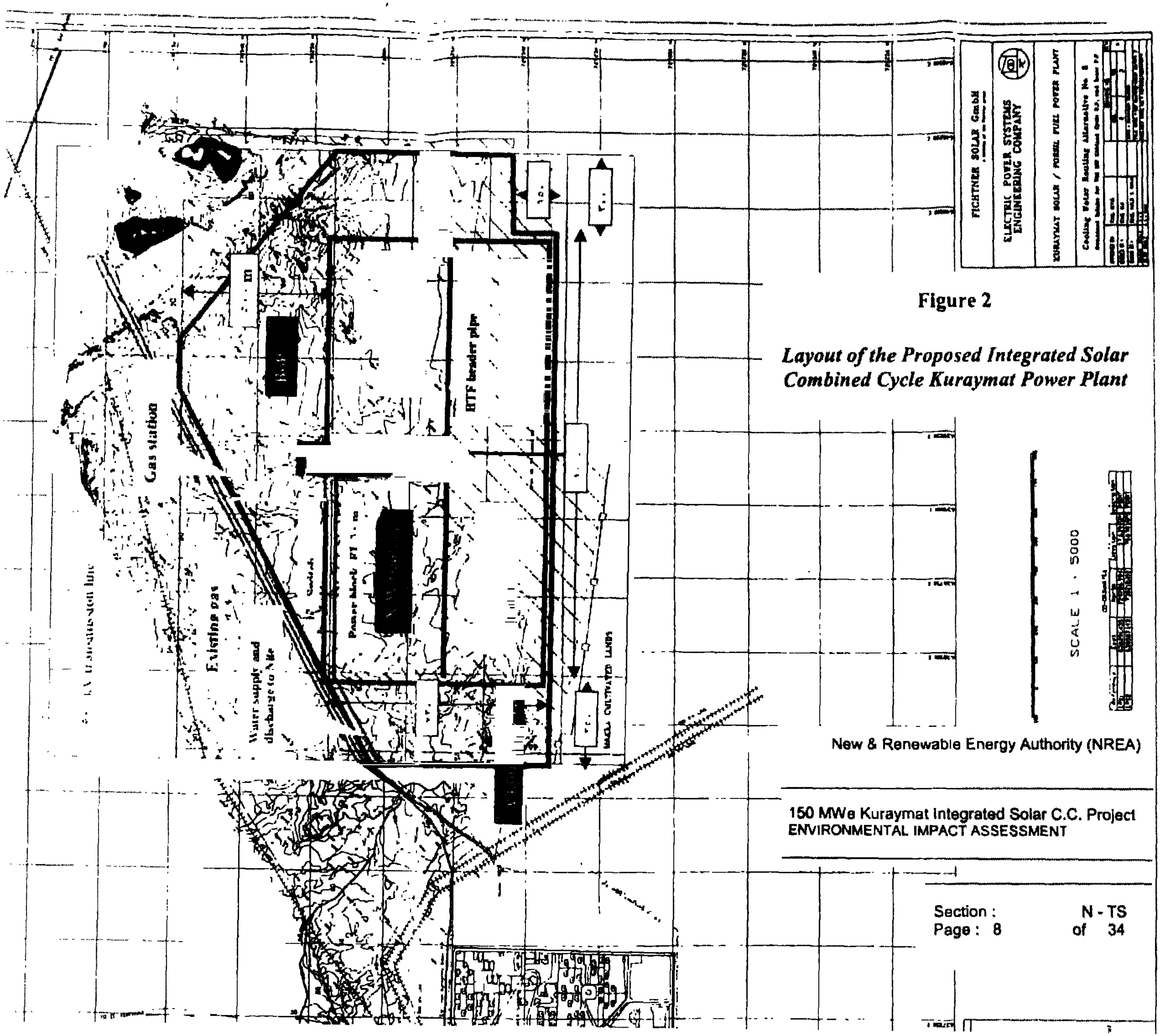


Figure 2

Layout of the Proposed Integrated Solar Combined Cycle Kuraymat Power Plant

New & Renewable Energy Authority (NREA)

150 MWe Kuraymat Integrated Solar C.C. Project
ENVIRONMENTAL IMPACT ASSESSMENT

- The final exhaust gases will be discharged to the atmosphere via two 35 m high stacks connecting both gas turbines. In operating in an open cycle, final exhaust gases will be discharged to the atmosphere via two separate stacks in accordance with emission standards set by the EEAA and IFC.

3.3 Operational Releases from the Power Plant

During operation, the key releases into the environment from the power plant will comprise the following:

- Exhaust gases, will be emitted into the atmosphere, normally from the HRSGs stack as result of fuel combustion. Emissions from the combustion of natural gas are carbon dioxide (CO_2), water vapor, carbon monoxide (CO) and nitrogen oxides (NO_x). Sulfur dioxide (SO_2) and particulates, which are typically associated with coal and oil combustion, will only be produced in trace quantities during natural gas firing. In emergencies when light fuel oil (sollar) is used instead of gas, SO_2 and particulates will however be key emissions from the power plant.

- Heated blow down from cooling towers and process water will be discharged into the ambient environment (drainage basin/wadi or a ground well) via the discharge system at a temperature of no more than 8-10°C above ambient. Any oil, chemicals and residual solids will be removed before discharge and the pH of discharged water maintained at between 6 and 9.

- Small volumes of solid wastes will be segregated, collected and disposed of by licensed waste disposal contractors.

The power plant incorporates a rang of measures to eliminate or reduce operational releases within its design and layout, such as low NOx combustors in the gas turbines, oil interceptors fitted to the site drainage system and effluent treatment facilities to treat wastewater prior to discharge. As a result, the power plant is designed to meet high environmental standards and comply with the emission limits of the Arab Republic of Egypt and the World Bank.

4. ANALYSIS OF ALTERNATIVES

4.1 Current Situation ("No Action" Option)

The no action alternative to the proposed Kuarymat ISCC power plant would result in the demand for electricity exceeding supply, with an increasing deficit as demand increases in the future. Hence the lack of a secure and reliable electricity generation and supply system, would have significant social, economic and environmental implications including constraining existing and future economic development and restricting socio-economic development. As a result, the "no action" option is not considered to be a viable or acceptable alternative to the proposed project.

4.2 Alternative Technologies and Fuels

On the basis of security of supply, response to demand and economic advantages, the Ministry of Electricity & Energy with its affiliate New and Renewable Energy Authority (NREA) have specified that the Kuarymat ISCC project should be an integrated solar gas/oil-fired combined cycle plant of 150 MWe nominal generating capacity. The NREA's rationale for choosing this technology in preference to other electricity generating technologies as follows:

- The parabolic trough distributed collector system is selected. More proved technology to be used for the first time in Egypt. It is the major type utilized today of linear concentrating system.
- The system is commercially available from several suppliers.
- The higher concentration ratio of this system compared to lower temperature systems leads to higher temperatures and higher efficiencies.
- No significant advers environmental impacts are predicted to occur with this system compared to potential localized environmental changes associated with heliostat fields.
- Accidental spills or potential leakages of the thermal fluid are manageable.
- Water use for mirror washing and cleaning is very limited and the resulting water drains are controllable.
- Existing and planned generating capacity using gas/oil-fired steam units is already considered sufficient and further reliance on this particular technology is not preferred for reasons of security of supply, response to demand and economics.
- An existing labor force is available which is competent in the construction, operation and maintenance of combined cycle units, whilst experience in other technologies are more limited. Hence, the selection of combined cycle units allows greater local employment benefits to be obtained and should be economically advantageous.

Hence, the technology chosen for the project is an integrated solar combined cycle system.

Natural gas has been selected as the main fuel for the power plant and compared to other fossil fuels generating technologies, gas-fired combustion turbine generators have one of the lowest emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), sulfur dioxide (SO_2) and particulates.

4.3 Power Plant Design

There are a wide variety of potential designs for the proposed power plant. On the basis of the most proven solar thermal technology for the solar field and the key design features selected for the power plant, together with the adoption of general good practices within its overall design and layout, fuel and chemical storage facilities and pollution monitoring equipment, the power plant minimizes its potential impacts on the environment whilst ensuring safe, secure and efficient operation. Key aspects of the design, which have been compared with alternatives, are as follows:

- Parabolic trough distributed collector system is selected for the solar field, where no significant adverse environmental impacts are predicted to occur with this system compared to potential localized environmental changes associated with heliostat fields.

- the stack has been designed to maximize buoyancy and dispresion of emissions and its height meets good engineering practice;

- the gas turbines will be equipped with low NOx combustors, minimizing emissions of NOx which is the key pollutant associated with combustion of natural gas;

- closed circuit cooling water will be used to maintain generating efficiency within a relatively good order. Alternatives such as air cooled condensers (open, whilst using less water, result in lower generating efficiencies). The potential for visible vapour plumes or ground fogging is acceptable since prevailing wind in the NS and NE directions and the site is about 1.2 km distant from the road. Noise level will decrease to acceptable level at the power plant boundary and visual impacts will be accommodated within the wider landscape surrounding the site. The avaibility of water is not considered an issue for this project given the use of water from the Nile river or the underlying aquifer;

- cooling water will be supplied from a sustainable water supply, namely the Nile river or the underground aquifer, and the intake structures can be constructed and operated without significant impacts.

4.4 Alternative Sites

The NREA designated the proposed Kuarymat site for power plant construction from a group of four alternative sites, namely: Red Sea coast, Sinai Peninsula, West Desert and Kuraymat. The site area was allocated to NREA by the Government of Egypt. In selecting the required site, consideration was given to the following criteria:

Economic Factors:

- capital costs;
- operation and maintenance costs;
- requirement for natural gas;
- requirement for cooling and service water;
- demand loads for electricity; and
- requirements for electricity transmission lines and sub-stations.

Non-economic Factors:

- potential environmental impacts; and
- site development.

Following negotiations with the concerned authorities, the planned location of the Kuarymat power plant was found to be the most cost effective site for the following reasons:

- minimal additional infrastructure would be required;
- desirable benefits for development of the site area; and
- no workers' colony is required as a local workforce is available.

In addition, the power plant site will bring socio-economic benefits to the wider Kuraymat Region (i.e. south of Giza and North of Beni-sueif), through employment opportunities, supply contracts and the effects of project expenditure within the local economy.

5. KEY FINDINGS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Introduction

A thorough assessment of the impacts of the proposrd plant has heen carried out based on information provided by NRAE, E&E and their sub-consultants. A combination of quantitative and qualitative assessment techniques, ranging from computer modeling for air, water, noise and traffic impacts to ecological and aquatic surveys and visual evaluation, have been undertaken. The results of the assessment work have been compared with the environmental standards set by the Govrnment of the Arab Republic of Egypt and the World Bank, whichever is the more stringent.

The conclusions of the assessment are that (with suitable mitigation measures described in Tables 2 and 3) the project is in compliance with the environmental requirements of both the Government of Egypt and the World Bank with respect to stack emissions, ambient air quality, discharge quality and noise. Table 1 provides a summary of anticipated impacts in relation to the Egyptian and World Bank environmental guidelines for stack emissions, ambient air quality, liquid effluent and noise. The following discussion highlights some of the key considerations and results of the assessment.

5.2 Air Quality

Construction Dust

Construction activities will result in locally high levels of dust however no residential receptors or sensitive environments lie in the immediate boundaries of the power plant. Existing concentrations of airborne dust are already high in this area. Potential impacts from dust emissions on site will be significantly reduced by careful management and the implementation of mitigation measures to reduce dust generation

Stack Emissions

The power plant will burn natural gas as its primary fuel. As a result, the principle pollutant during normal operation will be NOx. During emergency operation (and for not more than 2% of operating time), the burning of light fuel oil (sollar) will result in emissions of particulate matter and SO_2 along with trace amounts of other pollutants. Emissions from the plant will meet Egyptian and World Bank Guidelines.

In order to analyze the potential impacts of the plant's emissions during normal operation (firing gas) on ambient air quality in the project area, dispersion modeling has been undertaken.

Table 1

Environmental Impacts and Environmental Guidelines

Impact Area	Predicted Max. Concentration from KuarymatPower Plant	Egyptian Standard	World Bank Cuideline
Stack emissions (70% load) (when firing Natural Gas)			
NOx	<25 mg Nm^{-3}	300 mgNm^{-3} (1)	320 mg Nm^{-3}
SO_2	<1 mg Nm^{-3}	2,500 mg Nm^{-3}	2,000 mg Nm^{-3}
TSP - General (all sizes)	<5 mg Nm^{-3}	500 mg Nm^{-3} (2)	50 mg Nm^{-3}
Stack emissions (70% load) when firing Light Fuel Oil (<2% of total annual operating time))			
NOx – oil firing	35.88 mg Nm^{-3}	300 mgNm^{-3}	460 mg Nm^{-3}
SO_2 – oil firing	41.78 mg Nm^{-3}	2,500 mg Nm^{-3}	2,000 mg Nm^{-3}
TSP – General (all sizes)	0.37 mg Nm^{-3}	500 mg Nm^{-3} (2)	50 mg Nm^{-3}
Ground Level Concentration (when firing Natural Gas)			
NOx – 1 hour	33.7 μgm^{-3}	400 μgm^{-3}	-
NOx – 24 hours	14.1 μgm^{-3}	150 μgm^{-3}	150 μgm^{-3}
NOx – 1 year	2.7 μgm^{-3}	-	100 μgm^{-3}
SO_2 – 1 hour	Trace	350 μgm^{-3}	-
SO_2 – 24 hours	Trace	150 μgm^{-3}	150 μgm^{-3}
SO_2 – 1 year	Trace	60 μgm^{-3}	80 μgm^{-3}
PM_{10} – 24 hours	Trace	70 μgm^{-3}	150 μgm^{-3}
PM_{10} – 1 year	Trace	-	50 μgm^{-3}
Liquid Effluent			
pH	6-9	6-9	6-9
BOD	<30 mg/l	<30 mg/l	-
Chromium	-	0.05 mg/l	0.5 mg/l
Copper	<0.5 mg/l	1 mg/l	0.5 mg/l
Iron	<1 mg/l	1 mg/l	1.0 mg/l
Zinc	<1 mg/l	1 mg/l	1.0 mg/l
Oil and Grease	<5 mg/l	5 mg/l	10 mg/l
Total Suspended Solids (TSS)	<30 mg/l	30 mg/l	50 mg/l
Residual Chlorine (tota)	<0.2 mg/l	-	0.2 mg/l (3)
Noise (4)			
Daytime (max.)	Max. <55 dB(A)	60-70 dB(A)	40 dB(A)
Night time (max.)	Max. <50 dB(A)	50-60 dB(A)	70 dB(A)

(1) There are no Egyptian standards for NO_2.
(2) The Egyptian Standard for TSP (all sizes) refers to emissions far from inhabited urban areas.
(3) "Chlorine shocking" may be preferable in certain circumstances, which involves using high chlorine levels for a few seconds rather than a continuous low level release. The maximum value is 2 mgl^{-1} for up to 2 hours, which must not be more frequent than once in 24 hours (and the 24 hour average should be 0.2 mg/l).
(4) There are no sensitive receptors for noise within 0.5 km of the power plant. The area has been categorised as "Industrial area" with respect to Egyptian ambient noise standards and "Industrial commercial" with respect to World Bank guidelines.

The assessment indicates that maximum 1-hour ground level concentrations of NO_2 (the key pollutant) from the ISCC-KPP, are predicted to occur on about 145° at a distance of 430 m from the power house site. The majority of 24-hour maximum impact areas due to the operation of the two ISCC Kuarymat gas turbine units occurred between 150° and 160° at a distance between 500 and 550 m. The highest value of these both maximum values, including background level, didn't exceed 55% of the corresponding national permissible limits. The majority of the 24-hour maximum combined impact areas due to the operation of both Kuraymat power plants (existing thermal power plant including its proposed extension and the proposed ISCC-KPP) occurred at SWW direction to the plant at distances between 2400 m and 2500 m. The highest impact area is at SWW direction about 2450 m from the origin of the modeling grid network (i.e. the power house of the proposed ISCC-KPP). The maximum 1-hour impact levels are very similar among the same years of meteorological data considered. The majority of the maximum impact areas occurred far from the site boundary to the SWW of the plant at a distance of about 2580 m from the origin of the modeling grid network. The results further indicated that the maximum combined impact area for each of the five years considered all occurred at the same location. The maximum combined concentrations reached at these locations, including background level, didn't exceed 74% of the national permissible limits and their monitoring will be the responsibility of the Upper Egypt Electricity Production Company (UEEPC) which operates existing Kurymat thermal power plant and already owns a fully operational monitoring system. It is quite obvious that for the ISCC-KPP, the maximum concentrations reached expressed as an annual mean and daily mean concentrations, and shown in *Table 1*, are a relatively small fraction of the value required to equal that which cause an exceedence of either World Bank or Egyptian guidelines.

5.3 Aquatic Environment

Cooling water and process water for power plant operation will be drawn from the Nile river or the underground aquifer via an intake structure. Potable water will be supplied to the power plant via same source. Waste cooling water will be treated before discharge to a nearby drainage basin/wadi or a ground well. Also, process water will be disposed of after treatment via the same discharge pathway. Sanitary waste water will be treated and re-used for the plant plantation irrigation program. No ground water or other surface water will be used during power plant construction and operation. The key potential impacts of the power plant on the aquatic environment will therefore be limited impacts to the aquatic flora and fauna during power plant construction and operation.

The aquatic environment surrounding the project site is characterized by generally fair water quality. The aquatic flora is characterized by poor biodiversity and no sensitive ecosystems. No commercial fishing and no artisanal fishing occurs in the vicinity of the project.

During construction of the power plant dredging and construction of the intake structures-if water decided to be abstracted from the Nile river- could lead to potential impacts on physical aquagraphy, water quality and removal of, or disturbance to, aquatic habitats, flora and fauna. Given that the area of impact is very localised, losses are in many cases temporary and field survey data available do not indicate significant or sensitive habitats, the impacts of power plant construction on the aquatic environment are not considered to be significant In addition,, good site management and engineering practices during construction will ensure that any residual impacts are reduced to a minimum.

Power plant operation will result in a heated blow down water from cooling towers being discharged after treatment into the ambient environment. Process water will, also, be disposed of the same way. All discharges of process water will be treated prior to discharge to ensure that the Egyptian and World Bank waste water quality guidelines are met. Treatment includes neutralisation, oil separation, and filtration. Effects on ambient water quality will be further reduced through implementation of good site management practies including adequate site drainage.

Physical aquagraphy, Nile bank access, fishing and navigation are not predicted to be significantly affected by the presence of the intake structures.

5.4 Noise Impacts

The construction of the Kuarymat integrated solar thermal combined cycle power plant is expected to generate a maximum noise level of <60 dB(A) during the day at the fence of the power plant and <55 dB(A) at night. These worst-case construction noisr level are both within Egyptian and World Bank[(1)] guidelines, and for most of the construction period, the noise levels will be lower than these values. There are no residential or sensitive receptors within 0.5 km of the plant.

Construction traffic on local roads will also generate additional noise, however noise levels on local roads predicted for peak construction activity (during 2005/2006) is expected to be only 0.3dB(A) above ambient levels. This magnitude of increase is generally not perceptible to the human ear, consequently no construction traffic impacts are predicted.

The potential noise emissions from the Kuarymat ISCC plant during operation have been modeled to provide noise contours in the area around the site. The predicted opertaional noise levels at the site boundary and at all receptors are below the Egyptian and World Bank guidelines during daytime and nigh-time.

5.5 Flora and Fauna

No areas protected for their conservation value are located on, or in the vicinity of, the project area. The proposed site itself and the majority of surrounding land is poorly vegetated (desert) with no much of the area having been disturbed by urban developments. Given that the

(1) There are no World Bank Guidelines for construction noise, therefore Operational noise guidelines are applied here.

potential impacts of construction and operation on power plant area likely to be localized, and good site management practices will be implemented, no significant effects are predicted.

5.6 Land Use, Landscape and Visual Impacts

The land use at the project site is un-used, infertile land. The loss of this land to the power plant development is therefore not significant.

The surrounding land use is generally industrial and commercial. As the land is not urbanized with limited vegetation, all existing views will be in significantly influenced by the power plant and given the surrounding industrial context, due to the existence of the present Kuraymat thermal power plant and enormous number of scattered lime quarries, the visual intrusion of the power plant will be minimal.

Visual impacts of the power plant from the residential community to the west of the proposed plant site are also not expected to be significant given the orientation of the apartments. The potential landscape and visual impacts of the project are therefore expected to be minor and not significant.

5.7 Soils, Geology and Hydrology

Due to the characteristics of the soils and geology of the site, in particular the lack of any sensitive features, and the mitigation measures proposed as part of the construction and operation of the power plant, no significant impacts are predicted to occur. In addition,, geotechnical investigations confirmed the site as being uncontaminated.

5.8 Traffic

The assessment of traffic and transport covers the changes in traffic conditions in terms of delay and congestion during construction and operation.

The greatest potential for traffic impacts to occur arises during a short period at peak construction. There is some potential for increased congestion on the main roads to the power plant, however the impacts will only occur during the peak construction phase and during peak hours. The overall impact is therefore predicted to be insignificant. Mitigation measures will be put in place to reduce the potential for impacts to arise.

During operation, a small number of workers and HGVs are associated with operating the power plant and no impacts are predicted to occur.

5.9 Socio-economics and Soico-cultural effects

It is anticipated that the power plant will provide a net positive socio-economic impact through the provision of employment opportunities and attraction of economic investment into the area. In addition., the use of local labor (95% during construction), will maximize these positive impacts through the development of the local skill base and will also generate increased demand for local services, materials and products.

5.10 Archaeology, Historical and Cultural Heritage

No available information was found which identified any archaeological, historic or cultural remains on the site or in the surrounding area. Consequently, no impact is predicted to occur on any known archaeological, historic or cultural resources.

NREA have incorporated mitigation measures into the construction program to ensure that any potential finds of significance are recorded and are accorded the required protection in consultation with the Competent Administrative Authority.

5.11 Natural Disaster Risks

An assessment of the risks to the power plant from seismic activity has concluded that given the engineering measures incorporated into the design of the power plant, the potential environmental impacts of a seismic event during power plant operation are not anticipated to be significant.

The risks of flooding during power plant construction and operation were also examined. However, site drainage will be constructed to minimize any risks of contaminted water reaching the surroundings, no significant flood risk impacts are anticipated.

5.12 Major Accident Hazards

Given the land uses surrounding the proposed Kuarymat ISCC power plant site and the measures incorporated into the design of the plant to minimize the risk from fire and explosion, the plant is not anticipated to pose a potential risk of any significance to any third party facilities.

5.13 Solid Waste Management

The management of wastes during construction and operation of the powr plant will include mitigation measures to collect and store waste on-site, record all consignments of hazardous or contaminated waste for disposal and periodically audit waste contractors and disposal sites to ensure that disposal is undertaken in a safe and environmentally acceptable manner.

During both construction and operation, all wastes including general waste, packaging waste, commercial wastes, raw-water pre- treatment sludge, tank sludge and interceptor sludge will be disposed of by licensed waste contractors.

Solid waste management is not predicted to cause any significant impacts.

5.14 Occupational Health and Safety

With the provision of a high standard of health and safety management on site, construction and operation of the power plant in accordance with good industry practice, the occupational health and safety risks associated with construction and operation of the power plant will be minimized and are not significant.

5.15 Associated Infrastructure

Connections to existing gas and electrical facilities will be the responsibility of GASCO and the NREA respectively. In regard to the gas connection with the gas reducing station of the site no environmental or social impacts are anticipated.

Connection switchyard will connect the plant to the 220/500 kV substation already existed to the immediate west of the site at the present Kuraymat thermal power location. No significant impacts are anticipated.

6. ENVIRONMENTAL MANAGEMENT AND MONITORING - THE ENVIRONMENTAL ACTION PLAN (EAP)

The Environmental Action Plan (EAP) includes mitigation measures, design of monitoring programs where appropriate, and specification of management measures (including institutional responsibility and training requirements).

The key features of the EAP relate to air quality, aquatic discharge and implementation of good site management practice. The EAP is summarized in *Tables 2 and 3* which relate to construction and operational phases respectively.

7. PUBLIC CONSULTATION AND DISCLOSURE

Public consultation has been carried out according to the WB/IFC guidelines and the EEAA regulations which require coordination with other government agencies involved in the EIA, obtaining views of local people and affected groups. This coordination based on discussions with local stakeholders and interested parties during prepation of the environmental documents for local permitting requirements as well as discussions with local stakeholders during scoping and preparation of the EIA. However, Public Consultation and Disclosure Plan (PCDP) for the project is prepared to be implemented. This PCDP is defined in accordance with IFC guidelines. In addition to discussions mentioned above, the main elements of public consultation and disclosure include:

- press advertisements describing the project and inviting interested parties to attend the public meeting and review the Draft Final EIA Report;

- the organization of a Public Meeting in the Giza Governorate with the full involvement of the Governor;

- preparation of this non-technical summary in Arabic, describing the project, its potential environmental impacts and the measures to address them and disclosure of this document, together with disclosure of the EIA report locally in NREA and/or Giza for 60 days; and

- on-going consultation through an "open-door" policy during construction and operation of the power plant.

The process and results of the public consultation activities held to date are documented in the EIA, Chapter 9 and Annex A.

A number of environmental concerns were raised during consultation activities undertaken. The concerns raised included:

- the potential for additional pollution problems in the Giza southern zone as a result of the power plant discharge;
- compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area;
- underlying concern regarding compliance with environmental regulations; and
- the potential impacts of the power plant on the local industrial and commercial activities as well as tourism.

These issues have been taken into account and addressed in the EIA through assessment and the inclusion of mitigation, management and monitoring requirements which are detailed within the EAP.

Ongoing Consultation and Disclosure

NREA/ISCC-KPP Assistant Plant Manager, who is responsible for the Environment, Safety and Quality Assurance program for the plant, will have full responsibility for implementing and supervising the EAP. This role includes ongoing communication with local industrial and commercial interests, local authorities and other interested parties. An "open door" policy will be adopted to allow stakeholders to voice ongoing concerns.

Table 2

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Air Quality			
Dust emissions caused by construction activities, construction vehicle movements, and transport of friable construction materials.	Implementation of good site practices including: • appropriate siting and maintenance of stockpiles of friable materials so as to minimize dust blow; • minimizing drop heights for material transfer activities such as unloading of friable materials; • construction phase to begin with construction of access roads; • roads will be kept damp via a watering or using other techniques that meet national and local regulation; • roads will be compacted and graveled if necessary; • site roads will be maintained in good order; • regulation of site access; • sheeting of lorries transporting friable construction materials and spoil; • enforcement of vehicle speed limits to <35 km/h.	Initiate baseline air quality survey in cooperation and coordination with existing KPP. Measurements and analysis of these pollutants to be made by a trained staff assigned by NREA/ISCC-KPP and submitted to EEAA, WB or any other concerned authority. Annual reporting of summary results (or more if requested) and submitted to the EEAA, WB or any other concerned authority. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA responsible for management of the air quality monitoring. Submission of annual summary reports to EEAA, WB or any other concerned authority Basic training of persons employed to undertake monitoring. NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practice.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Aquatic Environment			
Dredging and construction of the intake structure and pipe-laying for water intake (if Nile waters abstracted) increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.	The following measures will be taken: • Construction Method Statement to be produced by the Contractor; • dredged areas limited to minimum area required; • disposal of dredged sediments to an agreed site; • all works will be made clearly visible using flags, beacons and/or signals; • bank area will be reinstated following construction.	Nile river survey undertaken July 2003 and May 2004 along many profiles fronting the site. Report to be maintained for later monitoring and evaluation during operation.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practice. These mitigation measures must be a condition of any construction contracts commissioned.
Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils (see also under "Soils and Hydrology").	Mitigation activities will include the following. • no discharge of effluents into the ambient environment unless effluents has been checked and meets all the local requirements, • development of a site drainage plan which reduces flow velocity and sediment load; • protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, and sheeting • maintenance of well kept construction site.	Continuous monitoring is required to ensure the implementation of good management practices during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Noise			
Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Implementation of good site practices including. • enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction plant equipment to be fitted with silences; • limited noisy construction activities at night; • prohibition of heavy vehicle movements at night; • use of protective hearing equipment for workers.	Continuous monitoring and supervision by NREA is required to ensure the implementation of good site management practices by all contractors during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices
Flora and Fauna			
Site Clearance-Vegetation removal and habitat disturbance.	Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads.	Continuous monitoring and supervision by NREA is required to ensure the implementation of good site management practices by all contractors during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Soils and Hydrology			
Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented • development of effective site drainage systems; • restriction of access only to construction site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse on-site. (e.g. for landscaping) at appropriately licensed sites; • provision of oil interceptors. • management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillage.	Continuous monitoring is required to ensure the implementation of good management practices during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Traffic and Transport			
Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • construction shifts will be staggered; • scheduling of traffic to avoid peak hours on local roads;	Continuous monitoring is required to ensure the implementation of good site management practices by all contractors during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices.
Socio-Economic Environment			
Positive impacts identified.	Public and Industry Relations will be maximized through open dialogue between NREA (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.	Record local employment provided by the project	Responsibility of NREA.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Archaeology			
Potential chance finds of archaeological remains during construction.	The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found NREA is committed to: • cease activities and consult Antiquities authority. • protection in situ if possible; • excavation of areas where protection not feasible; • preparation of a Chance Finds Procedure and Method Statement.	Supervision of construction activities.	NREA to ensure that all workers on site are aware of the importance of archaeological remains and must report any potential finds immediately. NREA will allocate responsibilities in accordance with the Chance Finds Procedure. Immediate liaison with Competent Administrative Authority should a potential find be uncovered.
Natural Disasters			
Flash Flooding.	Good engineering design will incorporate the following mitigation measures: • drainage system designed to direct flood water from main plant areas into a natural drainage basin/wadi or a ground well and direct potentially contaminated waters through the oil interceptor.	No monitoring measures are envisaged.	NREA to ensure that all workers on site receive training in emergency preparedness and response procedures.

Table 2 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Solid Waste Management	Good practice measures such as the following: • all waste taken off-site will be undertaken by a licensed contractor and NREA will audit disposal procedure; • segregation of wastes and safe storage; • recording of consignments for disposal. • prior agreement of standards for storage, management and disposal with relevant authorities.	Continuous monitoring is required to ensure the implementation of good management practices during construction. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors working on site are aware of EAP and all employees are given basic induction training on good construction and site management practices.
Occupational Health & Safety	Good local and international construction practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract all contractors and sub-contractors; • clear definition of the EHS roles and responsibilities of all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; and • maintenance of a high standard of housekeeping at all times.	Continuous monitoring is required to ensure the implementation of EHS Policies, plans and practices during construction. Implementation of Good Site Management practices and the EHS policies shall be the responsibility of all contractors on site under supervision of the Assistant Plant Manager.	NREA to ensure all contractors and sub-contractors for workers on site include reference to the requirements of the EAP and are aware of the EHS policies and plans. All employees will be given basic induction training on EHS policies and practices. NREA is responsible for ensuring that a Fire Safety Plan, which conforms to NFPA 850, is prepared and implemented prior to commissioning of any part of the plant.

Table 3

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Air Quality			
Emissions from stack are not expected to exceed standards.	Mitigation measures have already been included in the design of the plant and, given NREA/ISCC-KPP's strict commitment to use light fuel oil for <2% of available operating time, no further mitigation measures are proposed. NREA ISCC-KPP will however demonstrate the validity of the conclusions drawn in the EIA report.	Automatic monitoring of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stacks and bypass stacks. In addition, conduct surrogate performance monitoring.	Records must be kept and summary data (including any deviations from Egyptian and World bank standards) will be submitted to the Government and WB on annual basis (or more frequently if required).
Ambient air quality affected by emissions from the power plant.	NREA/ISCC-KPP will demonstrate the validity of the conclusions drawn in the EIA report, at least for once after normal operation. If ground level concentrations are found to be above local and World Bank standards options for further mitigation will be discussed.	Continuous monitoring in the area predicted to have the highest combined impacts will be the responsibility of existing KPP. However, NREA/ISCC-KPP may undertake ambient air quality measurements using third party (e.g. Ain Shams University or Air Pollution Preclusion Unit, National Research Center) in the area predicted to have the highest impacts resulting from the only ISCC-KPP, for once a year during the first three years of normal operation.	Annual reporting by NREA/ISCC-KPP to Government and WB, etc. (or more frequently if required) highlighting key features and comparing results with air quality standards and prediction in EIA report.

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Aquatic Environment			
Discharge of process. cooling blowdown and sanitary waters.	The design of the intake structures have already incorporated measures to reduce impacts. Wastewaters including drainage from treatment plant. HRSG blow down, HRSG area equipment drainage, cooling towers blow down and sample cooler will be treated first in a common effluent tank before off-site disposal through discharge, by means of 2x100% effluent disposal pumps. to a natural drainage basin/wadi or a ground well. Effluent treatment plant will receive wastes from combustion turbine area floor drain, ST lube oil centrifuge, tank farm area, ST area floor washing and transformer area drain and process them into an oil/water separator where wastewaters are channeled to the common effluent tank for treatment before discharge to a natural drainage basin/wadi or a ground well. GTG wash water will be collected in an individual sump and discharged with a portable pump to a tanker for off-site disposal via a licensed contractor. Waters contaminated by chemical wastes will be channeled from neutralization pit and combustion turbine compressor wash effluent to the common effluent tank for treatment before off-site disposal.	Prepare regular water quality monitoring program including. • quality of all water prior to discharge (continuous monitoring of all discharged water for temperature and pH, daily monitoring of process water for COD, TSS, oil & grease and residual chlorine and monthly monitoring of heavy metals and other pollutants). Annual monitoring of benthic environment within a 200 m radius of the intake point (over a 3 year period). Weekly monitoring of fish catches on intake screens including species, numbers and size (over a 1 year period).	Records will be kept and compared on regular basis against Egyptian and World Bank standards and impacts predicted in EIA. Summary reports (with any exceptions identified) will be submitted to the Government and WB etc. on annual review basis (or more frequently if required). NREA/ISCC-KPP to ensure that all employees are given basic induction training on the requirements of the EAP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Aquatic Environment Discharge of process, cooling blowdown and sanitary waters.	Sanitary wastes will be collected via plant sewage and sewerage lines in a local sanitary treatment plant where the treated waters will be re-used in the plant plantation irrigation program while the dirt will be collected for off-site disposal by sanitary road tankers of a licensed contractor. Solar field will be provided with emergency strategy for immediate response to any accidental spillages, operational leakages or droplets of thermal oil to allow collection and control as required. Water spillage from mirror washing and cleaning will be monitored and controlled. Bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system Oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank. Areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump; equipped with a manually operated valve. Transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Stormwater runoff from equipment slabs that may be subject to oil contamination exposure, will be collected and channeled through an oil/water separator prior to discharge into the discharge pathway.		

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Aquatic Environment Discharge of process, cooling blowdown and sanitary waters.	In addition, good site management practices including the following will be implemented: • neutralization, oil separation, flocculation and filtration of any contaminated water before discharge, • no disposal of solid wastes into the discharge structure; • regular maintenance of site drainage system to ensure efficient operation; and • all discharges will comply with local Egyptian and World Bank guidelines NREA/ISCC-KPP will demonstrate the validity of the conclusions drawn in the EIA report. If pollutant concentrations in the discharge or impacts to the surrounding environment are found to be above local and World Bank standards or unacceptable, options for further mitigation will be discussed.		

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Noise	Specific design mitigation measures to minimize noise impacts include: • gas turbines; • steam turbine generators are equipped with appropriate sound protecting enclosures; • air compressors are equipped with silencers; • noisy outdoor equipment are designed to a noise limit of 85 dB (A) at 1 m. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The plant will operate in accordance with internationally accepted health and safety measures.	Given that no sensitive receptors are located in the immediate vicinity of the plant, no monitoring is envisaged.	Should any complaints be received regarding noise, these will be logged and the Assistant Plant Manager will investigate problem. NREA ISCC-KPP to ensure that all employees are given basic induction training on the requirements of the EAP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.
Flora and Fauna Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • restrict personnel and vehicle movements to access roads and within boundaries of site only; and • control of noise during operation.	No monitoring is envisaged.	NREA/ISCC-KPP to ensure that all employees are given basic induction training on the requirements of the EAP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Visual Impact Visual image of power plant from surrounding areas.	The visual effect of the power plant will be improved through: • creation of landscaped boundary along the fence of the power plant.	No monitoring is envisaged.	Considered management of landscaped areas to maximize visual image and habitat creation. NREA/ISCC-KPP to contract a suitable firm to manage landscaped areas.
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as described under Aquatic Environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation.	The Assistant Plant Manager will continuously monitor application of EAP and good site management practices and take corrective action if required.	NREA/ISCC-KPP, through the Assistant Plant Manager, will implement a Spills Response Plan and all employees will receive corresponding training.
Solid Waste	Good practice measures undertaken during the construction phase will be continued into the operation phase (See Table 2).	Continuous monitoring is required to ensure the implementation of good management practices during operation. Implementation of Good Site Management practices shall be conducted under supervision of the Assistant Plant Manager.	NREA/ISCC-KPP to ensure all employees are given basic induction training on good operation and site management practices.

Table 3 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Monitoring	Management and Training
Occupational Health and Safety, Risks and Hazards	Standard international practice on EHS issues shall be employed on site. The mitigation measures summarized in Table 2 apply. In addition, the following measures will be undertaken: • Provision of training in use of protection equipment and chemical handling • Use of protective equipment. • Clear marking of work site hazards and training in recognition of hazard symbols. • Development of site emergency response plans.	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management.	NREA/ISCC-KPP to ensure that all employees are given basic induction training on H&S policies and procedures, Emergency Preparedness and Response Plan and a Spills Response Plan. The Assistant Plant Manager is to ensure implementation of procedures. NREA/ISCC-KPP is responsible for ensuring that the site emergency response plan is complete and implemented prior to commissioning any part of the power plant.

Visual Impact Visual image of power plant from surrounding areas.	The visual effect of the power plant will be improved through: • creation of landscaped boundary along the fence of the power plant.	No monitoring is envisaged.	Considered management of landscaped areas to maximize visual image and habitat creation. NREA/ISCC-KPP to contract a suitable firm to manage landscaped areas.
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as described under Aquatic Environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation Thermal fluid leakage at the connection with the troughs would be managed through collecting sumps to be installed immediately underneath the connection points with the troughs.	The Assistant Plant Manager will continuously monitor application of EAP and good site management practices and take corrective action if required.	NREA/ISCC-KPP, through the Assistant Plant Manager, will implement a Spills Response Plan and all employees will receive corresponding training.
Solid Waste	Good practice measures undertaken during the construction phase will be continued into the operation phase (See Table 2).	Continuous monitoring is required to ensure the implementation of good management practices during operation. Implementation of Good Site Management practices shall be conducted under supervision of the Assistant Plant Manager.	NREA/ISCC-KPP to ensure all employees are given basic induction training on good operation and site management practices.

1. INTRODUCTION

1.1 BACKGROUND

1.1.1 The Power Plant

The New and Renewable Energy Authority (NREA) proposes to construct and operate an Integrated Solar Combined Cycle (ISCC) Power Plant at Kuraymat. The site is within an existing fenced area of uncultivated land in the eastern desert about 2 km distant from the Nile river at the kuraymat area in the southern part of Giza Governorate, approximately 95 km south of Cairo and 30 km north of Beni-sueif and about 750 m east of the existing residential community of the present Kuraymat thermal power plant. The overall proposed site area is approximately 2,772,000m^2.

The proposed power facility will consist of an integrated solar combined cycle power plant consists of a solar field and a combined cycle power block. Solar field basically composed of parabolic trough collectors and Heat Transfer Fluid (HTF) heat exchangers to generate steam. Combined cycle block mainly consist of two industrial heavy-duty type gas turbines (GT) each with a nominal electricity generation capacity of around 43 MWe at ISO conditions, unfired Heat Recovery Steam Generators (HRSGs) and steam turbine generator (STG) sized to match the maximum steam output from HRSGs and solar steam generator with capacity rated at about 67 MWe. The overall generating capacity of the power plant will be 150MWe. The power plant is intended to be fully operational by the year 2007.

The power plant will utilize natural gas as its primary fuel, and also have the capability to operate using sollar (fuel oil # 2). The ability to "dual-fuel" the power plant (with natural gas or sollar) will provide security of electricity supply in the event that gas supplies are unavailable for any reason.

1.1.2 The Proposed Site

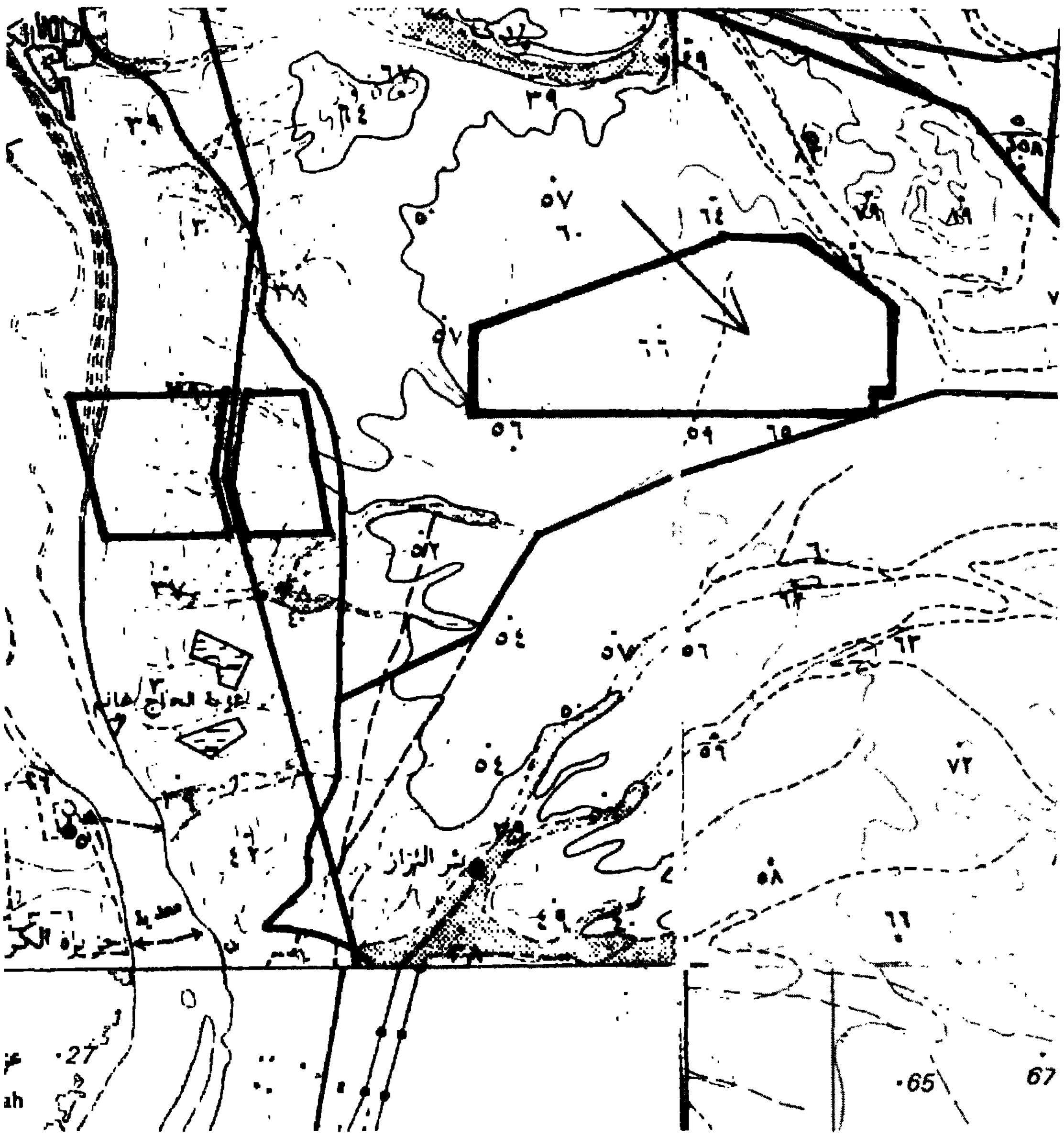
The proposed ISCC Kuraymat power plant site is located within 660 Feddans (i.e. 2,772,000 m^2) fenced uncultivated compound, which also does not contain any structure or activity, around 95 km south of Cairo. The site is surrounded by desert land and agricultural and residential properties. The Nile river is located to the west of the site area at an average distance of 2 km from the site boundaries.

The site of the proposed power plant is shown on *Figure 1-1.*

1.1.3 Fuel Supply

Natural gas will be delivered to the power plant by GASCO via an existing underground gas pipeline passes through the immediate north of the site boundary and supplying gas to the

Figure 1-1
The Site of the Proposed Power Plant



Existing Kuraymat power plant from Suez region. The pipeline will link the power plant with a pressure reducing station within the northern part of the site land.

1.1.4 Water Supply and Cooling

The power plant will incorporate a closed circuit cooling system using water abstracted from the Nile River. The abstracted water will also be used following pre-treatment demineralization, to provide process water make-up in the HRSG systems. Potable water supplies as well as other service waters will also be drawn from this water after treatment to support the plant water requirements.

The main demand for water is due to the closed circuit system. The use of a closed circuit cooling system minimizes the capital cost and maintains the electrical efficiency of the power plant at a good level. Only make-up water will be required to compensate water losses. Evaporative cooling towers are required; hence there is opportunity for water drift and the formation of visible plumes of water vapor and ground fogging.

To provide the make-up and service water, a pumping facility will be constructed on the Nile intake, the water will be abstract from the Nile river underground pipelines will be extended from the site across the bank line and out into the Nile river.

1.1.5 Electricity Supply and Transmission

The electricity generated by the proposed power plant will be exported via the 500 kV electricity transmission system of the existing Kuraymat power plant. The power plant will be connected to the 220/500 kV switchyard via step-up transformers. A 220 kV switchyard is proposed for the power evacuation considering the size of the power plant and the existing 220 kV/500 kV substation at a distance of about 2 km from the project site in the nearby steam power plant. A 220 kV switchyard will be located in the ISCC-KPP. Interconnection of this switchyard with the nearby switchyard at the existing thermal power plant, and providing additional outgoing line feeder for evacuating the power, if required, is to be decided in the course of further engineering in consultation with the concerned authorities. The generated power will be evacuated to the national grid via an overhead transmission line. The 500 kV lines are tied to Cairo via two single circuit overhead lines.

1.1.6 Access

The direct route to be taken to the site from Cairo starts with the Cairo/Beni-sueif road. This main road passes through Tebbin and Es-Saff leading to the Kuraymat site. There is another

Path which is around 60 km longer than the previous one. This path starts from Giza to El Badrashein, then to El-Ayyat, El-Wasta and finally Beni-sueif via Upper Egypt agriculture road along the west bank of the Nile River. From Beni-sueif, it crosses the Nile to the east bank and then follows Beni-sueif desert road 30 km to the north till the main entrance of the power plant. This path could be used as an alternative road only when Beni-sueif road is blocked for traffic.

The power plant has access from the Cairo/Beni-sueif Road from the west. A second access to the site is available from Beni-sueif Cairo Road from the west too. Third access road to the site is available from suez and El-Soukhna ports, direct to Zafarana and then to kuraymat site

1.2 ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROJECT

1.2.1 Requirement for an Environmental Impact Assessment (ELA)

The Guidelines for Egyptian Environmental Impact Assessment published by the Egyptian Environmental Affairs Agency (EEAA) specify that a " *...thermal power plant with a capacity greater than 30MWe"* falls within the category of "Black List Projects" which, due to their potential and substantial environmental impacts, must submit a full EIA to the Competent Administrative Authority (CAA) (the Govemorate of Giza) in order to obtain permission for development.

1.2.2 The EIA Report

This Environmental Impact Assessment Report (E1A Report) presents the findings of an assessment of the likely environmental impacts associated with the construction and operation of the power plant and associated cooling water infrastructure. The EIA report has been prepared to accompany the applications for consents from the Egyptian Government and local authorities to construct and operate the power plant.

1.2.3 Specified Information

The Egyptian Environmental Affairs Agency (EEAA) has published guidelines which require that certain information is provided in an ETA report (i.e. specified information).

Table 1-1 summarizes the required content of the EIA report which is indicated by the EEAA guidelines, and establishes where the information is provided within the EIA report. For information purposes, and for submission to the WB, *Table 1-1* also includes the equivalent requirements for an ETA report from the International Finance Corporation (IFC)/World Bank

Table 1-1
Location of Specified Information* in *the EIA Report

EEAA Guidelines for Egyptian Environmental Impact Assessment	*IFC/World Bank Guidance for Preparation of an Environmental Assessment*	*Section of the EIA Report*
1. Description of the proposed plant and	***Description of the proposed project:***	*Section*
• *Location of all related sites* • *general layout* • *maps showing setting* • *general* • *flow diagr'ms of operations* • *types of plant and equipment* • *raw material consumption* • *construction and operational activities* • *staffing* • *support facilities* • *waste production and storage* • *emissions to the air* • *noise generation* • *required off site investments* • *life expectancy*	• *location of the site(s), including directly linked invesvnents* • *provision of off-site services((energy, water, transport)* • *process flow diagram* • *location of effluent discharge points* • *emssions to air* • *emission to water* • *pollution control technology/treatment systems* • *alterations during construction (land grading)* • *clearance, road-building, etc.)* • *employment* • *organization of environmental management staff and associated training.* • *occupational health and safety conditions, programs and training(noise workplace air quality, hazardous areas, etc.)*	
2. ***Description*** *of* ***the environment,*** *including* ***baseline conditions and any changes expected in the future prior to development:***	***Description*** *of the* ***baseline environment using graphical presentation where*** *possible*	*Section 5*
• *geology, seismology, topography and soils* • *climate, meteorology and winds* • *air quality and existing sources of air pollution* • *surface water hydrology and flood* • *risks* • *coastal features,* • *water quality, existing sources of water pollution and uses* • *flora and fauna, sensitive habitats and species of commercial importance* • *local communities, land use,* • *planned developments, labor* • *market, income distribution,* • *goods and services, recreation* • *and public health* • *cultural, archaeological and* • *historical sites.* • *indigenous populations and* • *traditional tnbal lands*	• *climate and air quality* • *landform (topography, geology, soils)* • *hydrology, water quality,* • *groundwater resources* • *ecology, flora and fauna* • *land and water resource uses* • *socio-economic conditions* • *archaeological, historical and cultural* • *resources* • *environmental problems related to* • *past or current industrial operations*	

EEAA Guidelines for Egyptian Environmental Impact Assessment	***IFC/World Bank Guidance for Preparation of an Environmental Assessment***	***Section of the EIA Report***
3. Review of legislative and regulatory considerations, including regulations and standards at national, regional and local levels: • *environmental quality* • *health and safety* • *protection of sensitive areas* • *protection of endangered species* • *siting* • *land use control*	*Identification and outline of **all** applicable regulations and standards, including numerical standards:* • *environmental quality* • *health and safety* • *liquid effluents* • *emissions to air* • *solid waste management*	*Section 2*
*4. Determination of the potential impacts of the proposed **plant,** covering and long term impacts, including (but not limited to):* • *employment* • *wastewater* • *thermal effluent* • *emissions to air* • *land use* • *infrastructure* • *exposure to disease* • *noise* • *traffic* • *socio-cultural behavior* • *Terms of Reference for future* • *monitoring studies*	▪ *description of potential impacts of the proposed plant, including all significant environmental, socio economic, human health and safety impacts, covering construction and* • *operation, positive and negative, direct and indirect, immediate and long term impacts.* • *identification of any significant impacts which are unavoidable or irreversible* • *description of impacts in terms of environmental costs and benefits, assigning economic values where feasible* • *characterization and explanation of information deficiencies in the assessment*	*Section 6* *Annex B* *Annex C*
5. Description of alternatives to the proposed plant, inducing the "no action" alternative, and comparison of potential environmental impacts, capital and operating costs, suitability for local conditions and monitoring requirements: • *sitting* • *design* • *fuels* • *raw materials* • *technology* • *construction techniques and phasing* • *operating and maintenance procedures*	*Comparison of the impacts of alternative sites and processes, and key factors in decisions to select the proposed site and process*	*Section 3*

EEAA Guidelines for Egyptian Environmental Impact Assessment	***IFC/World Bank Guidance for Preparation of an Environmental Assessment***	***Section of the EIA Report***
6. Development of a management plan to mitigate adverse impacts including potentially significant construction and operational impacts and accidental events: • *effect of the mitigation measures* • *proposed work program* • *budget estimates* • *scheduling* • *institutional requirements* • *staffing and training requirements* • *support services* • *compensation for affected parties where no mitigation measures available*	*Proposals of mitigation of any significant adverse impacts and plans for ongoing management:* • *description of feasible and cost effective mitigation measures* • *budget estimates for capital and recurrent costs* • *institutional requirements* • *training requirements* • *work plans and schedules for mitigation* • *compensation for affected parties where no mitigation available*	*Section 7*
7. Development of a monitoring plan covering the implementation of the mitigation measures and impacts during construction and operation, including budget estimates of capital and operating costs	*Preparation of a detailed plan for monitoring to allow determination of rates and concentrations of emissions and waste discharges, occupational health and safety, effectiveness of mitigation measures, capital and operating costs, including (but not limited to):* • *stack emissions and ambient air quality* • *effluents released to surface water* • *accident frequency and severity* • *workplace temperature, noise and air quality* • *socio-economic conditions*	*Section 8* *Annex D*
8. Securing of inter-agency co-ordination and public / NGOs participation, including keeping of records of meetings, other activities, communications and comments	*Consultation with local NGOs, affected communities and other affected groups including keeping of records of steps taken to consult local interested parties, consultation meetings, other activities, communications, comment, key concerns of local interested parties and actions taken to modify the project and EM in response to public and community inputs*	*Section 9* *Annex A*

EEAA Guidelines for Egyptian Environmental Impact Assessment	*IFC/World Bank Guidance for Preparation of an Environmental Assessment*	*Section of the EIA Report*
9. ***Preparation of an Environmental Impact Assessment (EIA) report, organized according to the following outline:*** • *executive summary* • *golicy, legal and administrative framework* • *description of the proposed project* • *description of the environment* • *signifiant environnemental impacts* • *analysis of alternatives* • *mitigation/management plan* • *monitoring plan* • *inter-agency and public / NGOs* • *involvement* • *non-technical summary* • *list of references*	***Outline of an Environmental Impact Assessment (EIA) report:*** • *executive summary* • *introduction* • *policy, legal and administrative framework* • *project description* • *baseline data for the project site and area* • *environmental impacts* • *ntitigation / environmental management plan* • *monitoring plan* • *references* • *record of consultations with affected parties*	*Sections 1-9* *Annexes A-D*
	References including full citations for published sources and details of unpublished information and personal communications	*Section 1-9* *Annexes A-D*

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 PERMITS REQUIRED TO CONSTRUCT AND OPERATE THE POWER PLANT

The key permits required for the construction and operation of the proposed power plant are set out in *Table 2-1. These* permits set out and regulate the standards to which the power plant must be designed, constructed and operated.

Table 2-1

Key Permits Required for the Construction and Operation of the Power Plant

Permit	Permitting Authority	Relevant Legislation	Role of Permit
Construction Permit (for establishing a power plant project)	Egyptian Electric Utility and Consumer Protection Regulatory Agency	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection	Authorization to construct the power plant project
Construction Permit (for Buildings)	El-Burumbul Local Governing Unit, Giza Governorate	Law 101 (1996), *"Law for Buildings "*	Authorization to construct the power plant's Buildings.
Environmental Permit	Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs in conjunction with the Giza Governorate and New & Renewable Energy Authority (NREA)	Law 4 (1994), *"Law for the Environment"*	Authorization of the environmental effects of development and operation of the power plant
Water Abstraction Permit	Egyptian General Authority for Shore Protection, Ministry of Irrigation and Water Resources in conjunction with the EEAA	Law 4 (1994), *:Law for the Environment " and* Law 12 *(1984), "Law for Irrigation and Drainage"*	Authorization to construct and operate the abstraction of raw water via inlet pipeline coming to the plant boundary from the Nile river
Stack Construction Permit	Armed Forces Operations Authority, Ministry of Defense and Civil Aviation Authority, Ministry of Transport	Defense Regulations	Authorization to construct a stack from military considerations
Operation Permit	Egyptian Electric Utility and Consumer Protection Regulatory Agency	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection.	Authorization to produce electricity

In addition, a number of subsidiary permits will be required related to connection to, and use of, existing services and infrastructure, including the following:

- Electricity Supply Permit (if required) (Middle Egypt Electricity Distribution Company (MEDC), Egyptian Electricity Holding Company (EEHC), Ministry of Electricity & Energy);

- Connection to Gas Pipeline, Utilization of Gas Supply and Alternative Fuel Storage Permit; Egyptian Natural Gas Holding Company (EGAS) and Egyptian General Petroleum Corporation (EGPC), Ministry of Petroleum);

- Water Supply Permit (Giza Water Authority);

- Roadside Occupation (or Construction) Permit (General Authority for Roads, and Land Transport (GARBLT) Bridges Ministry of Transport),

- Transport of Special Loads Permit (Central Administration for Executing and Maintaining Roads and Bridges, Ministry of Transport);

- Communications Network Permit (Giza Telephone Authority, Egyptian Company for Communications, Ministry of Communications & Information); and

- Carrier (Portable) Communication Devices Permit (Giza Telephone Authority, Egyptian Company for Communications, Ministry of Communications & Information).

2.2 RELEVANT ENVIRONMENTAL POLICY, LEGAL AND ADMINISTRATIVE ISSUES

The environmental policy, legal and administrative framework which is relevant to the permitting of the power plant comprises the following:

- Requirement to conduct an EIA to accompany the development of the power plant;

- Regional development planning, which must be addressed in the development of the power plant, in particular:
  - land use planning and control;
  - siting;
  - protection of environmentally sensitive areas;
  - protection of endangered species.

- Environmental standards which must be considered in the design, layout, construction and operation of the power plant, including:

- emissions to air;
- generation and disposal of liquid effluents including cooling water;
- generation and disposal of solid and hazardous wastes;
- ambient environmental quality;
- health and safety.

Each of these aspects is reviewed in the following sections. In each case both Egyptian and International Finance Corporation (IFC) / World Bank (WB) standards and guidelines are considered, to reflect the relevant national requirements and those which may be expected from international financial institutions.

2.3 REQUIREMENT FOR AN EIA

2.3.1 Egyptian Requirement for an EIA

The development of a new power plant can only commence if a permit has been granted by the appropriate Competent Administrative Authority (CAA). Egyptian *Law 4 of 1994, Law for the Environment* (hereinafter referred to as Law 4) stipulates that applications for a license from an individual, company, organization or authority, subject to certain conditions, require an assessment of the likely environmental impacts.

The Egyptian Environmental Affairs Agency (EEAA) is the authority responsible for determining the type of development that requires an environmental appraisal and the level of detail at which the study should be conducted. The EEAA publication *Guidelines for Egyptian Environmental Impact Assessment* stipulates that *"..... thermal power plant with a capacity greater than 30 MWe"* falls within the category of "Black Listed Projects". This category requires a full EIA to be submitted to both the Competent Administrative Authority (CAA) (which, for thermal power plants, is the Egyptian Electricity Holding Company (EEHC) of the Ministry of Electricity & Energy) and the Licensing Authority (Which, for such type of project in the designated area, is the Giza Governorate) in support of any application for a permit to develop a power plant).

Since the proposed power plant has a nominal generating capacity of 150 MWe, a full EIA must be prepared and submitted to the Giza Governorate and EEHC for consideration prior to development of the plant.

2.3.2 IFC / World Bank (WB) Requirement for an EIA

The IFC follows a policy which stipulates that all operations are carried out in an environmentally responsible manner and that projects must comply with appropriate IFC guidelines or, if these have not been specifically developed, World Bank guidelines.

The World Bank sets out its procedures and policies with regard to conducting environmental assessment in *Operational Directive* 4.01: *Environmental Assessment* (October 1991). Annex E of the Directive identifies the process by which the level of investigation required in the environmental assessment is determined. It provides an illustrative list of Category "A" developments which require a full EIA, which includes thermal and hydro power projects.

Accordingly, if WB funding is sought, a full EIA for the power plant following World Bank guidelines must be conducted and submitted to the WB for consideration as part of any application for funding.

Other international banks and financing institutions also follow a similar approach and use the IFC / World Bank guidelines as a benchmark for the environmental assessment of international power projects prior to provision of finance. Hence, an EIA of similar scope is likely to be required to obtain commercial funding for the power plant from international institutions.

2.4 SCOPE OF THE EIA

The Egyptian Environmental Affairs Agency (EEAA) has published guidelines which require that certain information is provided in an EIA report (i.e. specified information).

Table 1-1 summarizes the required content of the EIA report which is indicated by the EEAA guidelines. and establishes where the information is provided within the EIA report. For information purposes, *Table 1-1* also includes the equivalent requirements for an EIA report from the World Bank.

The requirements for the scope of the EIA under Egyptian and IFC procedures, as described in Section 1.2, include the following:

- description of the proposed power plant;
- description of the baseline environment at the site;
- identification of the environmental standards which will be applied to the project, including those applying to protection of ambient environmental quality and specific conditions on the construction and operation of the power plant;
- identification of potential environmental impacts associated with the project;
- description of alternatives to the power plant, in terms of options for electricity supply in Egypt, design of the power plant and operating systems;
- development of proposals for mitigation and management of any potential environm-ental impacts;

- description of monitoring plans proposed to provide surveillance of the environmental impacts of the power plant during construction or operation; and
- demonstration that consultations with interested parties have been carried out as part of the EIA process.

In addition, both Egyptian and IFC/World Bank guidelines specify the broad organization of the EIA report, requirement for a non-technical summary for local, especially public, information and clear referencing of sources of data used in the assessment.

2.5 REGIONAL DEVELOPMENT PLANNING

The guidelines for EIA produced by the EEAA specify that the power plant should demonstrate compliance with national. regional and local development plans with respect to the following key aspects:

- Land use planning and control: a new industrial zone, and surrounding developments.
- Siting.
- Protection of environmentally sensitive areas.
- Protection of endangered species.

The proposed site lies on a land planned for development of power generation facilities by the NREA within the Giza Governorate, next to the present Kuraymat thermal power plant, at a distance of about 2 km east of the thermal power plant site.

2.6 INTERNATIONAL AND NATIONAL ENVIRONMENTAL STANDARDS/ GUIDELINES

2.6.1 Introduction

The Egyptian and IFC/World Bank environmental standards and guidelines relevant to the construction and operation of the power station cover the following issues:

- Atmospheric emissions and ambient air quality.
- Liquid effluent discharges to the Nile River environment.
- Noise emissions and ambient noise levels.
- Solid waste management.
- Solid hazardous waste management.
- Operation management: health and safety, air quality and noise levels.
- Construction management.
- Other environmental management issues.

The Egyptian standards have been drawn from the range of provisions in *Law 4 and the Prime Minister's Decree No. 338 of 1995,* which promulgate the *Executive Regulations of Law 4, as* *well as in the Law 48 of 1982 regarding the protection of the River Nile and waterways from pollution and its Implementary Regulations.*

The IFC guidelines have been taken from the IFC *Pollution Prevention and Abatement Handbook – Part III* (July, 1998). Supplementary to the guidelines set out in the IFC *Pollution Prevention and Abatement Handbook*, reference has also been made to the World Bank guidelines as set out in the *World Bank Environment, Health and Safety Guidelines: Thermal Power Plants* (1994).

2.6.2 Atmospheric Emissions and Ambient Air Quality

The Egyptian Government and IFC/World Bank have established ambient air quality standards applicable to power projects. The Egyptian standards and the IFC/WB guidelines on ambient air quality are shown in *Table 2-2.*

Table 2-2

Ambient Air Quality Guidelines (μgm^{-3})

Pollutant	Averaging Period	Egyptian Standards	WB Guidelines
Nitrogen oxides (NOx)	1 hour 24 hours 1 year	400 150 --	No Limit 150 100
Sulfur dioxide (SO2)	1 hour 24 hours 1 year	350 150 60	No Limit 150 80
Carbon monoxide (CO)	1 hour 8 hours	30,000 10,000	- -
Thoracic particles (PM10)	24 hours 1 year	70 --	150 50
Total suspended particles	24 hours 1 year	230 90	230 80

Egyptian standards and IFC/World Bank guidelines require the Owner to ensure that emission levels (or leakage) during construction and operation do not exceed set maximum limits for pollutant concentrations. Egyptian and IFC/WB guidelines for power stations on the maximum limits for pollutants in emissions to the air are shown in *Table 2-3.*

Table 2-3

Maximum Atmospheric Emission Guidelines (mg/Nm³)

Pollutant	Egyptian Standards (a)	WB (b) Guidelines
Nitrogen dioxide		
Gas	300	125
Oil	300	165
Sulfur dioxide	2,500	2,000 (c)
Suspended particles		
General	200	50
Sources in urban areas or near residential areas (d)	250	-
Sources far from inhabited urban areas (e)	500	-
Carbon monoxide	2,500 (d)	

Notes:

(a) The Egyptian regulations for fuel burning sources (Law 4, Article 42) do not specifically state whether emission limits refer to emission under standard or actual flow conditions. For consistency with other standards it has been assumed that the limits refer to standards flow conditions.

(b) IFC/WB guidelines for gas turbines differ than those for steam ones, whether the Egyptian standards are the same for both kinds of turbines. These guidelines should be achieved for 95% of the operating time of a plant.

(c) Total SO2 emissions from the power plant must not exceed 118 tone per day, calculated by WB approach of allowing 0.2 tpd per MWe for first 500 MWe and 0.1 tpd per MWe for each subsequent MWe. If two or more power plants are operating in the same airshed then the combined SO2 emissions must not exceed 500 tpd.

(d) Law 4, Article 42 states that emissions of suspended ashes in urban / residential areas should not exceed Ringlemann Chart 1, which Article 42 states is equivalent to an emission concentration of 250 mg/m^3.

(e) Law 4, Article 42 states that emissions of suspended particles far from inhabited areas should not exceed Ringlemann Chart 2, which Article 42 states is equivalent to an emission concentration of 500 mg/m^3.

Law 4 also applies specific conditions to the burning of fuels in power plants, as follows:

- Fuel / air mixtures and the combustion process should provide full burning of the fuel.

- The use of mazout and heavy oil is prohibited in residential areas.

- The Sulfur content of fuels is restricted to equal or less than 1.5% in or near urban and residential areas. The use of high Sulfur content fuels is permissible in regions far from inhabited urban areas provided that suitable atmospheric factors are present and adequate distances are observed to prevent these gasses from reaching residential and agricultural areas and watercourses.

- Emissions of carbon dioxide should be through stacks of sufficient height to ensure that the gases are dispersed before reaching ground level.

- Stack height should reflect the volumetric flow of flue gases. Law 4 states that for emission rates of 7,000-15,000kg hr^{-1} the stack height should be between 18-36m. If emission rates exceed 15,000 kg hr^{-1}, then the stack height should be at least 2.5 times the height of surrounding buildings.

IFC WB guidelines reinforce the Egyptian requirement of minimum stack heights by requiring plants to use stack heights not less than the Good Engineering Practice(1) values unless impact analysis has taken into account building downwash effects.

2.6.3 Liquid Effluent Discharges

Law 4 states that all establishments are prohibited from polluting the marine environment. Subsequently, no permit will be granted for an establishment on, or near, the coastline, which may result in discharges of polluting substances.

Annex 1 of the *Executive Regulations of Law 4* sets out the Egyptian standards concerning the concentration of pollutants in effluent discharged to the marine environment. A selection of the standards, relevant to thermal power plants, is shown in *Table 2-4*. In addition, the table also presents the equivalent World Bank guidelines. It should be noted that WB guidelines relate to all liquid effluent discharges, not solely to those to the marine environment.

Decree No. 8 of 1983 promulgating the Implementary Regulations of the Law 48 of 1982 regarding the protection of the River Nile and waterways from pollution provides the standards set by the Ministry of Health for permits to discharge treated industrial liquid effluents into the fresh water bodies and groundwater reservoirs (Article 61). *Table 2-4* also presents these standards.

(1) US Code of Federal Regulations Title 40, Part 51.100. Good Engineering Practice Stack Height = H + 1.5 L where H is the height of nearby structures and L is the lesser dimension of height or projected width of nearby buildings

Table 2-4

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) [(a)]

Parameter	Standards and Specifications Mandated by Law 48/1982 The maximum limits of constituents in treated industrial liquid effluents discharged to (Art. 61)		Limits & Specificcations for draining and disposing of certain substances in mandated by Law 4/1994(a) the marine environment	World Bank Wastewater Effluent Guidelines (1996)
	River Nile from its Southern Egyptian Border to the Delta Barrages	Nile Branches, main canals, branch canals, ditches & groundwater reservoirs		
Temperature (b)	35°C	35°C	Not more than 10 degrees over existing level	3oC increase above ambient (b)
pH	6-9	6-9	6-9	6-9
Color	No Col. substance	No Col. substance	Free of colored agents	
Biochemical Oxygen Demand (BOD)	30	20	60	-
Chemical Oxygen Demand (COD) (Dichromate)	40	30	100	
Total Dissolved Solids	1200	800	2000	
Fixed (Ash of) Dissolved Solids	1100	700	1800	
Suspended Solids	30	30	60	50
Turbidity			NTU 50	
Sulfides	1	1	1	
Oils and Grease	5	5	15	10
Hydrocarbons, of oil origin			0.5	
Phosphates	1	1	5	
Nitrates	30	30	40	
Phenolates			1	
Fl uorides	0.5	0.5	1	
Aluminum			3	
Ammonia (Nitrogen)			3	
Mercury Compounds	0.001	0.001	0.005	
Lead	0.05	0.05	0.5	
Cadmium	0.01	0.01	0.05	
Arsenic	0.05	0.05	0.05	
Chromium, total	0.05	0.05	1	0.5
Copper	1	1	1.5	0.5
Nickel	0.1	0.1	0.1	0.5
Iron	1	1	1.5	1.0
Manganese	0.05	0.05	1	
Zinc	1	1	5	1.0
Silver	0.05	0.05	0.1	
Barium			2	
Cobalt			2	
Pesticides			0.2	
Cyanide			0.1	

Table 2-4 (Contd.)

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) [(a)]

Parameter	Standards and Specifications Mandated by Law 48/1982 The maximum limits of constituents in treated industrial liquid effluents discharged to (Art. 61)		Limits & Specificcations for draining and disposing of certain substances in mandated by Law 4 1994(a) the marine environment	World Bank Wastewater Effluent Guidelines (1996)
	River Nile from its Southern Egyptian Border to the Delta Barrages	Nile Branches, main canals, branch canals, ditches & groundwater reservoirs		
Fecal Coliform Count (No. in 100ml)			5000	
Dissolved Oxygen				
Organic Nitrogen				
Total Alkalinity				
Sulphate				
Synthetic Detergents	0.05	0.05		
Phenol	0.002	0.001		
Selenium				
Chemical Oxygen Demad (Permanganate)	15	10		
Total Heavy Metals	1	1		-
Total Residual Chlorine(c)	1	1		0.2 (c)
Total Coliform (MPN/ 100ml)				
Odour				
Tannin + lignin				
Carbon derivatives (chloroform)				

Notes:

(a) Units of mgl^{-1} unless otherwise stated.

(b) The effluent should result in a temperature increase of no more than 5 °C at the edge of the zone where initial mixing and dilution take place. Where this zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance.

(c) "Chlorine shocking" may be preferable in certain circumstances, which involves using high chlorine levels for a few seconds rather than a continuous low level release. The maximum value is 2 mgl^{-1} for up to 2 hours, which must not be more frequent than once in 24 hours (and the 24 hour average should be 0.2 mgl^{-1}).

Further to these guidelines, Law 4 also applies certain planning conditions for developments along or adjacent to the coastline:

- The discharge of effluents into swimming or fishing zones, or natural reserves, is prohibited to ensure that the economic or aesthetic value of the zones or reserves are not compromised.

- Any measures which are likely to cause changes in the natural coastline (erosion, sedimentation, coastal currents and pollution from the project or associated works) are restricted, except with the approval of the CAA.

- Any development within 200 m of the coast (sea shore) must gain approval from the CAA.

2.6.4 Noise Emissions and Ambient Noise Levels

Law 4 stipulates that a Owner must ensure that an establishment is compatible with the character of its setting. Amongst other issues, this involves limiting the effect of combined noise from all site sources on the surrounding environment to acceptable ambient limits. Guidance levels for ambient noise is dependent upon the land use surrounding the site, and Egyptian ambient noise guidelines are set with respect to five different land use categories. The Egyptian ambient noise guidelines are shown in *Table 2-5*, together with the related land uses.

The IFC/WB ambient noise guidelines differ from those of the Egyptian Government in that they only differentiate between two land use categories, as presented in *Table 2-6*.

Table 2-5

Egyptian Ambient Noise Limits for Intensity in Different Land Use Zones

Receptor	Daytime (a) dB(A)	Evening (b) dB(A)	Night (c) dB (A)
Industrial areas (heavy industries)	60-70	55-65	50-60
Commercial, administrative and "downtown" areas	55-65	50-60	45-55
Residential areas, including some workshops or commercial businesses or on public roads	50-60	45-55	40-50
Residential areas in the city	45-55	40-50	35-45
Residential suburbs having low traffic	40-50	35-45	30-40
Rural residential areas (hospitals and gardens)	35-45	30-40	25-35

Notes:
(a) Daytime from 7 am to 6 pm
(b) Evening from 6 pm to 10 pm
(c) Night-time from 10 pm to 7 am

Table 2-6

WB Ambient Noise Guidelines for Intensity in Different Land Use Zones

Receptor	Maximum Allowable $L_{Aeq, 1\text{-hour}}$ dB(A) (a)	
	Daytime 0.7:00 – 22:00	Night-time 22:00 – 07:00
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Notes:

(a) Noise abatement measures should achieve either the WB guidelines or a maximum increase of background levels of 3 dB (A). Measurements are to be taken at noise receptors outside the project property boundary.

2.6.5 Solid and Hazardous Waste Management

Law 4 stipulates that handling of hazardous substances and waste is prohibited unless a permit has been issued by the competent authority.

The handler of wastes must:

- possess a permit issued by the appropriate CAA to handle wastes;
- store and dispose of wastes in designated sites agreed with the CAA;
- maintain appropriate systems of storage, including packaging and labeling, containers and storage duration;
- operate appropriate transportation systems to authorized disposal sites;
- maintain a register of all hazardous wastes and disposal methods; and
- develop an emergency plan in case of spillages.

Further to the Egyptian guidelines, the World Bank requires that the individual / company operating the power plant must ensure that:

- all hazardous materials are stored in clearly labeled containers;
- storage and handling of hazardous materials is in accordance with national and local regulations appropriate to their hazard characteristics; and

- fire prevention systems and secondary containment should be provided for storage facilities, where necessary, to prevent fires or the releases of hazardous materials to the environment.

2.6.6 Occupational Environmental Management and Health & Safety

Workplace Air Quality, Temperature and Humidity

Egyptian regulations require that the owner of the power plant must ensure that air quality in the workplace is maintained within fixed limits. Accordingly, the owner is obliged to ensure the protection of the work force through implementing health and safety measures on-site, including by the choice of plant and equipment, process substances, types of fuels, ventilation of working areas or other air cleaning methods.

The IFC/World Bank requires that any individual / company managing or operating a power plant must:

- conduct periodic monitoring of the workplace air quality with respect to air contaminants relevant to employees tasks;
- maintain ventilation and air contaminant control, and provide protective respiratory and air quality monitoring equipment; and
- ensure that protective respiratory equipment is used by employees when levels of welding fumes, solvents and other materials exceed international, national or local accepted standards.

Egyptian and IFC/World Bank threshold limit values for carbon monoxide, nitrogen dioxide, sulfur dioxide and particulate in the workplace are provided in *Table 2-7.*

In addition to air quality, under Law 4, the owner of the power plant must also ensure that temperature does not exceed maximum and minimum permissible limits, as set out in *Table 2-8.* In case of work in temperatures outside these limits, the owner must provide suitable acclimatization to workers and/or protective measures.

Table 2-7

Egyptian and World Bank Air Quality Guidelines in the Workplace

Atmospheric Pollutant	Egyptian Guidelines [a]	WB Guidelines
Carbon monoxide	55 mg m^{-3}	29 mg m^{-3}
Nitrogen dioxide	6 mg m^{-3}	6 mg m^{-3}
Sulfur dioxide	5 mg m^{-3}	5 mg m^{-3}
Particulate [b]	10 mg m^{-3}	10 mg m^{-3}

Notes:
(a) Egyptian air quality guidelines in the workplace are determined by exposure time. Readings provided are "mean time", the limit to which workers are exposed during a normal working day.
(b) Inert and nuisance dust.

Table 2-8

Egyptian Maximum Air Temperature Limits [a]

Type of Work	Low Air Flow	High Air Flow
Light	30.0°C	32.2°C
Medium	27.8°C	30.5°C
Hard	26.1°C	29.8°C

Notes:
(a) In periods of high temperature, workers should be monitored. No worker should work be exposed to heat stress (above 24.5°C for women and above 26.1 °C for men) for more than one continuous hour or one intermittent hour in every two, without acclimatization.

Workplace Noise

Law 4 restricts noise in the workplace to within limits of intensity and exposure time. Egyptian guidelines are shown in the following tables:

- *Table 2-9* presents occupational noise guidelines with respect to continuous exposure to noise below 90 dB (A).

- *Table 2-10* presents occupational noise guidelines with respect to permitted exposure periods to continuous noise in excess of 90 dB (A).
- *Table 2-11* presents occupational noise guidelines with respect to exposure periods to intermittent noise.

It has been assumed that these limits apply at worker positions and will be generally free field noise levels.

In addition to the Egyptian guidelines, the World Bank guidelines require that the individual/ company managing or operating a power plant must ensure that.

- noise in work areas is reduced by using feasible administrative and engineering controls (including sound-insulated equipment and control rooms);
- good maintenance practices to minimize noise production from plant and equipment; and
- personnel use hearing protection equipment when exposed to noise levels above 85 dB (A).

Table 2-9

Egyptian Guidelines for Maximum Permissible Limits of Sound Intensity Inside Places of Industrial Activity

Receptor	Maximum Allowable Level of Sound (dB(A))
Work premises with up to 8 hour shifts with the aim of limiting noise hazards on hearing[1]	90
Places of work that require hearing signals and good audibility of speech	80
Places of work for the follow up, measuring and adjustment of operations with high performance	65

Notes:
(a) For periods extending longer than 8 hours lower noise limits will be defined

Table 2-10

Egyptian Guidelines on Periods of Exposure to Noise

Noise Intensity (dB(A))	Period of Exposure per Day (Hours)
> 90-95	4
>95-100	2
>100-105	1
>105-110	0.5
>110-115	0.25

Table 2-11

Egyptian Guidelines on Permissible Limits Concerning Intermittent Noise Inside the Workplace

Noise Intensity (dB(A))	Number of Permissible Noise Events During Normal Working Hours
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Electrical Safety in the Workplace

The Egyptian Code of practice of electrical safety in power system requires that any power plant management, and the IFC/World Bank requires that any individual / company managing or operating a power plant, must ensure that:

- Strict procedures are provided and followed for de-energizing and checking electrical equipment before maintenance work.

- Strict safety procedures are implemented, including constant supervision, when performing maintenance work on energized equipment.

- Personnel training is provided on revival techniques for electrocution.

Working in Confined Spaces

The Egyptian Industrial Codes and the IFC/World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- Prior to entry and occupancy, all confined spaces must be tested for the presence of toxic, flammable and explosive gas or vapors and lack of oxygen

- Adequate ventilation is available in any confined working spaces.

- Personnel working in confined spaces that may become contaminated or deficient in oxygen are provided with air-supplied respirators.

- Observers are stationed outside when personnel are working in confined spaces which are likely to become contaminated or to be affected by a shortage of air supply.

General Health and Safety

The Egyptian Industrial Codes and the IFC/World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- Sanitary facilities are well equipped with supplies and employees should be encouraged to wash frequently, particularly those exposed to dust, chemicals or pathogens.

- Ventilation systems are provided to control the temperature and humidity of working areas.

- Personnel working in high temperatures or humidity are allowed frequent breaks away from these areas.

- Pre-employment and periodical medical examinations are conducted for all personnel and surveillance programs instituted for personnel potentially exposed to toxic or radioactive substances.

- Personnel are protected by shield guard or guard railings from all belts, pulleys or gears and other moving parts.

- Elevated platforms, walkways, stairs and ramps are equipped with handrails, toeboards and non-slip surfaces.

- Electrical equipment is "earthed", well insulated and conforms with applicable codes.
- Personnel use special footwear, masks and clothing when working in areas with high dust levels or contaminated with hazardous materials.
- Employees are provided with appropriate protective equipment when working near molten or high temperature materials (protective equipment may include, amongst others, non-slip footwear, safety glasses, etc).
- Employees wear eye protective measures when working in areas at risk of flying chips or sparks or where bright light is generated.
- Employees wear protective clothing and goggles in areas where corrosive materials are stored or processed.
- Appropriate eyewash and showers are installed in areas containing corrosive materials.
- A safety program is implemented and regular drills are conducted.

Personnel Training

Law 4 stipulates that operators should be trained when using or handling any hazardous waste materials.

In addition, the EEAA Master Plan for Solid & Hazardous Waste Management and the IFC/World Bank require that the individual / company managing or operating a power plant must ensure that:

- employees are trained on the hazards, precautions, and procedures for the safe storage, handling and use of potentially harmful substances;
- training incorporates information from the "Material Safety Data Sheets" (MSDSs) for potentially harmful materials; and
- personnel are trained with regard to environmental health and safety matters, including accident prevention, safe lifting practices, the use of MSDS safe chemical handling practices and proper control and maintenance of equipment and facilities.

Monitoring and Record Keeping and Reporting

Law 4, Articles 17 & 18, requires, for industrial facilities, the operator monitors the site in order to optimize performance. Direct measurement of atmospheric concentrations of pollutants in the exhaust gas is required. Averaging times for direct emissions should be based on regular based measurements.

Law 4 also stipulates that the owner of the power plant should maintain an Environmental Register of written records with respect to the environmental impacts from the establishment. The written records should identify the characteristics of discharges and emissions, details of periodic testing and its results, procedures of follow-up environmental safety, and the name of the person in charge of follow-up. The owner of the power plant, or its representatives, are responsible for informing the EEAA of any emitted or discharged pollutants deviating from prescribed standards and any appropriate procedures taken to rectify them.

Also, the IFC/WB guidelines require the operator monitors the site in order to optimize performance. Direct measurement of atmospheric concentrations of particulate matter, NOx and SO2 and heavy metals in the exhaust emissions is preferable. Averaging times for direct emissions should be based on an hourly rolling average.

The IFC/WB guidance requires ambient air quality to be monitored at least at 3 locations where there is: a) least pollution expected; b) maximum pollution concentration expected; and c) sensitive receptors. The ambient air quality parameters that require monitoring for gas fired plants are NOx, SO_2 and PM_{10}.

Law 4 also, as well as IFC/WB guidance, requires the owner/operator to monitor the wastewater discharges. The parameters to be examined and sampling frequency are set out in *Table 2-12*.

Table 2-12

EEAA and World Bank Requirements for Monitoring Wastewater Discharges

Parameter	Proposed Monitoring Frequency
pH	Continuous
Temperature	Continuous
Suspended solids	Daily
Oil and grease	Daily
Residual chlorine	Daily
Heavy metals	Monthly
Other pollutants	Monthly

In addition, the EEAA and the IFC/WB require that the individual / company managing or operating an industrial facility (such as a power plant) must:

- maintain records of significant environmental matters, including monitoring data, accidents and occupational illnesses, and spills, fires and other emergencies;

- information from the above is reviewed and evaluated to improve the effectiveness of the environmental, health and safety program; and

- submit an annual summary of recorded information to the EEAA (and to the WB if involved).

2.6.7 Construction Management

Law 4 requires that guidelines on environmental management and protection, including those related to noise, land, aquatic and atmospheric pollution, waste management and health and safety must be adhered to during the construction process.

In particular, when handling and storing soils and wastes during construction, all organizations and individuals must ensure that storage and transportation is undertaken in such a manner to minimize escape or dispersion into the environment.

2.6.8 Other Environmental Issues

Pesticides and Chemical Compounds

Law 4 states that spraying of pesticides or other chemical compounds is prohibited except after complying with the conditions, norms and guarantees set by the Ministry of Agriculture, the Ministry of Health and the EEAA. The conditions for such use are as follows:

- Notification to the health and veterinary units of the types of sprays being used and antidotes before spraying.

- Provision of necessary first aid supplies.

- Provision of protective clothing and materials.

- Warning of the public in spraying areas.

- Training of laborers conducting the spraying.

Other Chemicals

The EEAA and the IFC/WB require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- use of formulations containing chromate's is avoided;

- transformers or equipment that either contain polychlorinated biphenyls (PCBs) or use PCB-contaminated oil are not installed;

- processes, equipment and central cooling systems that use or potentially release chlorofluorocarbons (CFCs), including Halon, are avoided;

- storage and liquid impoundment areas for fuels and raw and in-process materials, solvents and wastes and finished products are designed in such a way to prevent spills and the contamination of soil, groundwater and surface waters.

3. ANALYSIS OF ALTERNATIVES

3.1 CURRENT SITUATION ("NO ACTION" OPTION)

3.1.1 Electricity Demand

Egypt has a rapidly expanding economy that is dependent on the availability of reliable and low cost electric power. The annual average rate of growth of electricity demand in Egypt is expected to range between 6.5-7.5% during this decade. Peak demand is expected to rise from 14,400 MWe in 2003 to 22,000 MWe by 2010 and installed capacity is expected to increase from 17,750 MWe to 25,000 MWe during the same period.

In 2003, about 98.5% of the population was served by the Egyptian electricity grid. Of total demand of 88 TWh on the interconnected system, about 17% was met by hydropower, principally the High Dam and Aswan 1 & 2, and the remaining was met with thermal plants, of which 90% were supplied from natural gas and 10% heavy oil.

The rate of growth in demand for electricity is forecasted to continue at the aforementioned level before gradually decreasing to a growth rate of 5.7% per year over the subsequent 10 years.

In order to meet the forecasted demand, the Ministry of Electricity & Energy (MEE) estimates that an additional 10,000 MWe of new generating capacity will be required during the next 12 years.

3.1.2 Electricity Generation and supply

The Ministry of Electricity & Energy (MEE) is responsible for all aspects of the power sector in Egypt. The Egyptian Electricity Holding Company (EEHC) is responsible for power sector administration. The Egyptian Electricity Transmission Company (EETC) is responsible for ultra high voltage and high voltage transmission, system control and dispatching in Egypt and export-import contracts of energy.

The EETC owns and operates the electricity transmission system, which consists of over 36,000 km of 500 kV, 220 kV, 132 kV, 66kV and 33 kV transmission lines. Further developments of the transmission system is also planned.

In addition to EEHC, the power sector consists of a few IPPs selling to EETC: New and Renewable Energy Authority (NREA) Zafarana windfarm and three privately-owned power plants under Build, Own, Operate and Transfer (BOOT) financing schemes; and few IPPs selling power in the isolated markets.

3.1.3 Increased Need for Promoting Renewables for Power Generation

Earlier work by the New and Renewable Energy Authority, in cooperation with the World Bank-UNDP Energy Sector Management Assistance Program, identified wind and solar as the resources most likely to be economically exploitable for electricity production over the medium term.

Egypt's resolve to increase use of renewables is driven in part by environmental considerations, and in part by an interest in diversification of energy supply. The country has a powerful interest in climate change mitigation since it stands to suffer severely in the event of sea level rise by losing up to 20% of its inhabited area and is already affected adversely by land loss phenomena in the Nile Delta's coastal fringes. The power sector also plays a role in generating local air pollution though not as significantly as the transport and industrial sectors due to maximizing the use of natural gas as a primary fuel. The recognition of the need to maintain diverse energy sources remains important, given that Egypt is becoming increasingly dependent on a local single source-gas-which also has export market potential. The country also sees renewables as an important potential industry worthy of development, and one which plays well to its comparative advantage of a large, well educated and comparatively low-cost workforce, and to its strong trade links throughout the Middle East and North African regions, as well as Europe and United States.

Need for promoting renewables for power generation arises, also, from the social perspective of energy within the context of sustainable development.

Energy is of vital importance to the satisfaction of basic needs. Energy services constitute a sizable share of total household expenditure in developing countries such as Egypt. People living in poverty spend a higher proportion of their income on energy.

The substitution of modern energy carriers would confer sizable gains in purchasing power on poor urban households. Improvements in energy supply have considerable potential to reduce poverty in all of its key dimensions, and to facilitate development.

Policies and programs that directly address the creation of opportunities for people living in poverty to improve the level and quality of their energy services (by, for instance, shifting to higher quality energy carriers such as the ISCC project) will allow the poor to enjoy both short-term and self-reinforcing long-term improvements in their standard of living.

Policies which provide a better balance between conventional sources and renewables and efficiency improvements will have powerful direct, and indirect, influences on solving many of the national or global issues such as poverty, climate change and sustainable development.

In fact, energy renewables, such as ISCC project, are an instrument for the achievement of sustainable development.

This conforms with Egypt's follow-up to the Johannesburg WSSD which underscored the poverty alleviation benefits of energy by highlighting the merits of renewable energy and calling for parties to:

" .... take joint actions and improve efforts to work together at all levels to improve access to reliable and affordable energy services for sustainable development.... bearing in mind that access to energy facilitates the eradication of poverty. This would include actions at all levels to .... improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources.

3.1.4 The "No Action" Option

The no action alternative will result in the demand for electricity exceeding supply, with an increasing deficit as demand increases in future years. A lack of secure and reliable electricity generation and supply system has significant social, economic and environmental implications, since it will:

- constrain existing and future economic development and investment;
- restrict socio-economic development; and
- inhibit provision of public health and social services.

In addition, the no action alternative will result in inhibiting Egypt's ambitious program, supported internationally by the Global Environment Facility (GEF) and the World Bank (WB), to promote the supply and use of renewable energy, and in retrogression of the national efforts for combating climate change.

As a result, the "no action" option is not a viable or acceptable alternative to the proposed project.

3.1.5 MEE's Generation Expansion Plan

The Ministry of Electricity & Energy (MEE) has established a generation expansion plan which is intended to achieve the following:

- meet future demand for electricity;
- maintain and improve generation and transmission reliability; and
- introduce new technologies (fresh knowledge and modern know-how).

In adherence with this strategy, the MEE has identified the Kuraymat ISCC power project to help implement its expansion in generation capacity. Hence, the proposed generation project is compatible and an essential component of the MEE generation growth plan to meet present and future demand for electricity.

3.1.6 Selection of the Proposed Technology

The MEE has an objective to provide a secure, reliable electricity generation and distribution system for Egypt. A key element in meeting this objective is the establishment of a diversity of technologies to avoid over-reliance on any particular technology, which may adversely affect the ability to provide electricity or meet the fluctuations in demand which occur on a daily basis or seasonally.

The MEE generation expansion plan includes provision of the following:

- gas/oil-fired steam units;
- gas/oil-fired combined cycle units;
- gas/oil-fired simple cycle combustion turbine units;
- pumped storage;
- wind farms; and
- hybrid solar-thermal generation.

Consistent with the plan, the NREA has specified that the Kuraymat power project should be integrated solar thermal gas/oil-fired combined cycle power plant of 150 MWe nominal generating capacity. The reasons for the selection of this technology are as follows:

- Existing and planned generating capacity using wind farms is already considered on the run, given the greater commercial maturity of wind and the interest of bilateral donors which permitted a more rapid build up of experience in developing wind farms.

- Further step forward in promoting diverse of energy sources is important for the future of economic development of the country as well as the future diversification of renewable energy sources.

- There must be room for the development of new energy forms that would compensate for the finite nature of some types of existing energy supplies or would use technologies in new ways to reduce harmful side effects of current energy production or utilization. Energy diversification and GHGs minimization are relevant strategies.

- An existing labor force is available which is competent in the construction, operation and maintenance of combined cycle units. Hence, the selection of combined cycle units, integrated with a solar field to generate more steam for the combined part of the plant, allows greater local employment benefits to be obtained and should be economically advantageous.

Hence, the technology chosen by the NREA for the project is an Integrated Solar Combined Cycle system.

3.2 ALTERNATIVE DESIGNS OF THE POWER PLANT

There are a wide variety of potential designs for the proposed power plant which considers technical, economic and environmental issues. Key design features of the power plant that are associated with environmental impacts are summarized in *Tale 3-1*.

On the basis of the key design features selected for the power plant summarized in *Table 3-1*, together with general good practice included within its overall design and layout, fuel and chemical storage facilities and pollution monitoring equipment as a whole, the power plant offers a range of environmental benefits which minimizes its potential impacts on the environment whilst ensuring safe, secure and efficient operation.

3.3 ALTERNATIVE SITES

The NREA selected the ISCC project site for the power plant from a group of alternative sites:

- Zafarana;
- 6th of October City;
- Borg El-Arab; and
- Kuraymat Desert.

The key criteria used in the evaluation of the alternative sites by the NREA were as follows:

- Economic factors:
  - capital costs;
  - operation and maintenance costs;
  - requirements for cooling water;
  - requirements for electricity transmission lines/sub-stations; and
  - Requirements for natural gas.

- non-economic factors:
  - potential environmental impacts;
  - site development.

Table 3-2 provides with the conclusion of characteristics comparison and evaluation of potential sits selected by NREA for the ISCC project.

The key findings of the consideration of alternative sites are summarized in *Table 3-3*. The consideration of alternative sites by the NREA indicated that Kuraymat has no significant disadvantages and has several beneficial aspects and desirable site development characteristics. Therefore, Kuraymat was selected as the preferred site for the power plant.

Table 3-1

Alternative Designs of the Power Plant

Item	Discussion of Alternatives	Selected Design
Solar Thermal-Electric System (STES) (Solar Field)	Solar-thermal-electric systems (STES) collect solar radiation, convert it to thermal energy first and then to mechanical energy via a thermodynamic cycle to drive an electromechanical energy conversion device to generate electrical energy. Categories of STES: (a) distributed collector systems and (b) central receiver system. In distributed collector central generation system, solar energy is collected throughout the collector field and the heat is transported to a central energy conversion plant via a pumped fluid or chemical through a piping network. In another approach, electricity is generated at each collector and brought to a central point for transmission. This concept is known as distributed collection with distributed generation. In the central receiver system, a large field of steered mirrors (called heliostats) reflect solar radiation to a single receiver mounted on a central tower. The solar collector field, in effect, is a large parabolic steerable reflector of focal length equal to the tower height (typically 200 to 600m). With a proper design for the receiver, high temperature steam is generated which is then used in a steam turbine driving a generator to produce electrical energy. Solar thermal power plant do not emit gaseous, liquid or solid effluents like fossil fuel plants. They are relatively "neutral" as far as excess heat rejection is concerned: that is, heat left at the site is similar to what would have been deposited if no plants were there. A central solar thermal plant is estimated to create an excess of about 0.25 MW (t) per 1MW (e) which is very low in comparison to 1.7 MW (t) for a fossil fuel thermal plant.	The parabolic trough distributed collector system is selected. More proved technology to be used for the first time in Egypt. It is the major type utilized today of linear concentrating system. The system is commercially available from several suppliers. The higher concentration of this system compared to lower temperature systems leads to higher temperatures and higher efficiencies. No significant advers environmental impacts are predicted to occur with this system compared to potential localized environmental changes associated with heliostat fields. Accidental spills or potential leakages of the thermal fluid are manageable. Water use for mirror washing and cleaning is very limited and the resulting water drains are controllable.

Item	Discussion of Alternatives	Selected Design
	The heliostat field associated with a solar thermal power plant could produce localized changes in the net albedo, energy balance, moisture-balance, low-level wind-flow patterns, and air/surface temperatures. The impact of such changes on microclimate within and immediately surrounding the solar thermal power plant remains to be adequately assessed. It is commonly stated that a major draw-back of solar power plants is the extensive land requirement. However, the amount of land required for a solar plant is comparable to what required by the system which provides electricity from fossil fuels. While the area requirements are comparable in the case of fossil fuels, operation of the solar unit would actually involve a more benign use of the land. However, it is claimed that heliostat fields might disrupt the ecology of the area, especially if located in desert areas. Although this might be the case in certain locations, the location of heliostat fields in some deserts (e.g. in North Africa) would have beneficial effects by creating centres of activities in such barren areas, attracting, for example, nomads to settle down near such centres.	
Stack height	The stack can be a range of heights. Dispersion is improved by increasing the stack height, but engineering requirements, eg structural support and foundations, and associated costs are also increased with stack height.	35m stack height is in conformance with the Good Engineering Practice (GEP) stack height.

Item	Discussion of Alternatives	Selected Design
Air pollution control	There is a range of technologies which may be used to minimize emissions from the power plant, which can be divided into two categories: • fuel combustion controls • "end-of pipe" gas cleaning The most effective approach is to control combustion of the fuel such that the production of the emissions is minimized, obviating the need to use gas cleaning equipment (which addresses the results rather than the source of emissions). End- of- pipe solutions are also expensive compared to combustion controls.	The Gas Turbine units will be dry NOx type, minimizing the emission of NOx which is the key pollutant associated with combustion of natural gas. Detailed design will also consider further NOx reduction techniques, such as low NOx combustors. Air pollution control systems will ensure compliance with the EEAA emission standards and WB guidelines for power plant.
Cooling system	There are 3 generic cooling systems which may be used: • direct (once-through) water cooling; • indirect water cooling using evaporative cooling towers; • air cooling via air cooled condensers. Direct water cooling maximizes the generating efficiency of a power plant, but requires large quantities of cooling water and involve the construction of intake and outfall infrastructure. A cooling tower system uses less water, but is associated with relatively lower generating efficiency and visible plumes of water vapor which can cause ground fogging. Although cooling towers use less water it results in a net water loss which needs to be compensated by makeup. Air cooled condensers have the lowest generating efficiency but do not use water, although noise and visual impacts are higher than the other options.	Indirect water cooling utilizing evaporative cooling towers will be used, which maintains generating efficiency in a relatively good order and minimizes considerably the required capital cost. A sustainable water supply is available from the Nile river or the underlying aquifer via a ground well to be digged on the site. In case abstracting water from the Nile river, intake structures can be constructed without significant environmental impacts. The potential for visible vapor plumes or ground fogging is acceptable since the prevailing wind is in the NS and NW directions and the site of the power facility is about 1.2 km distant from the road. Noise will not trespass the power plant boundary and visual impacts will be accommodated within the wider landscape surrounding the site.

Item	Discussion of Alternatives	Selected Design
Cooling water intake structures	The cooling water intake may have a range of alternative designs, including the following key factors: • Relative locations on the Nile bed (which control potential re-circulation of warm water resulting from exiting Kuraymat power plant cooling discharge system into the intake). • Design (flow rate, flow velocity, height above Nile bed, orientation, .. etc). • Screens to prevent entrainment of aquatic organisms.	The cooling water intake infrastructure – if Nile waters decided to be used – will be located such that there will be no effects from the operation of the existing power plant through re-circulation of warm water from the cooling water discharge into the intake structure. The orientations, flow rates and flow velocities of the intake will be designed to avoid scour of the Nile bed and change to sedimentation. The cross section of the intake above the Nile bed will be designed to avoid any potential interference with Nile navigation. The intake orientation, flow rate and velocity will be designed to minimize entrainment of fish and other aquatic organisms. Fish screens will also be fitted to the intake.
Effluent treatment and disposal	There is a range of technologies which may be used to treat effluent from the power plant. The main effluent characteristics of concern are pH, suspended solid material and oil/grease residues. These characteristics may be treated by: • pH adjustment by acid/alkali addition; • filtration of suspended solids; • interception of surface oily substances; The available options for disposal are to discharge treated effluent to a natural drainage basin/wadi or to a ground well.	The treatment system consists of modules for treating wastewater streams generated by the power plant. This is achieved by selectively combining some of these waste streams and providing treatment as required prior to routing to a natural drainage basin/wadi or to a ground well. Effluent treatment systems will ensure compliance with the EEAA discharge standards for power plants.

Item	Discussion of Alternatives	Selected Design
Use of water treatment chemicals	There is a range of proprietary water treatment chemicals available for use in power plants. The approach to the use of water treatment chemicals is determined by the quality of the raw feedwater, requirements of the power systems to operate safely and efficiently and management of the power plant. The use of water treatment chemicals is inherent in the operation of the power plant, although how the chemicals are used can be controlled.	The use of water treatment chemicals will be reduced to the minimum required to achieve safe and efficient operation of the power plant. The control of the use of water treatment chemicals will include consideration of the type of chemical used, dosing regime and control of residual concentrations in the process effluent and cooling water drift.

Table 3-2

Characteristics of Egyptian Sites Reviewed

Site Characteristic		Zafarana	Kuraymat	6th of Oct.	Borg E-Arab
Geographical Location					
- Longitude		32°20E	32°20E	30°45E	29°30E
- Latitude		29°10N	29°5N	29°5N	30°39N
- Boundary - Landscape		Open area at red sea coasts surrounded by desert	Nile (W) & desert (E) adjacent to 2x600MW gas fired steam power plant	Desert (W) & Access road (G), open desert nearby the pyramids	Farm land Adjacent to substation
Radiation & Atmospherics					
Direct Radiation	kWh/m^2a	2688	2630	2590	2263
Avg. Wind speed at 10 m	m/s	7.8	2.5	2.3	5.3
Min. Ambient temp	°C	19.0	15.9	15.0	13.8
Max. Ambient temp	°C	27.3	28.4	28.0	28.2
Relative humidity	%	57	54	54	64
Avg. Cloud Cover	%	12.5	15	21	30
Land		NREA Owned	EEHC Owned	EEHC Owned	NREA Owned
Available Area	km^2	80.0	2.0	2.0	2.0
Avg. Cost	$\$/m^2$	Free	Free	0.50	Free
Current use		Open	Open	Open	Free
Soil type		Sand/gravel	Sand/gravel	Sand	Sand/gravel
Slope (Avg.)	%	<1	<1	2-3	<1
Earthquake potential		3-4	3		
Electric Grid					
Voltage	kV	220/66	220/66	500/220/66	220/66
Proximity	km	on site 1997	on site	on site	on site
Natural Gas Pipelines					
Pressure	bar	90	20	90	20
Proximity	km	on site	on site	(2-4)	
Requirement		reducing station	short connections	reducing station	
Water					
Source		Sea water/pipeline	Nile water	Pipeline	Pipeline
Proximity		on site/20km	(0.5-1)	(1-2)	on site

Table 3-3

Key Findings of the Consideration of Alternative Sites

Site	Key Findings
Zafarana	Significant infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
6th of October City	Significant infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
Borg El-Arab	Significant infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
Kuraymat Desert	Minimal additional infrastructure would be required. Cost-effective site for development (first lowest of the four alternative sites). A workers colony is NOT required as the project will use the local workforce from Giza and Beni-sueif area.

4. DESCRIPTION OF THE PROPOSED PROJECT

4.1 PROJECT INFRASTRUCTURE

Project infrastructure description is provided by Fichtner Solar GmbH. The development *of* Kuraymat Integrated Solar Combined Cycle Power Plant will consist of the infrastructure set *out in Table 4-1.* The proposed site *of* the power plant and the easements for the associated infrastructure are shown *on Figure 4-1.*

Table 4-1

Project Infrastructure for Kuraymat Integrated Solar C. C, Power Plant

Infrastructure	Brief Description	Comment
Power plant	150MWe power plant consisting of solar field (mainly include parabolic trough collectors and heat transfer fluid (HTF) heat exchangers) and a combined cycle power block. Combined cycle block mainly consists of Gas Turbines (GT), unfired Heat Recovery Steam Generators (HRSGs) and Steam Turbine (ST). Gas Turbines are of 2x43MWe capacity using natural gas as the primary fuel.	Power plant is the subject of this EIA report.
Cooling water supply	Abstraction of cooling water from the Nile river through intake structures .	Cooling water supply is the subject of this EIA report.
Fuel supply	Gas pipe line supplying gas to ISCC Kuraymat power plant (ISCC-KPP) runs across the site pressure reducing station.	No new gas pipeline will be required.
Electrical connection	Direct connection by overhead transmission lines and tie transformer into 220 kV power transformers and ISCC-KPP switchyard.	New limited off-site transmission lines required. No separate EIA required. Only Screening Form B to be introduced to the EEAA by EETC.
Potable water supply	Water will be provided from the Nile river to support potable water requirements for the plant and the staff facilities.	No new potable water pipeline will be required. Therefore, no separate EIA required.
Sewer Line	Sewer discharge lines from the plant buildings to the project sewage treatment system.	No new sewer pipeline is required. Therefore no separate EIA report is required.
Site access road	Access via an existing roads.	No new road is required (site access for heavy equipment may be ceded from the existing road). Therefore no separate EIA report is required.

4.1.1 Site Location

The ISCC site is located next to the Kuraymat power plant (KPP) *(Figure 4-2)*, a gas fired steam power plant with 2 x 625 MW capacity which was installed during the 1990's on the eastern shore of the river Nile. Nearby a housing complex was built in year 1996 for the staff of the IS CC KPP.

The buildings are not yet fully occupied. The next public tar-road is an interconnection between the village of kuraymat and Beni Suef and crosses the area between the ISCC KPP ground and the ground of the housing complex. The site is located to the eastern side of the existing ISCC KPP. The land is owned by ministry of agriculture and is about 2.7 km^2 area. The site is an unused desert land.

4.1.2 Fuel Source

Natural gas is the main fuel source for this project. Gas pipeline supplying gas to ISCC KPP which is running from the suez region to centers of use for farther south of kuraymat runs across the site from eastern side to north western side. Fuel for ISCC will be tapped from this gas line.

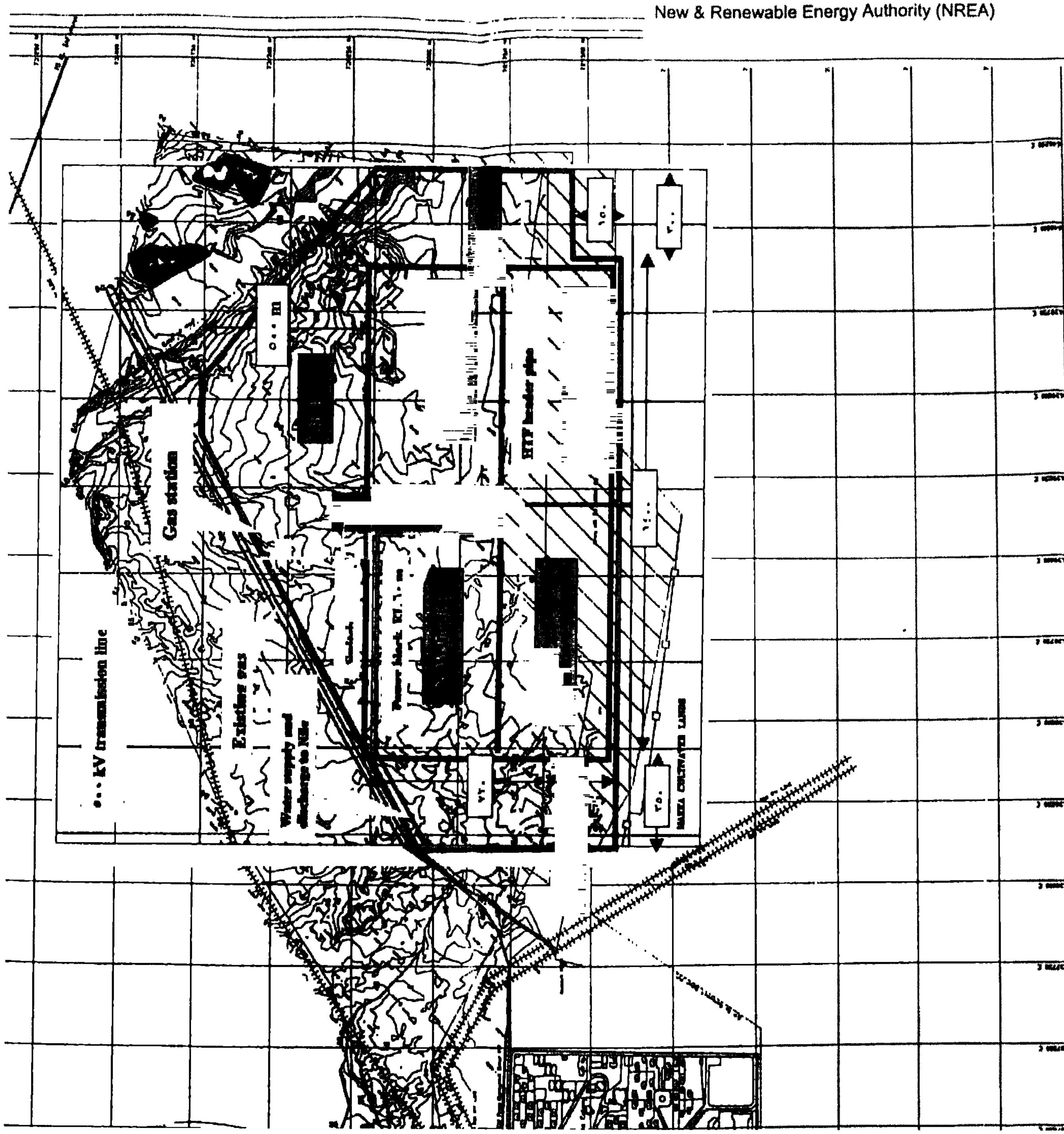
Gas is available at a pressure of about 40 bar.

4.1.3 Water Source

Water source for plant will be from river Nile, which is about 2.5 km away from the eastern side of the site.

4.1.4 Grid Interconnection

The evacuation of power is proposed at 66 kV voltage level. The 66 kV outgoing line from the Power Plant switchyard will be interconnected to the nearby 66 kV substation at a distant of about 2 km and additional outgoing line to be planned for routing the power to the other substations in consultation with the authorities.



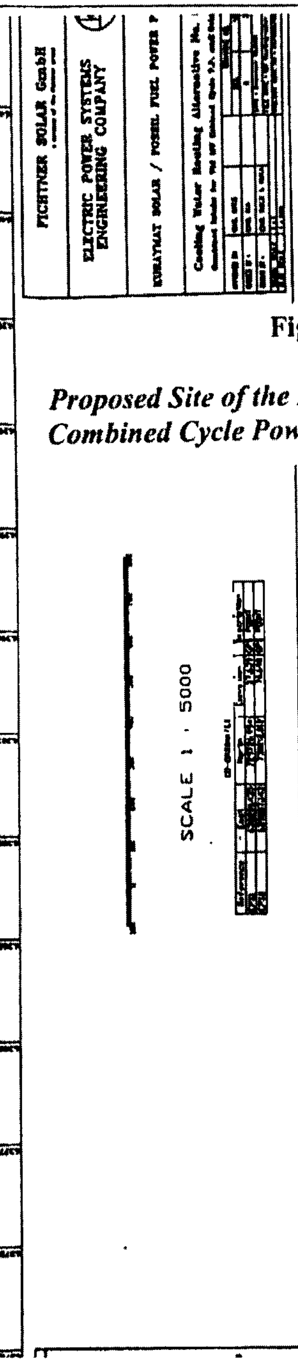
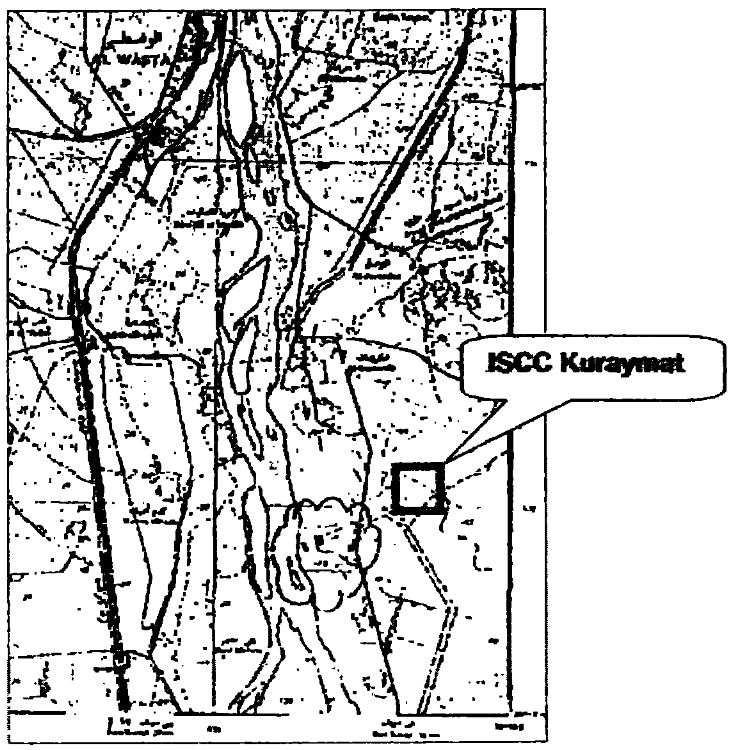


Figure 4-1

Proposed Site of the Kuraymat Integrated Solar Combined Cycle Power Plant and its Easements

Figure 4-2

The Proposed Site Location
(Index Map-Egyptian Series, 1:50 000, Sheet NH36 E3c)



4.2 DESIGN OF THE INTEGRATED SOLAR COMBINED CYCLE POWER PLANT

4.1.5 Overview of the Power Plant Technology

An integrated solar combined cycle power plant consists of solar field and a combined cycle power block. Solar field mainly consists of parabolic trough collectors and Heat Transfer Fluid (HTF) heat exchangers to generate steam. Combined cycle block mainly consists of Gas Turbines (GT), unfired Heat Recovery Steam Generator (HRSG) and Steam Turbine (ST). Solar field is integrated with the combined cycle block by means of feeding the steam generated in the HTF heat exchanger into the HRSG module for further super heating and then injecting into the steam turbine along with steam generated in the HRSG. Hence the overall efficiency of the plant will be higher than the combined cycle power plant efficiency. Solar block consists of Parabolic Trough collectors, HTF Heat exchangers, HTF pumps and its associated piping, valves, fittings, etc. Combined cycle block consists of two (2) no. of identical Gas Turbine Generators (GTG) with dedicated HRSG for each GTG feeding a common Steam Turbine Generator (STG).

4.2.2 Design and Layout of the Power

Plant ***General***

The proposed design and layout has been developed with regard to the following considerations:

- Adequate clearances and access around each equipment for routine inspection and maintenance.
- Convenient power evacuation and intake connection of raw water piping, gas piping and road transportation.
- Project Schedule.

General Concept layout drawing of the proposed power plant technology is provided in *Figure 4-3*. The final layout of the power plant and detailed design with be completed by Fichtner and New & Renewable Energy Authority's (NREA's) Contractors who will construct the power plant.

In general, the site can be split into the main following components, namely: Solar field area, Power block area, balance of plant area and non-plant building area.

Solar Field Area

The Solar field area basically consists of parabolic trough collectors *(Figure 4-4)* and HTF piping along the solar field area *(Figure 4-5)*. Optimum spacing between the collectors will be provided to avoid shadowing also to utilise maximum solar energy.

Figure 4-3

General Concept Layout Drawing of the Kuraymat Integrated Solar Combined Cycle Power Plant

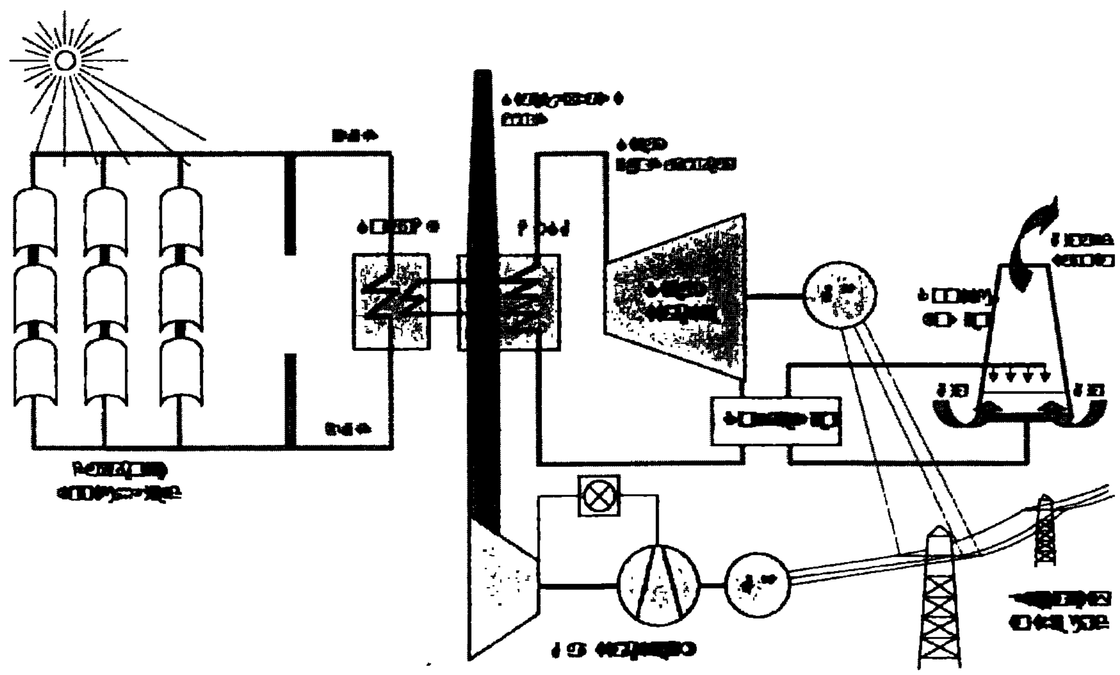
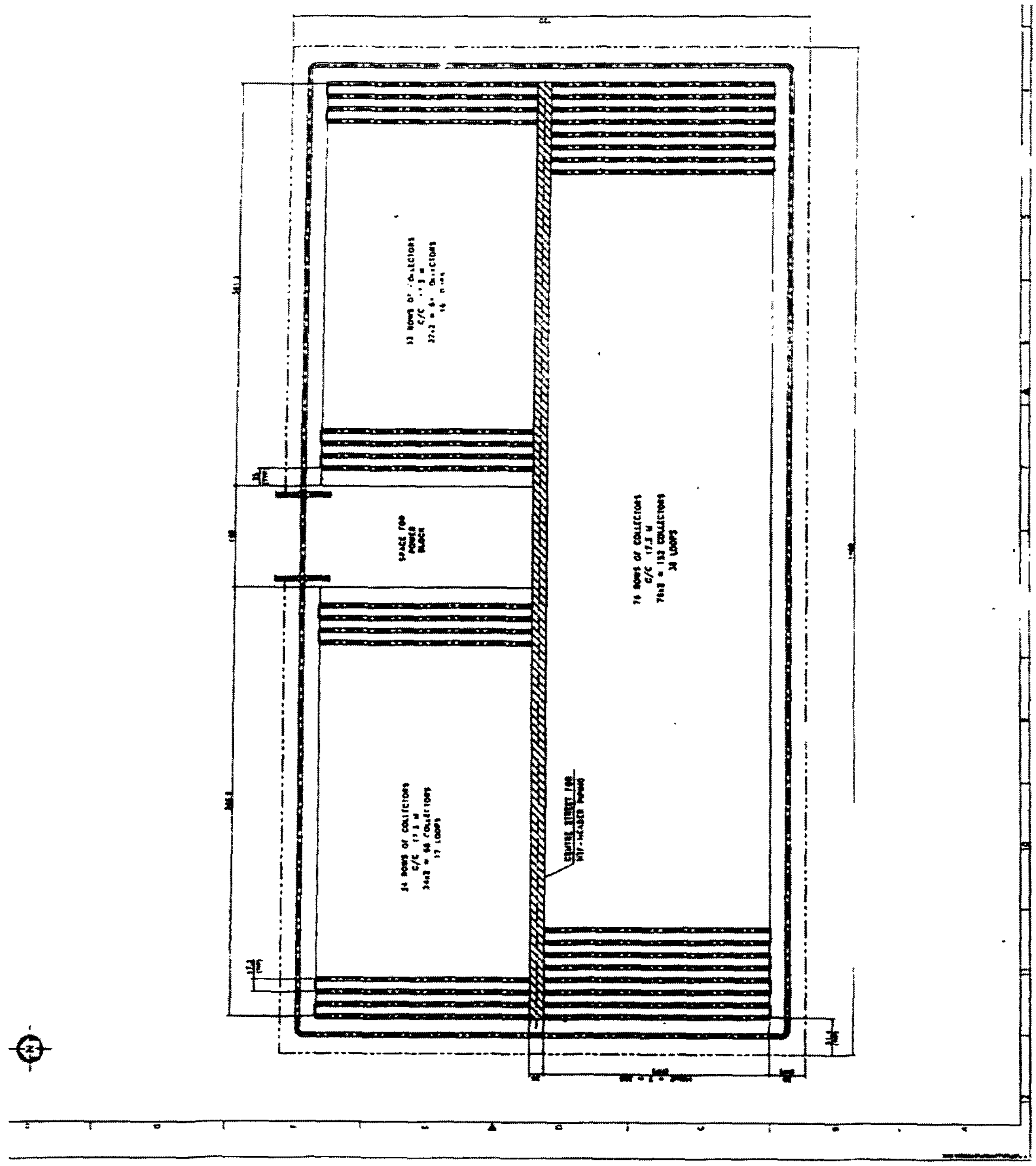


Figure 4-4

Parabolic Trough Collector

Figure 4-5

Layout – Solar Field



Power Block Area

Provisonal layout drawing of the power block area is provided on *Figure 4-6.* Power block main components are as follows:

- Steam Turbine Generator(STG) hall
- HRSG area
- Gas turbine area
- Control & switchgear building
- Transformer yard area
- HTF Heat Exchanger Building

STG Hall

The STG will be accommodated in a Turbine Hall of adequate span based on its model and frame size. STG building will be of structural steel construction. Adequate space for maintenance of steam turbine/generator and condenser will be provided in the layout. The STG lay down area will be provided on the generator end.

The crane rails of the turbine hall will be at sufficient elevation with adequate clearance from the crane main hook to the operating floor level.

The operating floor for the STG will be at suitable elevation level The vertical CEP's, will be located adjacent to the condenser, which would be located in the ground floor of the STG building.

A mezzanine floor will also be provided to accommodate STG auxiliaries like lubricating oil system, ejectors/vacuum pumps, gland sealing system etc.

HRSG area

The HRSG associated with GTG is located axially inline to the GT exhaust ducting. The lay down area for the HRSG will be provided on any one side of HRSG, which would facilitate easy access for erection and maintenance.

Gas Turbine Area

The gas turbines are located outdoor inside a weatherproof enclosure. The off base equipment of gas turbines will be located adjacent to the main gas turbine skid.

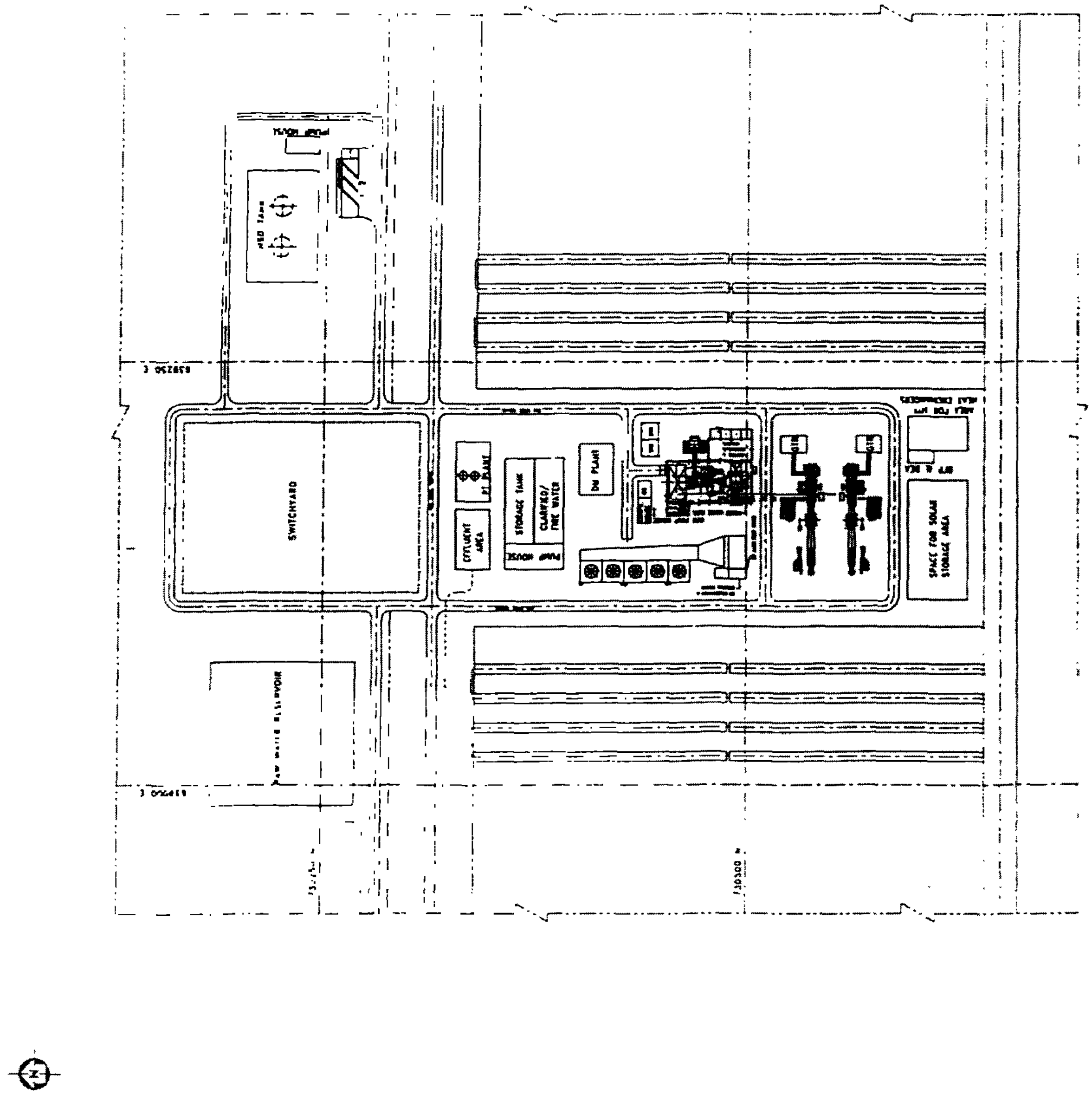
Control & Switchgear Building

The control and switchgear building will be suitably located adjacent to the STG hall considering cable routing and interconnection.

The control & switchgear building will be provided in three levels, cable spread room at the lower level, then the switchgear room and subsequently the control room at the top level. The battery room and the airconditioning system also will be accommodated in the control & switchgear building

Figure 4-6

Layout – Power Block Area



The control room will house the DCS, switchyard control/relay panels and other electrical control panels. UPS panels will also be located adjacent to the main control room.

Transformer Yard area

All power transformers will be located outdoor. Generator transformers and unit auxiliary transformers will be located close to the power plant area so as to reduce the bus duct connection from the generator. LT transformers will be located adjacent to switchgear building.

HTF Heat Exchanger Building

The building will house HTF Heat Exchanger, HTF circulating pumps and its auxiliaries. This building will be located suitably considering HTF pipe routing between the HTF exchanger and parabolic trough collectors and also to HRSG & STG building.

Balance of Plant Area

The Balance of plant areas consists of the following:

a) Water treatment area
b) CW/ ACW pump area
c) Air compressor and DG area
d) Effluent handling area
e) Cooling tower area
f) Fuel gas area
g) Fuel oil area

The water treatment plant will consist of Pre-treatment, Dual media filters and DM plant. Pre-treatment plant will include clarifloculators, aerators, etc. The DM plant area will house ion exchangers, carbon filters, acid & alkali storage tanks, DM water storage tank etc. The control panels for DM plant will be located in a separate room within the DM plant area.

The Cooling Tower (CT) and CW/ACW pumps will be suitably located considering buried cooling water piping to the power block and the make-up water piping from the water treatment plant. The pumps will be located in the CW pumphouse at CT weir end & cooling water from the CT will enter the CW/ACW sump through a fore bay.

The air compressor and emergency DG are located in separate building in the power block area. Also the CCW pump house & SWAS room are located in a separate building in the power block area.

Raw/fire water pump house will be located adjacent to the raw water reservoir from which both raw water and fire water pumps will take its suction.

The Effluent Treatment plant will be suitably located considering the source of effluent generation and the point of effluent disposal at the plant boundary and will ensure conformance to the local environment regulations.

The interconnection pipework between plant utilities and power block equipment will be routed through pipe racks / sleepers, pipe trenches or buried. The CW/ACW water piping will be laid below ground and buried.

Non-plant Buildings

The following non-plant building are envisaged.

a) Administration building
b) Canteen
c) Recreation
d) Security
e) Workshop

Layout of other facilities

On-site raw water reservoir

The raw/fire water reservoir will be located considering the raw water inlet pipeline coming to the plant boundary from the Nile river. The reservoir will be above ground open tank and of reinforced cement construction (RCC)

On-site fuel storage

Storage facility for standby/emergency fuel (HSD) will be provided in a common dyke for treated and untreated tank. The layout of the tank farm will conform to the stipulation of local statutory regulations/laws.

4.3 PROCESS DESCRIPTION

4.3.1 Electricity Generation Process

The typical steps in the generating process at the power plant are illustrated on *Figure 4-7,* and the key features are as follows.

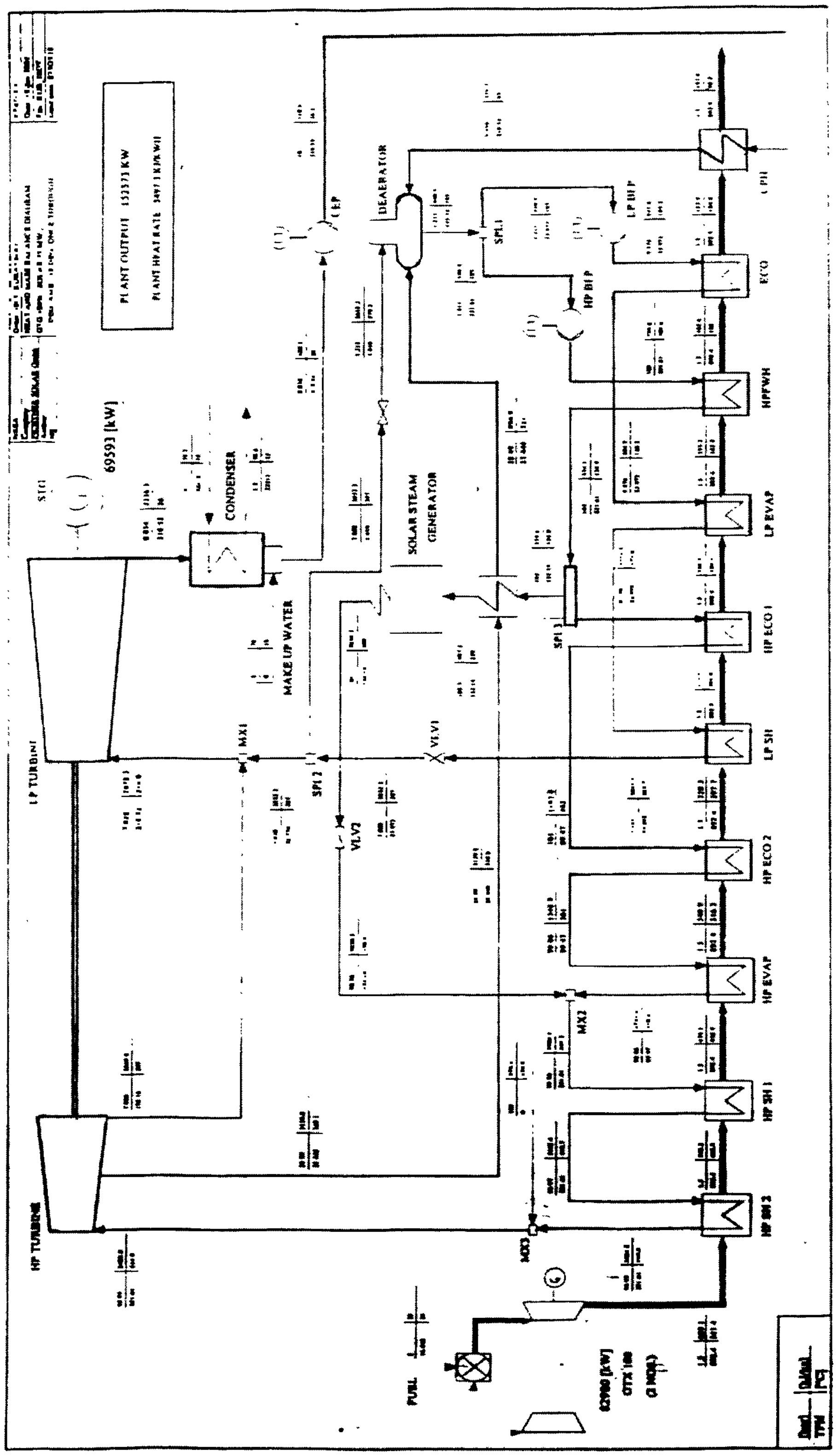
General

A conventional combined cycle system generally is designed for the generation of 2/3 of the total electricity output by the gas turbine and 1/3 by the steam turbine. The total efficiencies achieved by modern combined cycle systems vary in the range from 50 to 55%, depending mainly on the type of fuel and available source for cooling and on ambient temperature.

The Integrated Solar Combined Cycle (ISCC) plant integrates the solar thermal cycle into the combined cycle power block. The thermal output delivered by the solar systems is always supplied to the steam power section of the combined cycle in the ISCC. The integration increases the conversion efficiency of the solar thermal input, saves fossil fuel and reduces the specific emissions of the overall system compared to the conventional combined cycle.

Figure 4-7

Kuraymat Integrated Solar Combined Cycle Power Plant Flow Diagram - Steps of the Generation Process



Solar Thermal Cycle

The solar thermal cycle consists of two subsystems; the solar field and the solar heat transfer system. In HTF-Trough System these are the solar collector field and the HTF boiler subsystem for steam generation. The basic element of the solar field is the parabolic trough collector. Parabolic trough-shaped mirrors are used to focus sunlight on thermal efficient receiver tubes, called heat collecting elements (HCE), that contain the heat transfer fluid (HTF). Typical operation temperatures of parabolic trough HCEs are in the range from 240 to 400°C. *Figure 4-8* depicts the flow scheme of HTF system.

The solar collector field is composed of a large number of solar collector arrays (SCA). One SCA is a line of several parabolic trough collectors, which may be arranged in a straight line or in a loop with U-turn. The axes of the SCAs are horizontal and oriented from North to South. Each collector in an SCA is equipped with a hydraulic drive and an individual control unit for tracking. As tracking is done by rotation of the trough around its gravitational axis, the tracking is denominated as "one-axis tracking".

The HTF passing from one end of the SCA to the other collects the heat absorbed by the HCEs. Header pipelines at the cold and hot ends of the SCAs connect these to the HTF-boiler integrated into the power block. The HTF-boiler is a conventional steam generating heat exchanger similar in design to boilers used for industrial process heat applications. Depending on the integration design of solar steam supply into the power block, the HTF-boiler may generate saturated steam or superheated steam. The common HTF in parabolic trough solar fields is a thermal oil. The operation pressure is below 20 bar and temperature of the HTF is limited to 400°C to avoid cracking. Typically the upper temperature in the HTF circuit is 390°C.

Combined Cycle Block

The Combined Cycle power block consists of two (2) no. of Gas Turbine Generator (GTG) with two (2) no of Heat Recovery Steam Generator (HRSG) and a Steam Turbine Generator (STG).

The unfired HRSG will be coupled to the GTG exhaust through bypass and isolation dampers. The gas turbine exhaust, after passing through respective HRSG, will be discharged to atmosphere through HRSG main stack.

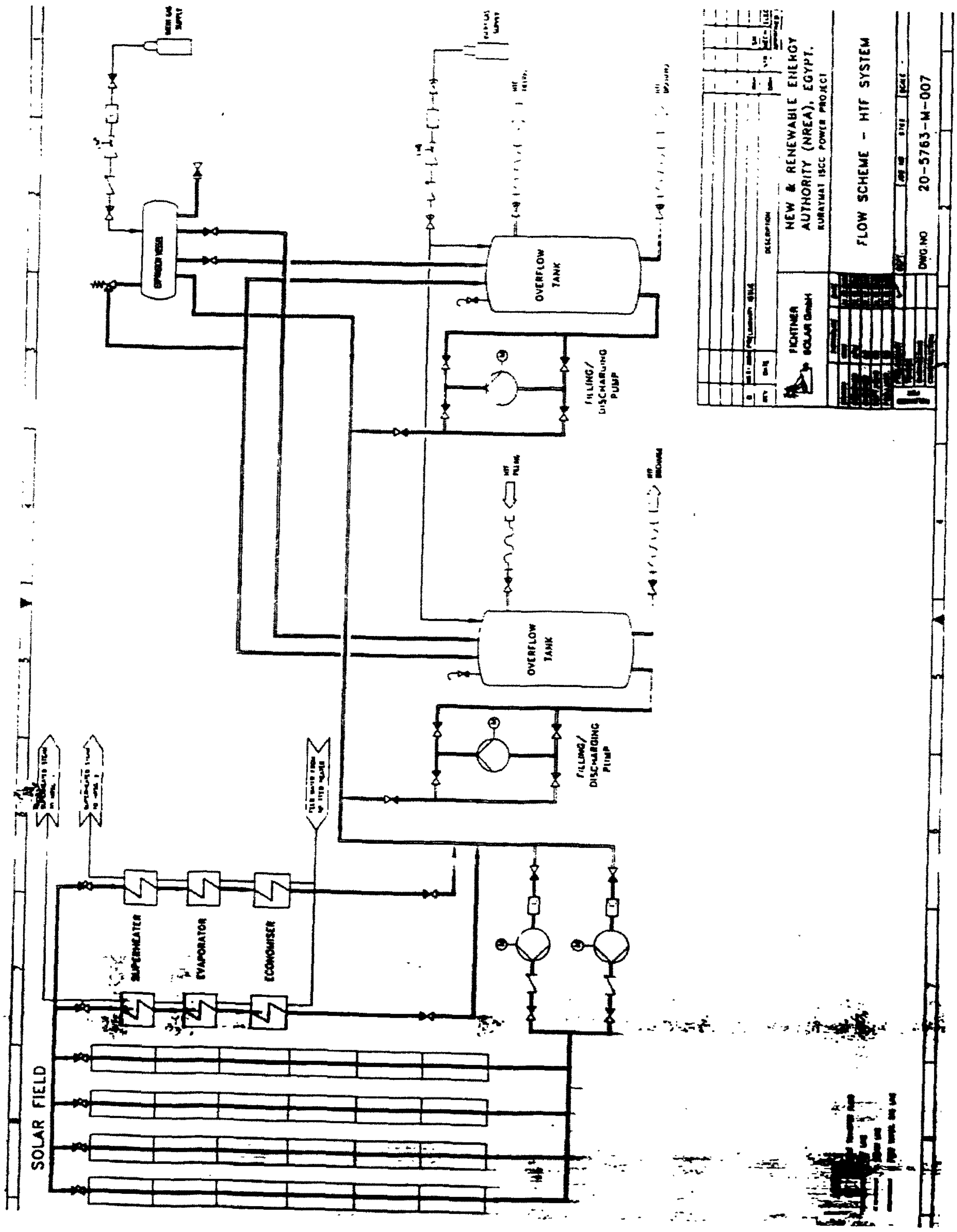
Steam generated in different pressure levels (HP & LP) from the HRSG is fed through respective pressure level supply headers to the steam turbine. A bypass station will be provided across the steam turbine to facilitate starting/partload/load throw-off conditions. Steam turbine exhaust will be condensed in the condenser and the condensate will be pumped to the integral deaerator of each HRSG through gland steam condenser and ejector condensers by the Condensate Extraction Pumps. From the integral deaerator, feed water will be pumped to both the HP circuit of HRSG by HP Boiler Feed Pumps (BFP) and to the LP circuit by LP

New & Renewable Energy Authority (NREA)

150 MWe Kuraymat Integrated Solar C.C. Project
ENVIRONMENTAL IMPACT ASSESSMENT

Figure 4-8

Flow Scheme – HTF System



Boiler Feed Pumps. There will be two (2) boiler feed pumps, of which one will be normally running and one will remain as standby. Auxiliary steam requirements of the plant such as ejector steam in case of steam jet ejectors shall be through suitable Pressure Reducing and Desuperheating Station (PRDS) from the main steam line. The non-condensable gases will be taken out from condenser by suitable sized vacuum pump or steam jet air ejectors.

Integrated Solar Combined Cycle

The Solar field is integrated to the combined cycle power block in which the steam generated in the solar steam generator is super heated in a super heater which is one of the heat transfer module of HRSG and fed into the STG along with steam generated in the HRSG. Feed water heater is added as a module in the HRSG and the HP heater is located in the feed water circuit of the solar steam generator. The capacity of the steam turbine will be more taking into account of additional steam generation from the solar steam generator. All the other cycle requirements are similar to the combined cycle block.

Gas Turbine Generators and Auxiliaries

The gas turbine shall be of industrial heavy-duty type with gross output of around 43 MW at ISO condition. The gas turbine shall have dual fuel firing capability, both liquid and gaseous fuels independently.

Natural gas will be used as primary fuel for the gas turbine. HSD will be used as a standby/emergency fuel. Gas Turbine is provided with Dry Low Nox(DLN) combustor in order to limit the NOx level in the gas turbine exhaust.

The lube oil system of the gas turbine shall be in accordance with manufacturer's standard specification/design and normally includes main oil pump, auxiliary oil pump, emergency oil pump, control oil pump, oil coolers, filters and oil tank. The system will be designed to cater to the GT requirement during normal operation/ emergency trip/shutdown and coast off as well as during start-up condition.

The cooling water for the GT lube oil cooler, generator air cooler and control oil cooler will be catered by closed loop DM water which is in turn cooled by fin-fan coolers.

The GT intake air system will be provided with automatic self-cleaning filters, plenum chamber, silencer, expansion joints, ducts and supports. The compressed air requirement of intake air filter will be met by GT bleed air.

The GT exhaust will be ducted to the HRSG. A divertor damper of tight shut off will be provided between the HRSG inlet duct and the bypass stack so as to isolate the bypass stack during HRSG operation and to isolate HRSG during HRSG trip and GTG running condition. In addition to the divertor damper a 100% leak proof guillotine damper shall be provided in HRSG side.

The bypass stack will be provided with an exhaust gas silencer and the stack shall be thermally insulated from inside.

Heat Recovery Steam Generator

HRSG will be of forced/natural circulation type with dual pressure and solar super heater modules as per the optimum heat cycle design.
HRSG will be designed to accept the maximum gas flow and exhaust temperature of the connected gas turbine with supplementary firing at the GT exhaust. The heat transfer modules are arranged in such a way to recover maximum waste heat from the flue gas. The gas temperature at the stack should be sufficiently above the acid dew point of the gas to prevent cold end corrosion.

HP circuit of the HRSG shall have two (2) stage super heaters, an evaporator and two (2) stage economiser. LP circuit of each HRSG shall have single stage super heater, an evaporator, economiser and an integral deaerator. A condensate pre-heater will also be provided in each HRSG to maximise the heat recovery from the GT exhaust gas.

There will be two-(2) nos of HP and LP boiler feed pumps for each HRSG. HP Boiler Feed Pumps will cater to the HP circuit of HRSG and to the solar steam generator and LP Boiler Feed Pumps cater to the LP circuit of HRSG. So under normal condition, two pumps will run and one pump will remain standby in each case. Spray water for attemperators will be taken from HPBFP.

Steam Turbine Generator and Auxiliaries

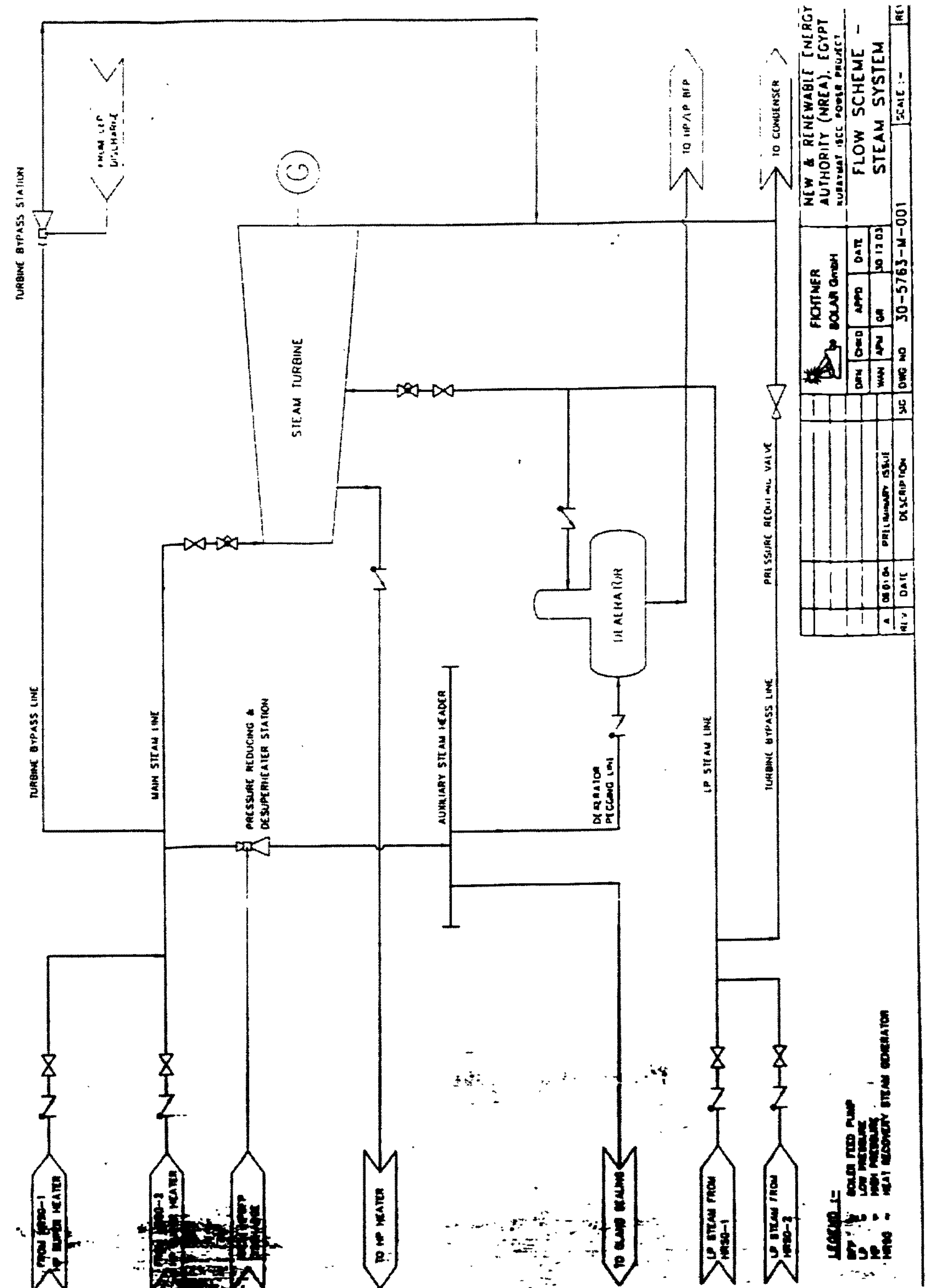
The Steam Turbine Generator (STG) set will be sized to match the maximum steam output from the HRSG and solar steam generator. *Figure 4*-9 provides with the flow scheme of the steam system. STG capacity rating will be about 67 MW. The turbine will be condensing type with LP steam injection. The HP and LP steam entry into the turbine will be through respective Emergency stop and Governing valves which will be hydraulically or electro-hydraulically controlled. The turbine will normally operate on constant pressure/sliding pressure in conjunction with HRSG following GT Load.

The steam turbine will be provided with HP/LP bypass system complete with necessary pressure reducing and desuperheating stations.

The lube oil system of the steam turbine shall be in accordance with manufacturer's standard specification/design and normally includes main oil pump, auxiliary oil pump, emergency oil pump, jacking oil pump, oil coolers, filters and oil tank. The system will be designed to cater to the ST requirement during normal operation/ emergency trip/shutdown and coast off as well as during start-up condition.

Figure 4-9

Flow Scheme – Steam System



The cooling water for the STG lube oil cooler, generator air cooler and control oil cooler will be catered by closed cooling water system. The condenser shall be of water cooled type capable of cooling maximum turbine exhaust steam when the HRSG and the solar steam generator is operating at maximum continuous rating. Duplicate condensing steam jet ejectors / vacuum pumps shall be provided for evacuation of non-condensable gases. Gland steam condenser will be provided for condensing the turbine gland sealing steam and the condensate is taken back to condenser. The condensate is then pumped to each HRSG through gland steam condenser/ejector condenser by means of Condensate Extraction Pump (CEP). Normally there will be two (2) CEPs, one working and one standby.

4.4 OPERATIONAL USE OF RAW MATERIALS

4.4.1 Water Consumption

Raw water for the proposed ISCC Power Plant will be from Nile river. The characteristics of the raw water which will be abstracted from the Nile river and will be considered for designing the water treatment plant are summarized in *Table 4-2*.

Table 4-2

Raw Water Analysis of the Nile River

Parameters	Unit	Min. Limits	Max. Limits
Total Dissolved Solids	mg/l	182	245
Specific gravity at 25°C		1	1
Conductivity	µmho/cm	300	362
Total Alkalinity as $CaCO_3$	mg/l	120	143
Chloride as Cl	mg/l	9	15
Sulfate as SO_4	mg/l	15	22.4
Total hardness as $CaCO_3$	mg/l	114	149
Calcium as Ca	mg/l	28	38
Magnesium as Mg	mg/l	10.32	14.4
Turbidity	NTU	3	9.8
Suspended Solids	mg/l	8	15
Sodium as Na	mg/l	8.3	26.5
Oil & Grease	mg/l	0.1	3.2
Iron as Fe	mg/l	0.01	0.025
Silica as SiO_2	mg/l	1.264	3.8
Organic Matter as $KMnO_4$	mg/l	7	13
Biological oxygen Demand (BOD)	mg/l	0.2	2.77
Phosphate as PO_4	mg/l	0.1	0.4
pH @25°		8.1	8.7

The water balance for the power plant is outlined in *Figure 4-10.* At full operation, the water resources to be used at the plant are as follows:

- Water for the condenser cooling system.
- Water for Heat Recovery Steam Generators make-up and other process uses, after filtration, treatment and demineralization as appropriate.
- Potable water from the treated water supply.

The total volume of water used in each process is illustrated in *Table 4-3.* A total of 6631.0 m^3 per day of Nile water will be abstracted to meet the power plant cooling water and process requirements.

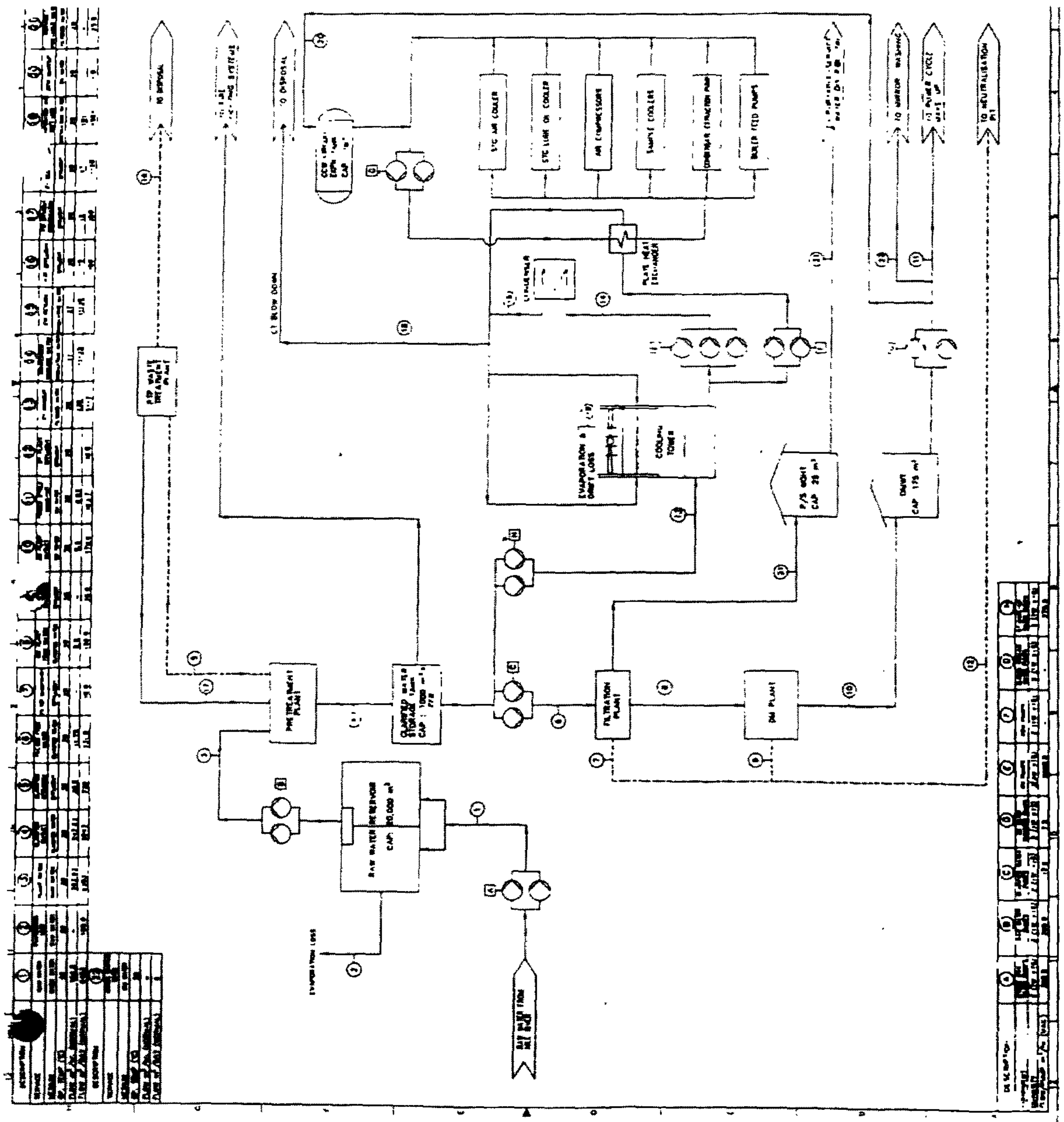
Table 4-3

Preliminary Water Balance Stream Data Table

Sl. No.	Description	Water Quantity required (m^3/hr)	m^3/day	Water Quality
1	For DM water production	8.5	170.0	DM water
1a	HRSG feed cycle make-up	6.82	163.7	DM water
1b	CCW make-up / service water	-	1.0	DM water
2	Potable / Service purposes	-	25.0	Filtered water
3	Cooling tower make-up	247.5	5940.0	Clarified water
4	Loss of water in water treatment plant backwash/regeneration	-	396.0	Raw water
5	Evaporation loss	-	100.0	Raw water
	Total water requirement per day		6631.0 m^3	

Figure 4-10

Preliminary Plant Water Balance Diagram



4.4.2 Consumption of Process Chemicals

The following chemicals will be used in the water treatment plant:
- Coagulants
- Flocculants
- Chlorine gas
- Sodium Hydroxide
- Hydrochloric acid
- Morpholine
- Trisodium phosphate
- Hydrazine

Coagulants and flocculants are added in the raw water during clarification. Chlorine gas will be injected in the raw water and also in the cooling tower basin for disinfecting the water.

Sodium hydroxide and hydrochloric acid will be used for the regeneration of the ion exchangers. For the neutralisation of DM plant effluent also these chemicals will be used.

Morpholine will be dosed in the DM water for pH boosting in the DM plant area.
Hydrazine will be dosed at the deaerator outlet for oxygen scavenging.

Trisodium phosphate will be dosed at the boiler drum to condition the boiler water and to increase the pH.

Antiscalants, anticorrosive agents and biocides will be dosed in the cooling tower basin for conditioning the circulating water. Boiler feed water treatment chemicals will be dosed in the Boiler drum for conditioning the feed water.

4.5 COOLING SYSTEM

Flow scheme for the main cooling water system and that for the auxiliary cooling water syetem are shown in *Figures 4-11 and 4-12, respectively.*

The plant cooling water system consists of the following independent system:
- Condenser cooling water system.
- Auxiliary cooling water system.
- Closed circuit cooling water system
- GTG fin fan cooling system

The heat sink for the Rankine part of the combined cycle can be established by dissipating the heat through water circulating through a steam condenser at the exhaust of the steam turbine. The heat carried by the circulating water is further dissipated to the atmosphere by a cooling tower. In this process a small amount of water evaporates and hence the same is to be made up by adding fresh water (wet cooling).

Figure 4-11

Flow Scheme – Main Cooling Water System

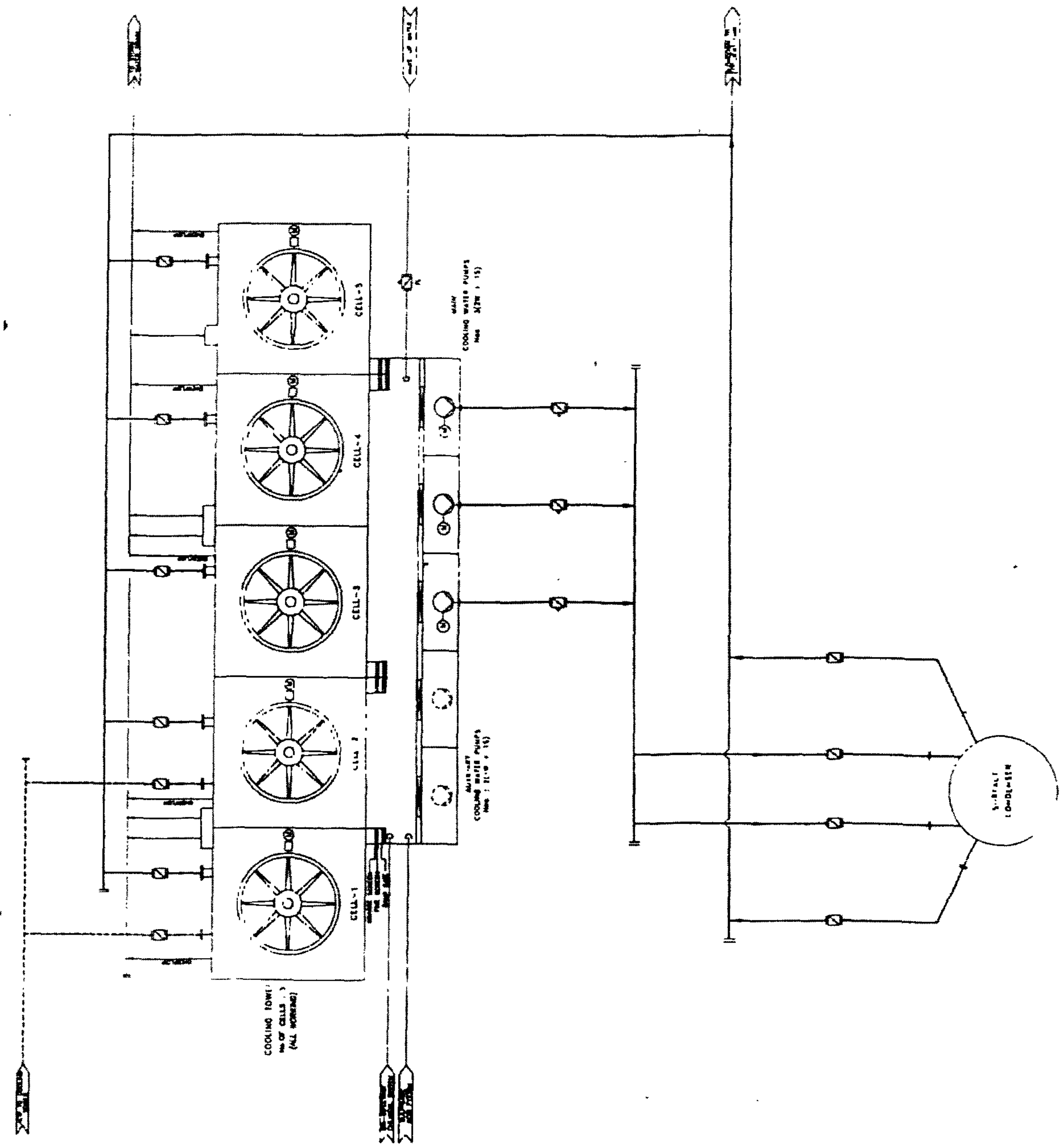
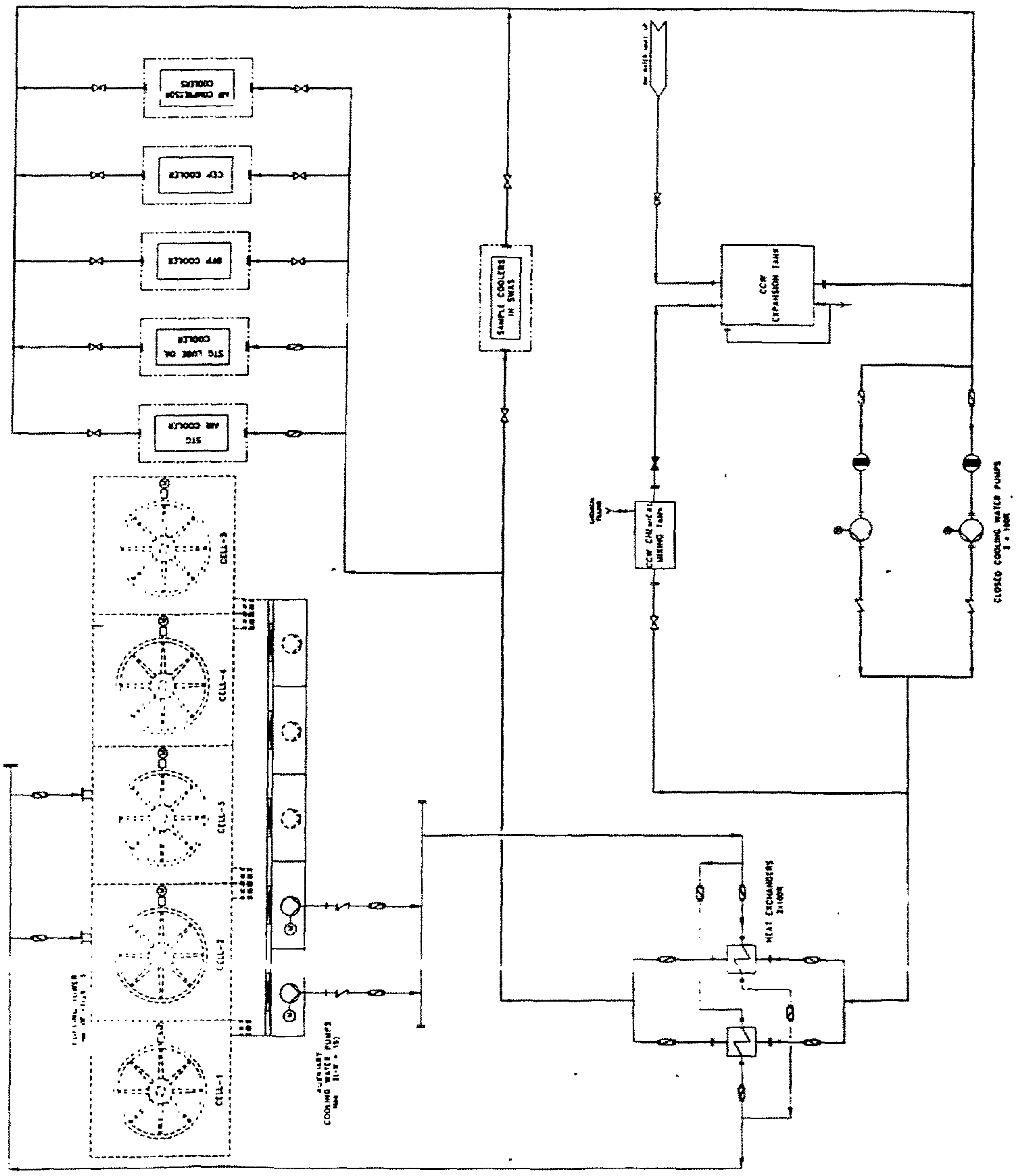


Figure 4-12

Flow Scheme – Auxiliary Cooling Water System



Cooling tower will be used to cool

- The circulating water used for condensing steam in the surface condenser
- The auxiliary circulating water which circulates through 2 x 100% plate type heat exchanger.

The Condenser cooling water and ACW cooling will be circulated through independent buried piping. The return hot water from the CW and ACW mains will be connected to the cooling tower. The tower will cool the hot return water and discharge it into the CW / ACW pump house through a RCC forebay. The cold water for CW / ACW system will be fed by independent CW and ACW pumps of vertical turbine type. The CW and ACW pumps will take its suction from the CW/ACW pump house sump. The CW/ACW pump house sump will be provided with trash screen to filter out any air-borne debris.

The cooling tower will be of mechanical, induced draft, multi cell, counter flow type. The construction of cooling tower will be of RCC. The tower will be designed in such a way that any cell can be operated independently of other cell and is capable of being repaired and maintained while the other is in service. The make up water will be added in the cooling tower basin and will be chlorinated to prevent algae growth.

The closed circuit cooling water (CCW) system circulates through STG lube oil cooler, STG air cooler, Sample cooler, BFP, CEP Vacuum pump coolers and Air compressor cooler. A DM water expansion tank will be provided for expansion and for any make up in CCW system due to leakage etc. The DM water will be cooled in the Plate type heat exchagers by Auxiliary cooling water.

The GTG fin-fan cooling system will be used to cool the circulating water (DM water) for GTG auxiliary viz.- generator air cooler, lube oil cooler etc. Each GTG will be provided with individual Fin fan cooler. The fin-fan cooling system will be complete with radiators, fans, circulating water pumps, expansion tank etc.

4.6 SUPPORTING INFRASTRUCTURE

4.6.1 Gas Handling Facilities

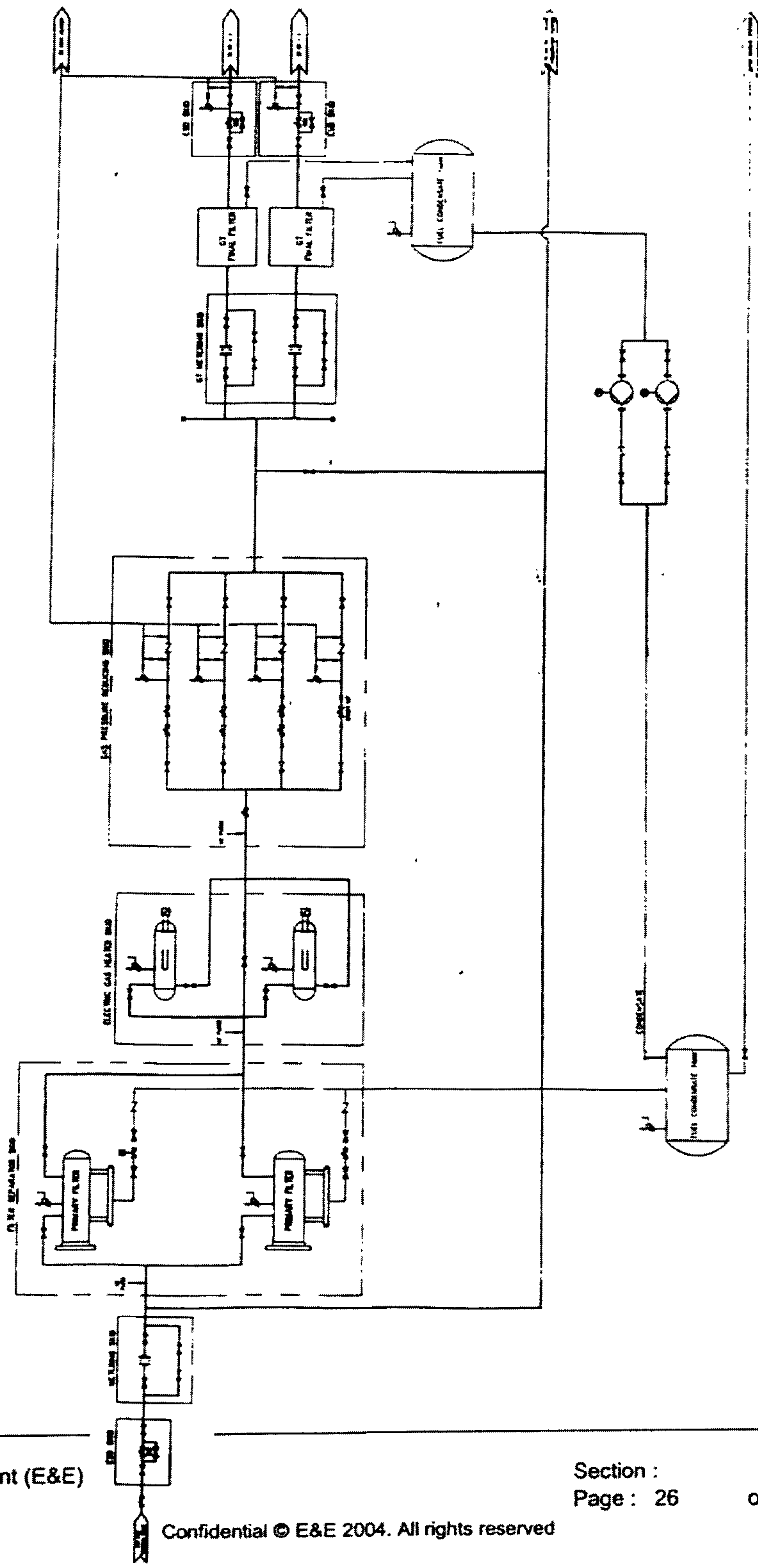
Natural gas shall be used as the primary fuel for the Gas Turbines. *Figure 4-13* illustrates the flow scheme of the fuel gas system.

The gas fuel supply system shall consist of:

- 1 x 100% capacity Emergency Shut-down valve (ESD) at tie-in
- 1 x 100% capacity common metering station with bypass.
- 2 x 100% capacity Gas conditioning skids.

Figure 4-13

Flow Scheme – Fuel Gas System



- 2 x 100% capacity fuel gas heaters
- 2 x 100% capacity Gas Pressure Reducing Station (GPRS)
- 2 x 100% capacity GT final filters per GT.
- 1 x 100% capacity GT fuel gas metering station for each GT.
- 1 x 100% capacity Emergency Shut-down valve (ESD) at each GT inlet

The gas condensate from Gas conditioning skids shall be collected in a common gas condensate drain tank in gas conditioning area. The gas condensate from GT final filters shall be collected in a gas condensate drain tank located near GT area. The gas condensate from the drain tanks shall be transferred to barrels using tank mounted sump pump for manual disposal.

All vents and safety relief valve discharge lines from the system shall be collected and disposed off in a common cold vent stack located in gas conditioning area. All vents near GT area shall be vented to safe heights locally.

The gas fuel supply system shall be so designed that the gas turbines can start, generate up to full load and shutdown on gas. In addition, it shall be possible to change automatically and manually from gas to liquid fuel whilst on load on sensing a falling gas pressure or manually from liquid fuel to gas whilst on load, and to operate on a mixture of fuels where burner design permits this.

The design flow rate of the gas fuel supply system shall be such that the maximum fuel gas demand of plant (Plant MCR) is met.

Gas Conditioning skids will be capable of removing solid and liquid contaminants from the gas fuel to achieve the required quality and of supplying the required quantity of gas at the required dry and clean conditions. The equipment shall be selected based on the expected quality of gas and based on the quality of gas required by the GT.

The treatment equipment can be inertial type, cyclone type, filter/separator type or a combination of these types. The heavy particles including liquid particles shall be removed and re-carrying of liquid droplets shall be avoided. The bottom of the filter sump shall be equipped with valves and pipework leading to a condensate tank such that accumulated fluids & contaminants may be drained off on a regular basis.

The condensate drain tank will have sufficient storage capacity to store slurry and condensate and will be provided with a disposal pump.

The plant shall be provided with a pressure reducing station consisting of 2 x 100% pressure reducing streams. The control valve shall be pneumatically actuated type. The control valve actuation shall be through the DCS.

A gas fuel heating system will be installed to ensure the necessary fuel gas temperature required by GT. This will also prevent formation of hydrates, which might have an adverse effect on gas combustion equipment. The gas heaters shall be gas fired water bath heaters. Each heater shall be provided with water drum, burner with burner management system, exhaust stack, controls & instrumentation etc. Each gas heater shall be provided with a local control panel. All alarms of the system shall be annunciated in the DCS.

Each GT shall be provided with 2 x 100% final filters/separators. These filter/ separators shall have two sections. The first section shall a coalescing section and the second section shall be a separator section. The condensate collected in these two sections will be routed to the condensate collection tank.

A complete integrating gas flow metering system with bypass shall be provided at tie-in point as well as for each GT. The function of flow metering is to measure and record the total gas quantity used by the power plant as well as the unit consumption.

Table 4-4 (a)

Characteristics of the Fuel Gas to be Used by the Power Plant (Minimum Specification of the EEHC)

Composition	Rich, Mol	Lean, Mol%
N2	0.06	1.049
CO2	3.022	0.227
C1	85.506	95 684
C2	8.346	2.907
C3	1.87	0.122
IC4	0.391	0.005
NC4	0.421	0.003
IC5	0.141	0.002
NC5	0.091	0.001
NEO-C5	0.003	0
C6+	0.149	0
Total	100	100
M.WT	19.18	16.68
G.C.V, BTU/SCF	1102	1021

Quality of Gas

The quality of gas delivered to Owner at the delivery point shall at all times be free from dust, gums, oils, impurities and other objectionable substances and shall:

- Contain a maximum of zero decimal one mole percent (0.1%) of oxygen.
- Contain a maximum of three decimal zero mole percent (4.0%) of carbon dioxide.
- Contain a maximum of eight (8) parts per million by volume hydrogen sulfide.
- Contain a maximum of one hundred and fifty (150) milligrams of total sulfur per standard cubic meter with average mercaptans of fifteen (15) milligrams as sulfur per standard cubic meter.
- Have a water dew point below zero degrees Celsius (0°C) at a pressure of seventy (70) kg/cm^2 gauge.
- Form no hydrocarbon condensates or hydrates above five degrees Celsius (5°C) at any pressure below the delivery pressure.

- Have a gross calorific value within the limits of not less than nine hundred and eighty (980) BTU per SCF and not more than one thousand, one hundred and eighty (1180) BTU per SCF.

Table 4-4 (b)

Characteristics of the Fuel Oil no. 2 (Sollar) to be Used by the Power Plant (Minimum Specification of the EEHC)

Parameter	Value
Density @ 15°C, gm/ml	0.82 – 0.85
Flash Point P.M.C., °C min	55.0
Viscosity	
Kinematic @ 40°C, centistokes	1.9 – 4.1
R1 @ 40°C	30.0 – 36.0
Pour Point, °C max.	4.5
Water & Sediment, % vol max.	0.10
Conradson Carbon, % wt. max.	0.10
ASH Content, % wt. max.	0.01
Total Sulfer, % wt. max.	1.0
Copper Strip @ 100°C (3HRS), max.	DIV.1
Distillation	
• 90% distelled @, °C	350.0
• Residue After Dist, @ 370°C % vol.	2.50
Sodium & Potasium Content, ppm max.	2.0
Calcium Content, ppm max.	2.0
Vanadium Content, ppm max.	1.0
Lead Content, ppm max.	1.0

4.6.3 Fire Protection System

The fire protection system for the power plant is to provide for early detection, alarm, containment and suppression of fires. A multitude of systems will be provided to combat various types of fires in different areas of the plant and all such systems for various areas shall form a part of a centralised protection system for the entire combined cycle plant. The complete fire protection system will comprise of the following.

- Fire hydrant system (External and Internal)
- Automatic/manual fire detection & alarm system
- Fixed Water spray system (high velocity and medium velocity)
- Fixed foam protection system
- CO2 fire suppression system

- Portable fire extinguishers

The Fire Protection System is generally required to be designed in conformance with NFPA codes and local fire codes.

The various types of fire protection systems envisaged and the areas covered are as follows:

- Hydrant System : Entire Power Plant
- High Velocity Water Spray System : Oil filled transformers
- Medium Velocity Water Spray System : Cable Spreader rooms of powerstation and HSD tank.
- CO2 suppression system : Gas turbine enclosure and ST bearing and exciter enclosure.
- Fixed foam system : HSD tank
- Automatic Fire Detection & Alarm System : Entire power station
- Portable & Mobile Extinguishers : Entire power station

4.6.4 Plant Make-up Water System

Raw water from the river Nile, which is about 2 km will be conveyed to site by means of a pipe line of adequate size and suitable material. This will be collected in the raw water reservoir of 20000 m^3 capacity which will be sufficient to store three days plant water requirement. This system consists of Pre-treatment plant and Demineralisation plant.

Pre-treatment Plant

This plant consists of clarifiers, chemical dosing systems and sludge disposal systems. Plate type clarifier of 1 x 100% capacity will remove the suspended particles present in the water after proper chemical additions. Alum, lime and sodium hypochlorite are dosed to condition the raw water. Treated water will be collected and used as the feed to the filters / DM plant, cooling tower make-up water. Clarified water will be used as fire fighting water also. Clarified water is filtered in the pressure sand filter and activated carbon filter. Chlorine dosing will be done in the filtered water before using it as potable/service water. Sludge generated in the clarifier will be collected and treated in a sludge dewatering system. Dewatered sludge will be disposed off site by trucks.

Demineralisation Plant

The DM plant consists of Pressure sand filter, Activated Carbon filter and Demineralising ion exchangers like strong acid cation, strong base anion and mixed bed exchangers. This DM water will be stored in the DM water storage tank. It also consists of necessary acid and alkali tanks required for the regeneration of ion exchangers. Effluent generated in the DM plant will be neutralised using acid/alkali in a collection pit and it is transferred to the common effluent tank.

The various requirement of DM water for the power plant is based on the power cycle make-up and CCW make-up. The DM plant will be of 2x100% capacity each, one working and one standby. The quality of DM water produced will correspond to the requirement of the boiler make-up water quality.

Figure 4-14 provides with the flow scheme of the feed water system.

Waste Water System

The waste collection and treatment system receives, segregates, and transfers all plant process and liquid waste streams for plant water management and ensures conformance to the local environment regulations. *Figure 4-15* shows the flow diagram of the wastewater system.

The Power Plant effluents are of the following five kinds. They are :

- Oily waste
- Water waste
- Chemical waste
- Sanitary waste
- Solid waste (sludge)

The effluent disposal system consists of, floor trenches, sumps/pit and sump pumps to collect the plant wastes and transport them to the oil/water separator skid or to the common effluent tank or to off-site disposal.

In general, sump pumps will be submersible (centrifugal type). In the condition where the sump receives rainwater from a contained area, the pump will be sized to remove the design maximum rainfall over a 24-hour period. For the Sumps not receiving rainwater, the sump pump will be of adequate capacity to dispose the waste water collected in that sump.

Oily Wastewater

Oil/water separator will be located in the effluent treatment plant area. It receives waste from Combustion turbine area floor drain, ST lube oil centrifuge, tank farm area, ST area floor washing and transformer area drain. The wastewater from the oil/water separator skid will be transferred to common effluent tank. Separated oil from the oily water separator will be collected in a drum for offsite disposal.

Figure 4-14

Flow Scheme – Feed Water System

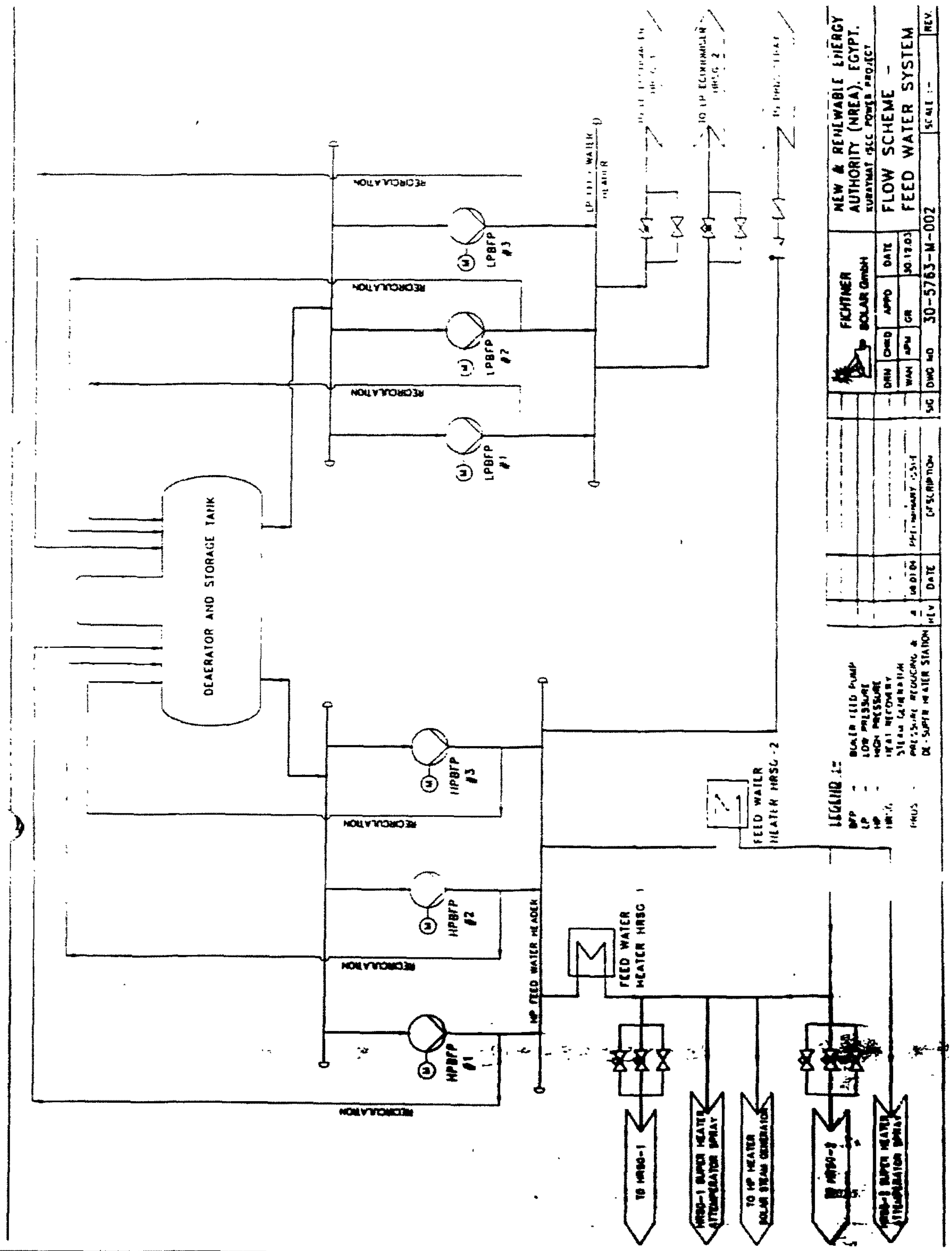
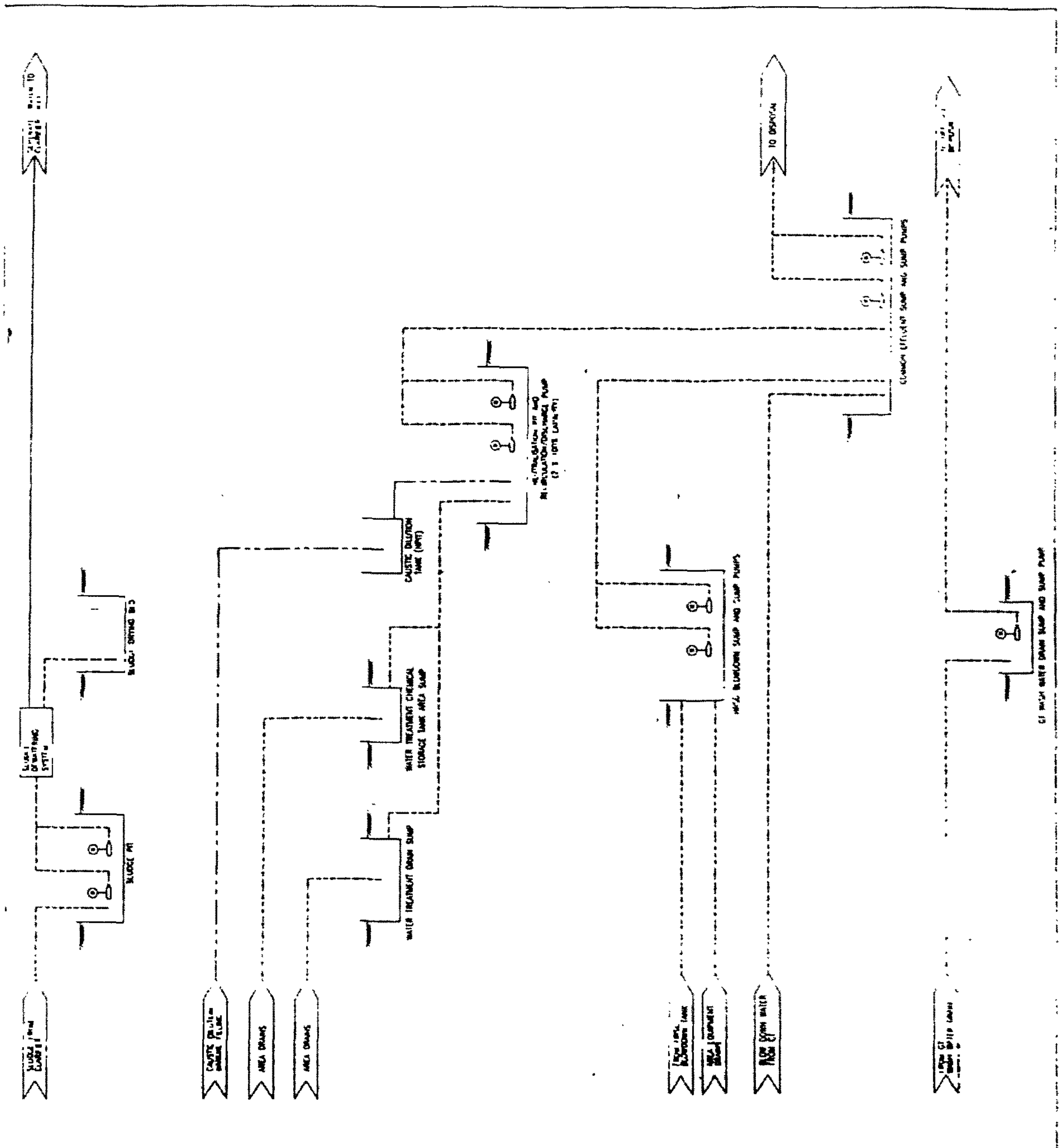


Figure 4-15

Flow Diagram – Wastewater System



Water waste

The plant water waste effluents are from water treatment plant drain sumps, HRSG blow down sump, HRSG area equipment drain, cooling tower blowdown and sample cooler. They will be collected in the common effluent tank. Separated waste water from the Pre-treatment plant dewatering system will be recirculated back to the clarifier. The GTG Wash water drains will be collected in an individual sump. Wastewater collected in the GTG sump will be discharged with a portable pump using flexible hose into a tanker for off-site disposal.

Chemical Waste

The chemical wastes to the effluent tank are mainly from Neutralisation pit and combustion turbine compressor wash effluent. The neutralisation pit receives waste from DM plant and Water treatment plant. In neutralisation pit, pH is maintained and monitored by addition of acid or caustic and by agitation as per local environmental regulations. The neutralised wastewater is then pumped to common effluent tank.

Sanitary Waste

Sanitary waste from the plant sewage and sewerage lines will be collected in local sanitary tanks. Wastewater will be allowed to overflow into soak pits and dirt collected over a period of time will be disposed off- site by sanitary road tankers.

Solid waste (Sludge)

The principal sources of solid waste are from the water pre-treatment plant and from the HSD centrifuge. Solid sludge from the sludge dewatering system will be collected and dried in drying beds, sludge cakes thus formed will be disposed off-site by trucks to be used for land filling. Sludge from HSD purifiers will be collected in individual sludge tanks for off- site disposal.

Effluent Tank

The waste collected in an R.C.C effluent pit will be discharged at a suitable disposal point away from the plant as per local environmental regulations by 2x100% effluent disposal pumps.

4.6.5 Electrical System

Main Distribution

The two gas turbine generators and the one steam turbine generator are rated for the voltage level of 11 kV or manufacturers standard voltage. All the three synchronous generators will be connected to the switchyard through step-up generator transformers. Each gas turbine generator will be connected to the respective generator transformer through a 11 kV generator circuit breaker by means of isolated phase duct. Two nos. (2 x 100%) 11/6.6 kV unit auxiliary transformers will be connected using tap off busduct from the generator busduct and will feed the 6.6 kV MV switchboard. The 6.6 kV switchboard will be in two sections connected by a bus coupler. The two unit auxiliary transformers will be connected to each of the two sections and will serve as the incoming feeders to the 6.6 kV switchboard. The 6.6 kV switchboard will cater to the entire unit and station loads of the Power Plant and the solar field.

The Steam Turbine Generator will be directly connected to the Generator Transformer by means of Isolated Phase Busduct without any generator circuit breaker.

Separate station transformer is not provided as the startup power for the plant is derived from the switchyard through the generator transformer and the unit auxiliary transformer keeping the generator circuit breaker open.

220 kV switchyard is preferred for the power evacuation considering the size of the Power Plant and the existing 220 kV/500 kV substation at a distance of about 2 km from the project site in the nearby steam power plant. A 220 kV switchyard will be located in the ISCCPP. Interconnection of this switchyard with the nearby switchyard and providing additional outgoing line feeder for evacuating the power if required is to be decided in the course of further engineering in consultation with the concerned authorities.

The low voltage auxiliaries of the power plant will be fed from the required number of service transformers taking power from the 6.6 kV switchgear. The transformers will be chosen with 2 x 100% rating so that failure of any one transformer will not affect operation of the plant. Motor control centres will be provided for each system of the power plant.

Auxiliary System

Illumination: Normal AC lighting fed from the low voltage wire system and emergency AC lighting (20% of normal AC luminaries) shall be provided to cover the lighting needs of the plant. In addition, DC emergency lighting shall be provided for the main control room and other critical areas and exits for the safe operation and personnel safety.

DG Set: For safe shut down of the plant and to provide emergency supply a DG set shall be provided. DG set shall supply emergency oil pump and barring gear motor of TG, the battery chargers, emergency lighting and other essential loads.

Communication System: Public Address (PA) System with facility for paging and private mode shall be provided in strategic locations of the plant in addition to EPAX system for internal communication.

DC System: 220 V DC battery along with redundant float cum boost chargers will be provided for steam turbine auxiliaries and station auxiliaries. 220 V DC battery (or 125 V DC battery if it is manufacturer's standard) with redundant float cum boost chargers will be provided for Gas Turbine and auxiliaries. Telephone and fire fighting system will have their own in-built DC system.

UPS System: For DCS and other essential auxiliaries of C&I system 110V UPS system with redundant inverters and converters shall be provided. Necessary battery set, static transfer switch and bypass transformer with voltage stabiliser shall also be provided.

4.6.6 Access Roads

A network of roads connecting solar field with the power block and as well as access to the individual buildings and installations of the power block has been envisaged. The road shall cater to largest of equipment and structures to be transported. The roads shall be provided with walkways for pedestrians. All roads shall be provided with storm water drains. Parking place with sunshade and paved with permeable stones is envisaged in front of the administration and control building.

Based on the width of the carriageway proposed, the roads are divided into 3 sub-groups:

i. Major plant roads around periphery etc.
ii. Access roads to various facilities
Ii Roads within solar block area

4.6.7 Administration Building

Administration building will be sized to accommodate all non-technical staff members of the plant. The building will be of RCC framed construction with blockwork cladding. Finish schedule will be as per architectural & finishing requirements. Toilet facilities and fixtures shall be decided based on the number of users.

4.7 LIFE EXPECTANCY OF THE POWER PLANT

The normal life of a power plant will be around 25 years considering periodic maintenance schedules, overhauls and replacement of parts is carried out as recommended by the equipment manufacturer. For Gas Turbines major overhaul has to be carried out for every 48000 equivalent operating hours.

4.8 OFF-SITE INFORMATION REQUIREMENT

4.8.1 Gas Pipeline

A Gas pipeline is running from the suez region to centres of use for farther south of kuraymat across the site from eastern side to north western side.. This gas pipeline is also supplying gas to existing SCC KPP. Fuel for ISCC will be tapped from this gas line. Gas is available at a pressure of about 40 bar.

4.8.2 Potable Water Pipeline

Raw water from the Nile river will be collected in a raw water reservoir inside the Power Plant. This raw water will be clarified and then filtered in the filters. Filtered water will be collected in a potable / service water overhead tank for further distribution to various areas inside the Power Plant.

Distribution of potable water will be by gravity. Pipes of suitable size and material of construction will be selected for this purpose.

4.8.3 Sewer Pipeline

Sewage generated from various areas of the Power Plant will be collected through sewage pipelines into the local sanitary tanks. These pipelines will be of suitable material of construction and will be buried at adequate depth. Overflow from the local sanitary tanks will be collected in the soak pits.

4.9 OPERATIONAL RELEASES TO THE ENVIRONMENT

4.9.1 Pollution Control Systems & Abatement Technology

The power plant will include a range of measures designed to avoid or minimize releases to the air, water or land (solid waste). Major measures are summarized in *Table 4-5*.

Table 4-5

Summary of Pollution Control and Abatement Systems

Release	Pollution Control/Abatement System
Emissions to the air	Combustion turbine generator will be equipped with dry low- NO_x combustors for natural gas (even in partial load condition), and water injection for solar oil.
Pollution to water	Effluent will be subject to pH adjustment by acid or alkali addition to pH6-9 prior to discharge. Effluent will be subject to treatment and suspended solids will be controlled to be within the allowable limits prior to discharge. Effluents that require no further treatment are disposed of directly into a drainage basin/wadi or a ground well. Site drainage from operational areas will be subject to separation of oil and greases and suspended solids prior to discharge. No wastes will be discharged into the underlying aquifer.
Generation and disposal of solid wastes	All solid wastes will be disposed of by sanitary land filling at authorised sites agreed with the EEAA.

The environmental impacts & pollution control with respect to major pollutants are indicated below

SPM : Since Natural Gas is a clean fuel, no SPM is envisaged from the Main stack or Bypass stacks.

SO2 : The Sulphur present in the Natural Gas is nil and hence no SO2 will be formed. Stacks of sufficient height as per local environmental regulations/norms will be provided for dispersion of Flue gases_

NO_x The proposed gas turbines will have Dry Low NO_7, which will limit the NO, emission to <50 ppmvd at 15% 02.

Effluents : The Effluent water generated in the power plant will be suitably treated and recycled to the extent possible. The balance effluent water shall be collected in central monitoring basin, checked and suitably treated before disposal. Part of the treated effluents will be used for horticulture and remaining will be sent to solar evaporation pond or mechanical evaporator for zero discharge.

Rainwater collection for in-plant use and recharging of ground water (water harvesting) or disposal to natural drains is envisaged. The condensate from knockout drum in Natural Gas System will be collected in underground drain tank and disposed off-site for further usage through road tankers. Domestic sewage will be treated in septic tank and effluent shall be used for horticulture.

Noise : Noises from major equipment will be kept below the permissible level of 85dBA at a distance of 1m from the equipment and 1.5m from the ground by proper design and by providing noise abatement devices. The noise level at the plant boundary during day time and during night time will be in accordance with local environmental regulation.

Thermal : Thermal pollution from the plant is minimized by provision of HRSGs.

Suitable analyzers will be provided in the stacks for continuous monitoring of the air pollutants such as SOx, NOx & CO content in the flue gas. Periodic analysis of the Effluents on daily and weekly basis will be done to monitor any deviation from the permissible levels of liquid pollutants and corrective action shall be taken in case of any deviation. Green belt around plant shall be maintained to reduce pollution and noise effect.

4.9.2 Operational Releases from the Power Plant

Inventory of Emissions to Air from the Power Plant

Since Natural Gas is a clean fuel, no SPM is envisaged from the Main stack or Bypass stacks. The Sulphur present in the Natural Gas is nil and hence no SO_2 will be formed. Since the proposed gas turbine has DLN combustor, NOx emission is limited to < 50 ppm @ 15%O_2.

Inventory of Liquid Effluent Generated by the Power Plant

Liquid effluent, will be generated from the following areas of the Power Plant:

- Water waste from water treatment plant
- Oily waste from combustion turbine area, ST area, transformer area and tank farm area
- Sanitary waste from various area toilets / canteen.
- Water waste from HRSG blow down tank. Cooling tower blow down line etc.

These liquid wastes will be treated suitably based on their constituents prior to the disposal.

Inventory of Solid Wastes Generated by the Power Plant

Solid waste from the water pre-treatment plant sludge dewatering system will be collected in the sludge drying beds. Dried sludge cake will be disposed off site by trucks.

Oily sludge from the HSD centrifuge will be collected separately for offsite disposal.

4.10 OPERATIONAL MANAGEMENT & STAFFING

4.10.1 Process Control & Staffing Facilities

The power plant will be controlled from a central control room, which will contain all the process control computing facilities. All main plant variables will be displayed on "mimic displays", which will reflect the current operational status of the plant.

Safety measures, controls and instrumentation will be provided via distributed control system (DCS), which will continuously monitor operating conditions and be capable of automatically initiating shutdown of the power plant if required. Hence, process control will have a high integrity and operator intervention will not be required to guarantee the safety of the power plant.

The plant will have adequate degree of automation requiring a minimum number of personnel. Approximately 300 people will be employed in the power plant. A General Manager who will have overall administrative as well as effective operation and maintenance control of the CCPP will head the plant. Adequate number of suitable technical and administrative personnel at the plant site will be under the disciplinary control of the General Manager.

The plant operation wing will be headed by Operations Manager and will be supported by experienced engineers for manning round the clock plant operation in shifts. Plant Control Engineer and Operating engineers will assist the Plant Shift Manager for the day to day operation of the plant.

The Operating Engineers will be involved in monitoring the performance of the CCPP, and will record power generation, fuel consumption, Plant load factor, operational efficiency etc. They will analyze CCPP performance and report to Plant Station Manager. their finding alongwith suggested means for the plant betterment.

Maintenance Manager will head the plant maintenance wing. Experienced maintenance engineers will be responsible for Mechanical, Electrical, Control & Instrumentation maintenance respectively; and will be assisted by Mechanical, Electrical and C&I maintenance staff with extensive experience in the similar capacity power plant.

In addition to above, the organisation will have a team headed by Manager – Finanace & Administration for office administration, finance, accounts, personnel, health etc. and a team headed by Materials & Contracts Manager for procurement related activities.

Plant staff members will be provided with facilities such as accommodation, medical, canteen, study centres, recreation and all other essential/emergency services.

Staff Training

Successful plant operation and maintenance depends upon the efficiency and performance of its personnel. To achieve high degree of efficiency in plant management and operation, it is desirable to train up personnel for the operation of the sets. The training schemes shall include:

- General theoretical training on power station operation and maintenance.
- Actual in-plant training in similar power stations elsewhere.
- Training at supplier's works/plant
- Training during erection of equipment at site by the supplier.

4.10.2 Operational Expenditure

The typical annual operational expenditure at the power plant will be US$ 2 million (as a 25-year average), although during periods when major maintenance is carried out the expenditure could rise to over US$ 3 million in a particular year. It is expected that 70% of the operational expenditure will be spent locally, on labor, consumables, equipment repair, general maintenance, etc. The payroll (including benefits and overtime) is expected to be approximately US$ 1.8 million per year.

4.10.3 Operational Environmental Health & Safety

The environmental health and safety plan for the operation of the power plant is described in *Section 8*.

The design, construction and operation of the power plant will comply with the applicable requirements of Egyptian and IFC guidelines related to environment, health and safety (*see Section 2*). The health and safety of the workforce and the local population and protection of the environment are of paramount importance in the design and operation of the power plant.

The operational environment, health and safety plan will include provisions to monitor compliance with the key provisions of the Egyptian and IFC guidelines listed in *Table 4-6*.

Table 4-6

Key Components of the Operational Environmental, Health and Safety Plan

Issue	Provisions within the Operational Environmental Health and Safety Plan
Atmospheric emissions and ambient air quality	• Ambient air quality standards. • Emission limits. • Specific conditions for fuel use.
Liquid effluent discharges	• Discharge limits. • Specific conditions for development on the canal bankline.
Noise emissions and ambient noise levels	• Noise emissions limits applicable to land use zone.
Solid and hazardous waste management	• Specific conditions on storage and handling of hazardous waste.
Occupational environmental management and health and safety	• Ambient air quality standards for the workplace. • Ambient temperature standards for the workplace. • Noise limits for the workplace. • Specific conditions on electrical safety in the workplace. • Specific conditions on working in confined spaces. • General conditions on health and safety • Specific conditions on personnel training • Specific conditions on record-keeping and reporting.
Use of pesticides and chemical compounds	• Specific conditions on the use of pesticides and related chemicals.
Use of chemicals	• Specific conditions on the use of hazardous chemicals.

Operational Environmental Health & Safety requirements will be in accordance with the local laws and regulations. Plant personnel will be equipped with all necessary safety equipment such as helmets, gloves, goggles, earmuffs, shoes etc. as required during operation and maintenance

Natural gas is used as the fuel for Gas Turbine, which is very clean and hence the stack exhaust is free from suspended particles and SO_2 emission. NOx emission is kept to very minimum as the gas turbine is equipped with DLN combustor. Hence there is no adverse impact due to air emissions on health safety.

The entire power plant is provided with fire protection system with hydrants, foam system, CO_2 system and portable fire extinguishers as applicable to take care any eventuality due to fire accidents. In addition to that a fire tender will also be available.

Insulation will be provided for personnel protection where the metal skin surface temperature is >60°C.

Necessary acoustic enclosures will be provided so as to maintain a noise pressure level of 85 dBA at a distance of 1m away from the equipment and 1.5m above from the ground. All safety valve discharge lines will be provided with silencers. GT exhaust gas bypass stack will be provided with silencer to keep the noise level to the acceptable limits.

All access platforms, walkways, ladders, etc will be provided with safety handrails.

The plant will be provided with first-aid medical facilities, health centres with ambulances to cater emergency requirements.

The entire plant will be protected with a boundary wall with security house at the main gate for the plant safety. Adequate number of security watch towers will be provided all along the boundary wall.

4.10.4 Construction Activities And Program

Construction Program and Schedule

The construction program is planned to be completed within 37 months.

The key phases and activities within the construction program are shown in *Table 4-7*. The normal hours of working for construction are shown in *Table 4-8*.

Construction Materials

Preliminary estimates of the main construction materials which will be required to construct the power plant, excluding specialist plant and equipment, are set out in *Table 4-9*.

Table 4-7

Summary of Construction Activities

Activity	Description of Activities	Indicative Timing from Mobilization
Construction Start and Site Set-up	Mobilization, establishment of site offices, installation of temporary utilities, site survey.	Months 1-3
Preliminary Works	Establishment of temporary facilities, topsoil stripping, excavation, construction of site roads access, drainage, services, fencing.	Months 1-6
Earthworks, Piling and Foundations	Piling, establishment of base slabs, footings, pits and tanks.	Months 5-15
Steelwork	Construction of steel frames for buildings and support of plant.	Months 10-22
Major Plant Installation	Installation of HRSGs, generators, etc.	Months 12-37
Mechanical and Electrical Installation	Installation of pipework, pumps, compressors, cooling water ducts, power cabling and switchgear process controls, HVAC, pumps, motors, fans heat exchangers.	Months 16-31

Table 4-8

Normal Hours of Working for Construction

Day of Week	Hours of Normal Working
Saturday-Thursday	07:00-03:00 hours [b]
Friday	No work
Holy Days and Holidays[a]	No work

Notes:

a. Holy Days and Holidays include Eid-El-Fitr, Sham El Nessim, Sinai Day, Labor Day, Eid-El-Adha, Moslem New Year, Revolution Day, Prophet's Birthday (El-Mawled El-Nabawy), Armed Forces Day.
b. Construction work between Saturday and Thursday will be undertaken in two x 8 hour shifts.

Table 4-9

Preliminary Estimates of Construction Materials

Construction Material	Quantity (tons, unless otherwise stated)
Cement powder	8000 tons
Fine aggregates	6000 m^3
Coarse aggregates	10,000 m^3
Structural steel	900 tons
Potable water	30 m^3/day
Raw water	50 m^3/day

Construction Workers

The NREA and their Consultant will seek to utilize qualified contractors with demonstrated performance in the construction of power stations and construction of projects in the region. Wherever practicable, local employment opportunities will be maximized.

Most fabrication will take place prior to delivery to the site and all erection of structures and installation of equipment will use local craft labor, including the following professions:

- engineers;
- boiler makers and installers;
- carpenters;
- cement masons;
- electricians;
- iron workers;
- millwrights;
- pipefitters;
- teamsters;
- laborers; and
- welders.

Construction Traffic

The traffic generated by construction is estimated as shown in *Table 4-10*. The amount of construction traffic will vary throughout the construction period.

Table 4-10

Estimated Construction Traffic

Vehicle Type	Traffic Generation Day shift		Traffic Generation Night Shift	
	Peak	Total in Shift	Peak	Total in Shift
Heavy Goods Vehicles (HGV)[a]	8	64	0	0
Construction Workers Vehicles [b]	60	120	60	75
Abnormal Loads [c]	0	0	2	3

Notes:

a. Assume that all HGVs travel to and from the site during the daytime shift.

b. Assume that 75% of the construction workers will reside in site. The remaining 25% of the work force will travel to and from the site by car at an occupancy rate of 3 per car.

c. The timing of deliveries of abnormal loads will be agreed with the CA; however, it is assumed that these deliveries will occur during the night shift to minimize road congestion There will be approximately 35 abnormal loads during construction.

Construction Safety

The Contractors will be required to develop and implement a construction Quality Control Program. A key part of the Quality Control Program will be a Health and Safety Plan, which the construction contractor(s) will be required to comply with as a condition of contract.

Environmental Management During Construction

The NREA recognizes that construction activities need to be well-managed and controlled to avoid potential environmental impacts from nois, dust, odor, effluent, traffic and other forms of disturbance by construction workers and fixed or mobile plant.

The construction activities will incorporate range of mitigation measures to minimize the potential for environmental impacts to occur (*see Section 7*).

5. DESCRIPTION OF THE ENVIRONMENT

5.1 GENERAL SETTING OF THE SITE

The ISCC Kuraymat site is located within an existing fencend area of uncultivated land. It is situated on approximately 277 hectare piece of land located in a desert area near the village of Kuraymat, in the Giza Governorate, on the eastern side of the Nile river. The site locus is approximately 95 km south of Cairo and 30 km north of Beni-sueif. The project area consists of two principal facilities-the solar field and the power block area in addition to the area designated to the balance of the plant (i.e. switchyard, administration building, fire station, workshop and storage, canteen & park area, main gate, security, visitor center, gas station, liquid fuel tank and unloading station) (*Figure 5-2 (B)*). One physiographic zone occupy this area: a rocky desert plateau east of the floodplain adjacent to the Nile. The site of the proposed power plant is about 2000 meters wide and has an average length of about 900 meters; in all the site encompasses 2,772,000 square meters. The site of the existing KPP community facilities, or colony, is located near the west side of the power plant area, the colony area measures 670 x 670 meters, or approximately 450,000 square meters.

On the north west side of the site is the Kuraymat village (about 3.0 km) and the Kuraymat irrigation pumping station (about 3.5 km). The site is about 2.5 km north-east of the Ezbet El-Hagg Ghanem. On the east side of the site is a wide-extended desert land and on the south side is an agricultural land. On the west side, and across the colony site, is a two-lane road running approximately paralle to the Nile river. On the western side of the site, across the two-lane road is the Kuraymat thermal power plant and then, the Nile river, about 2 km from the proposed site, where the existing power plant's cooling water intake and discharge structures are located.

The nearest town of importance is Es-saff, Markaz Es-saff, about 30 km along the road in the north direction. Towns of importance in the wide vicinity of the proposed power plant site are Giza, Imbaba, 15th of May, Beni-sueif and El-Wasta. The general site location is shown in *Figures 5-1, A , B and C* .

The site consists of approximately flat land, which is owned by the New and Renewable Energy Authority (NREA), exactly 660 feddan. Localized map of the proposed site is shown in *Figure 5-2, A and B*.

The land is identified by the north latitude of 29° 16' and the eastern longitude of 31° 15'. *Figure 5-3* presents the geographical location of the proposed site.

The Kuraymat site is located on the western edge of the North Galala Plateue, a desert environment ranging in elevation from 330 to 1,275 meters above sea level. The sit itself is at an elevation of 60m above sea level. Wadis drain into the Nile river from the west slope of the plateau. The development of the site will not affect the drainage in adjacent areas. The river bank in this reach of the Nile (El- Wasta to Beni-sueif) is generally steep, consisting of small floodplain areas on the east bank; however, more extensive agricultural lands occur on the west bank. Flat desert lands above the east bank (*Figure 5-4*) extend some 35 km inland to the Galala Plateau ridge. This area is not irrigated, but sporadic grazing occurs throughout the plateau. *F*igure 5-5 shows two views of the existing site from the 2003 site visits.

Small oases occur about 1 km south-west of the site, and also to the north-west of the site. These oases are located on wadis at their confluences with the Nile flood-plain. The oases and adjacent floodplain are used to grow a variety of fruit, vegetable, and forage crops and to graze livestock. Agricultural land to the immediate south of the proposed site also grow the same types of crops. The natural growth of palm trees and shrubs, combined with fig trees and other cultivated woody plants, provides habitat for a variety of songbirds and some shorebirds.

At least two different crops are planted annually on the lower areas, and in August, corn and peanuts are the predominant crops. Winter wheat is to be planted after the corn is harvested. Orchard and perennial crops included grapes, melons, guava, lemon, Indian fig (Opuntia ficusindica) and castor bean.

Natural stream bank vegetation forms a narrow border to the river and consists of Scirpus, Juncus, Phragmities, Typha, and other emergent species. Snails are abundant along the shoreline, as are nematodes and other bottom worms in shallow water. The shoreline also shows evidence of high siltation and periphytic growth. The shoreline at the reach is already stabilitized as a part of the existing KPP project. The elevation is on average not changed in the cultivated area but all areas are of uniform elevation.

The Kuraymat proposed site is within the El-Burumbul local governing unit, with the city of Es-Saff as the governing center of the district. No villages or individual residences are located on the site. Agricultural workers who farm the floodplain and the agicultural land to the south of the proposed site live in nearby villages. Kuraymat village is located some 3 km to the north-west of the site and *Figure 5-6* shows the view of the nearest part of the village from the road to the site.

The site is located within a totally rural/desert landscape with some small scattered residential communities.

Supply to the site is possible via railroad, road and barge from Alexandria, El-Dekheila, Damietta, Suez-Gulf or others. The power plant location can be reached by previously mentioned two-lane road which branches off the agricultural road connecting Alexandria with Cairo. This access road has a width of about 12 m starting from Helwan. The part of this access road which passes the Kuraymat site is paved but is full of asphalt pockets.

Another access road to the proposed site starts from Giza to El-Badrashein through El-Ayyat to Beni-sueif, then crosses the Nile to follow Beni-sueif desert road 30 km to the north till the main entrance of the proposed site.

The project area lies within the hyperarid climatic province of Egypt characterized by a mild winter and hot summer.

Generally, the project area is a rural-desert landscape. In the vicinity of the project site, almost no human settlements of any significant size occurs.

There is a typical rural housing with many small villages. The nearest villiage to the site is at about 3 km. No housing, except the existing KPP's colony, occurs in the immediate vicinity of the site which is totally surrounded by desert and farm lands. The satellite image taken recently *(Figure 5-1(B))* shows that these lands are as described.

There are no significant habitats within the project's area of influence.

The primary wildlife species observed onsite during the November 2003 and Februray 2004 field reconnaissance were birds. Within the wetlands, the cattle egret (Bubulcus ibis), moorhen (Gallinula chloropus), common swallow (Hirundo Rustics), and graceful warbler (Prinia gracilis) were commonly observed in the Scirpus – Juncus marshes. Most of the avian activity, however, was centered in the agricultural areas. Swallows were observed foraging the fields. Cattle egrets, spur-winged plovers (Hoploterus spinosus), crested larks (Galerida cristata), and Senegal stone curlews (Burhinus senegalensis) foraged on the ground in the fields. Palm doves (Streptopelia senegalensis) were commonly observed foraging on the ground as well as resting in the trees. No birds were observed in the desert on the site.

In addition, the field surveys have indicated that non-of the floral and faunal communities and/or species are of conservation value (rare or threatened). Meanwhile, no natural protectorates exist near the vicinity of the proposed site.

No industry, other than the existing power plant, is present near the site. Thus, the air in the background atmosphere is of appropriate quality.

No archaeological resources are known in this zone. During February 1991 and before the construction of the existing Kuraymat power plant, Kathryn A. Bard and Ricardo J. Elia of the Office of Public Archaeology, Boston University have conducted "Preliminary Archaeological Assessment for the Kuraymat", Egypt Feasibility study. Also, the local archaeological authorities surveyed the whole area around the site and they all proved that no historical resources exist.

Two water sources are available near the site, i.e. the Nile river and the underlaying aquifer. The quality of both surface water and groundwater in the Kuraymat reach of the Nile is generally good. Only in localized sectors where there are concentrated sources of contaminants, such as irrigation drainage return waters, would water quality degradation be expected to occur.

The groundwater basin, which lies both beneath and closely adjacent to the Nile Valley from Cairo to Aswan, includes an area of about 2 million feddans. Water storage in this linear basin has been estimated at approximately 27 billion m^3. However, because the hydrologic balance of the Nile Valley alluvial aquifer is directly connected with Nile surface flows, production from the aquifer is nominally the same as withdrawing water from the river. In essence, the valley aquifer is a transmission medium for river surface resources.

EGYPT

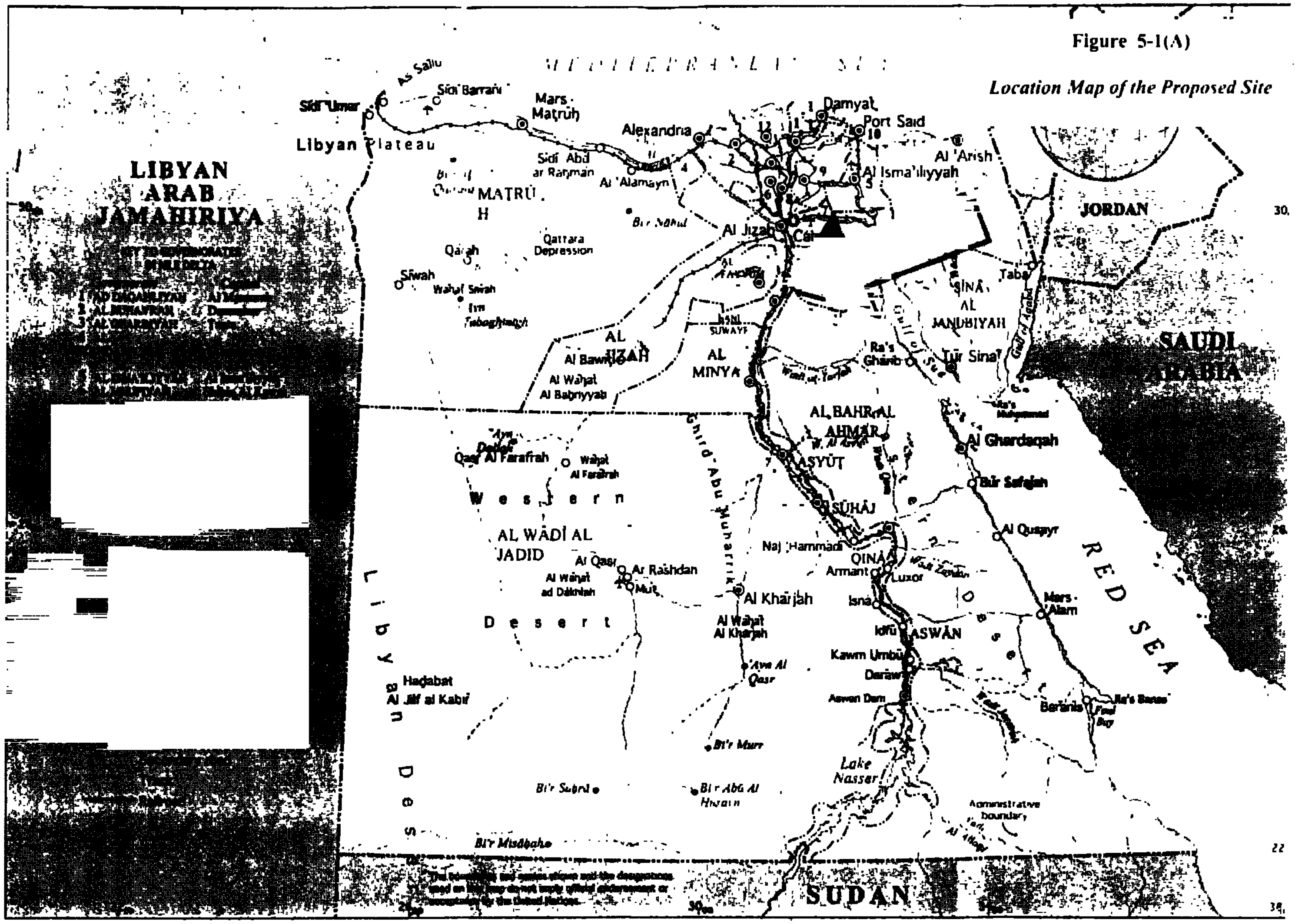


Figure 5-1(A)

Location Map of the Proposed Site

Figure 5-1 (B)

Part of Landsat TM Mosaic Covering the Project Area

Figure 5-1(C)

Location Map of Giza Wide Area Showing the Proposed Site of the Kuraymat Combined Cycle Power Plant

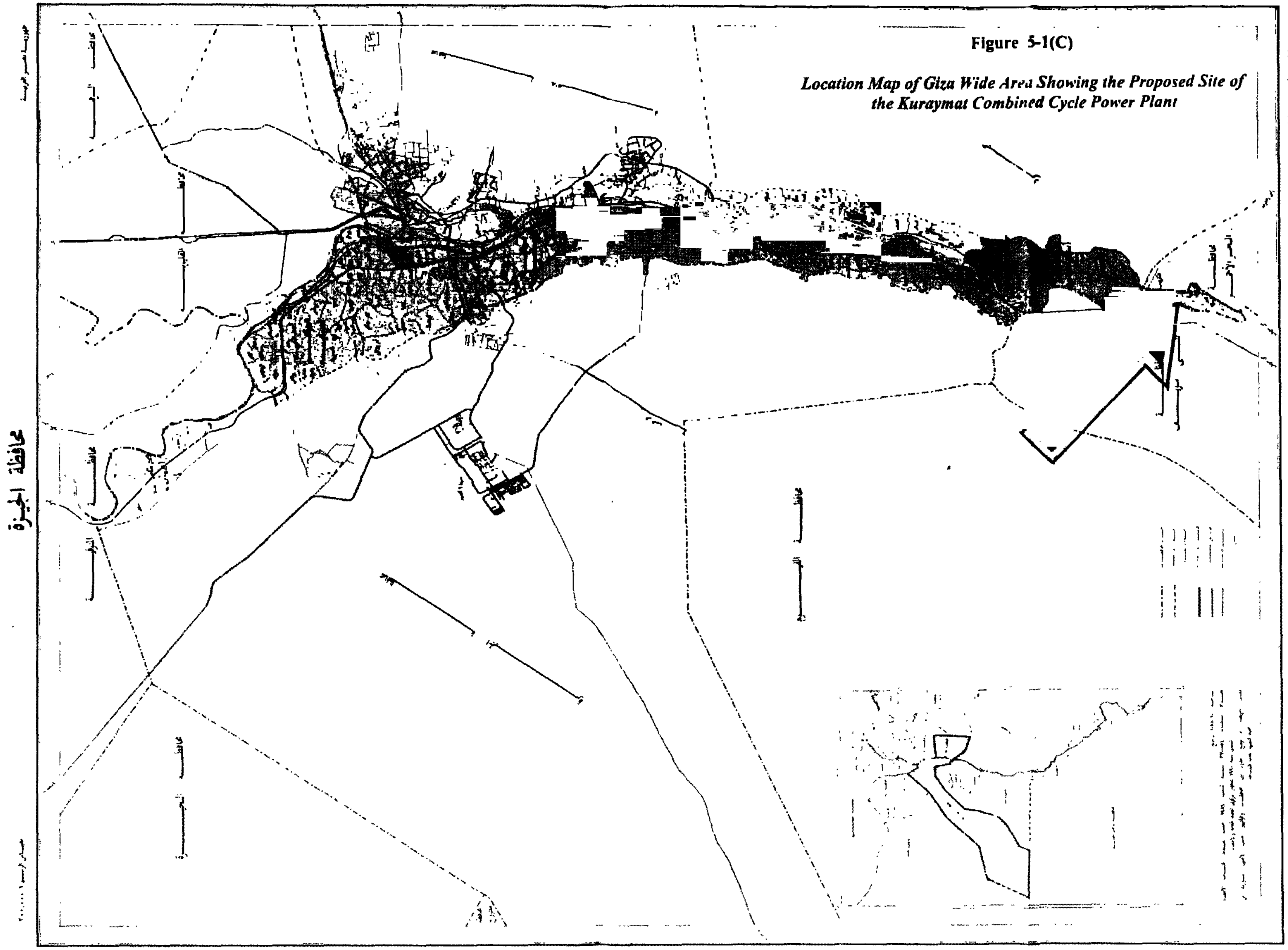


Figure 5-2 (A)

Localized Map of the Proposed Site

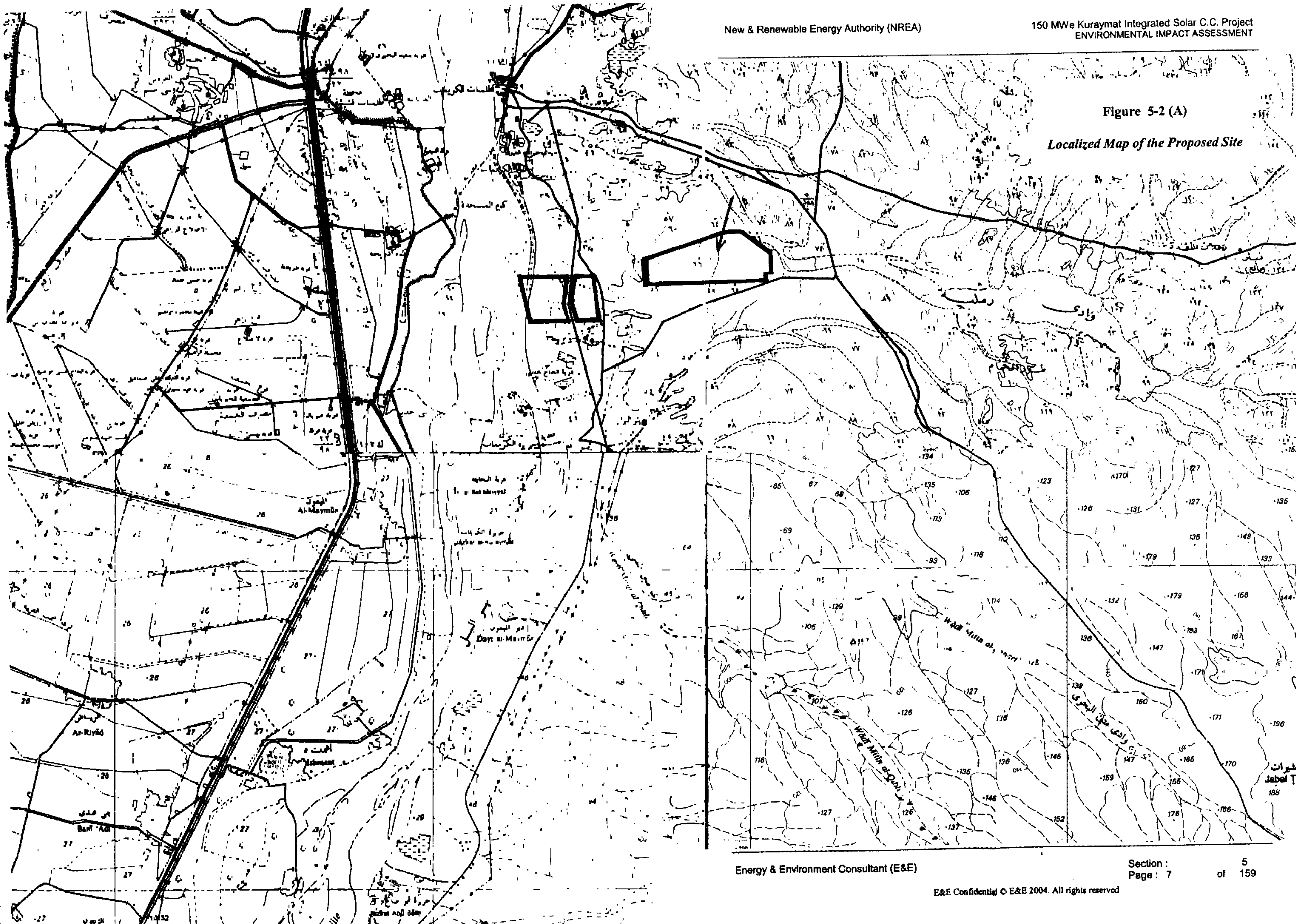


Figure 5-2 (B)

Location Map of the Proposed Site

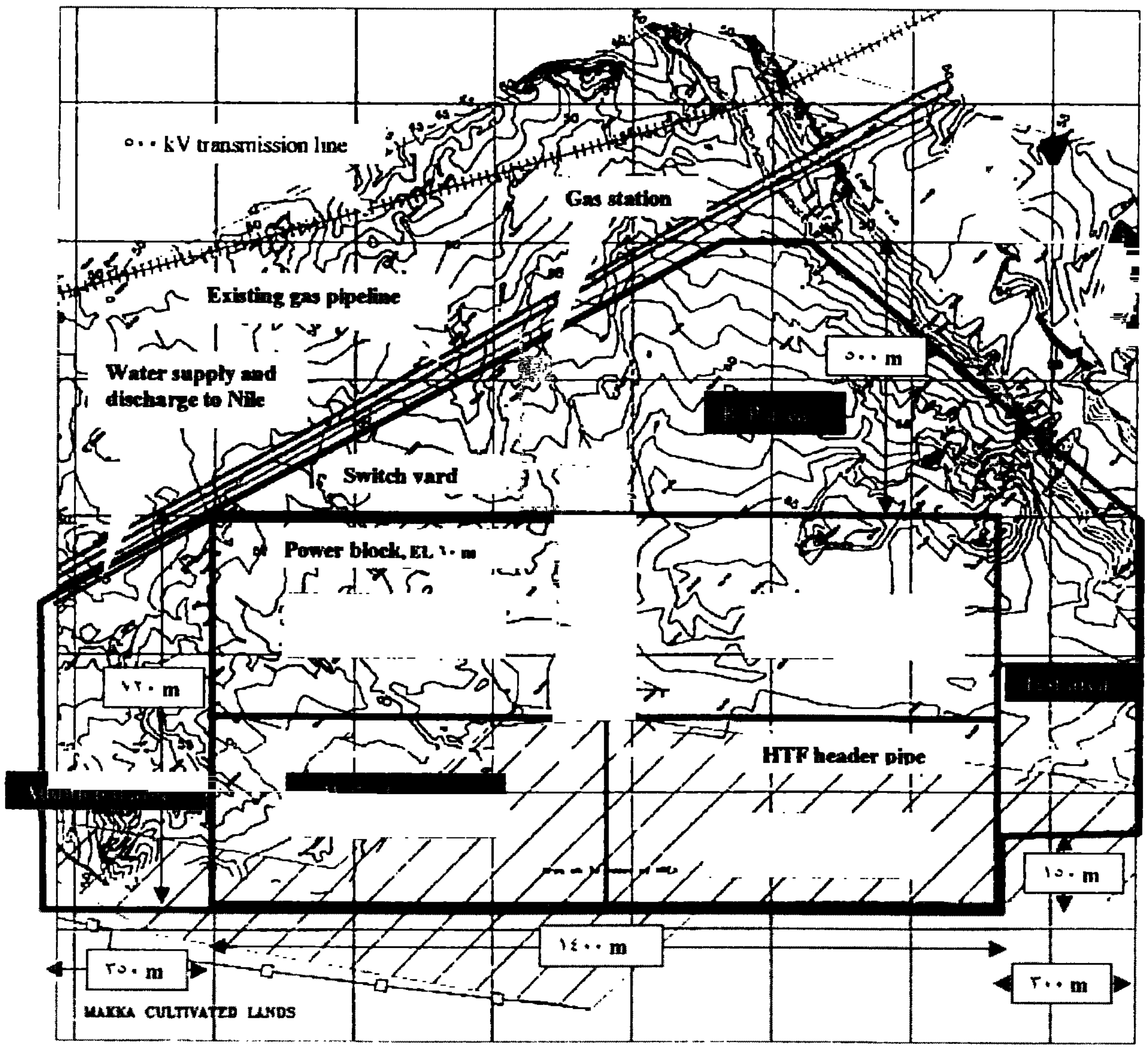


Figure 5-3

Geographical Location of the Proposed Site

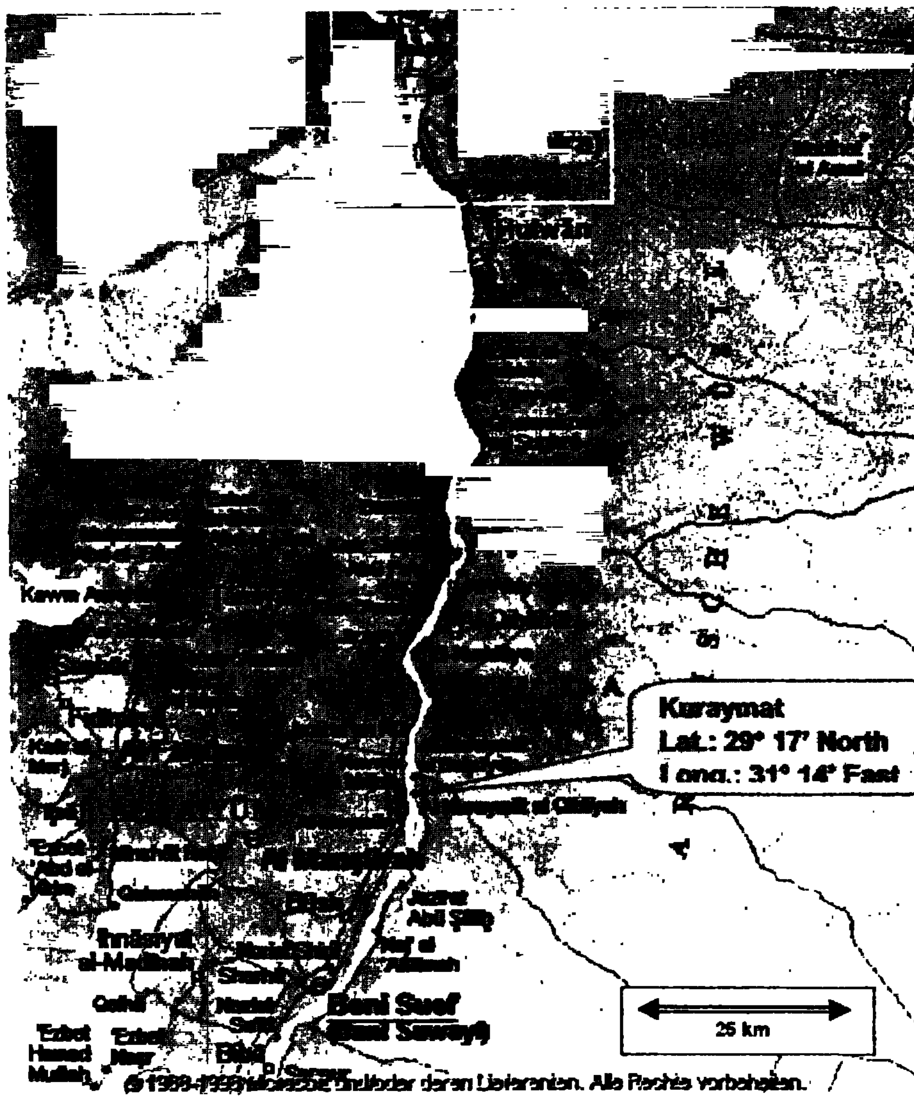


Figure 5-4 (A)

Flat Desert Lands Above the East Bank of the Nile River
(July 1991, Existing KPP-EIA Report)

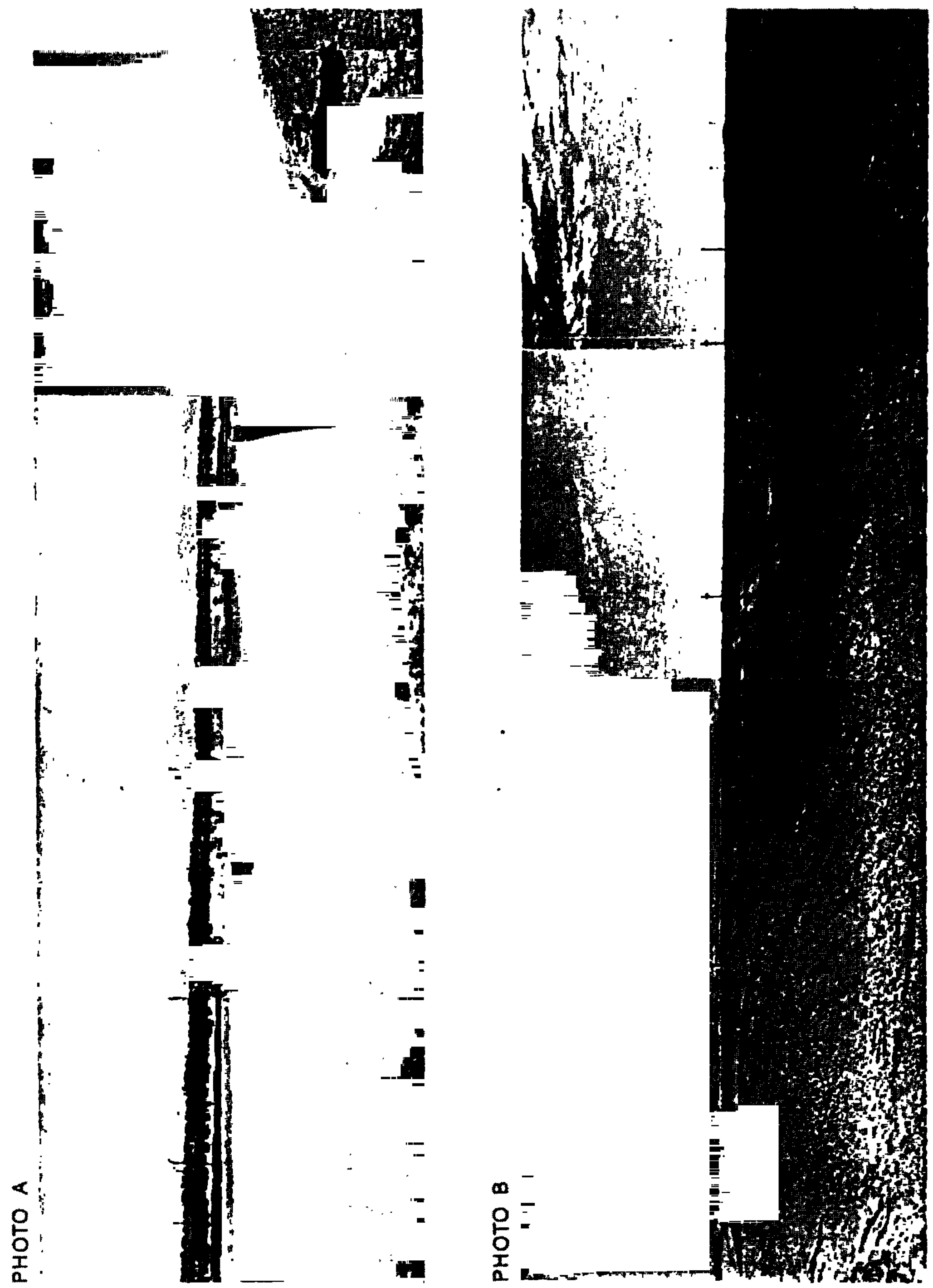


Figure 5-4 (B)

Flat Desert Lands Above the East Bank of the Nile River
(January 2004, Fichtner Solar GmbH)

Figure 5-5

A. Near View of the Site of the Existing Kuraymat Electric Power Station
B. Panoramic View Exhibiting the Site of the Existing Kuraymat Power Plant

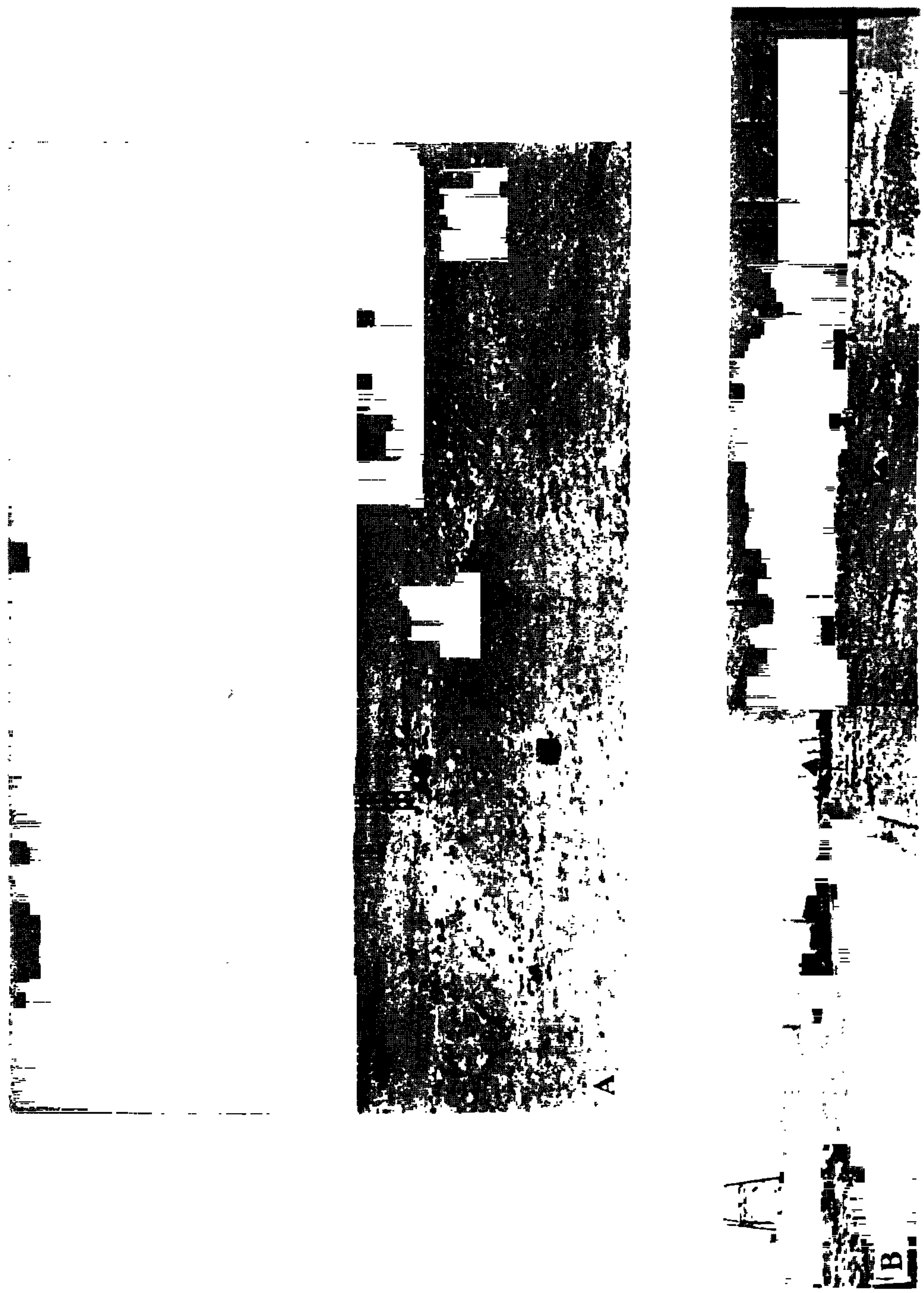


Figure 5-6

Kuraymat Village Photograph
(July 1991, Existing KPP-EIA Report)

5.2 SOILS, GEOLOGY, HYDROGEOLOGY, TOPOGRAPHY AND SEISMICITY

5.2.1 Introduction

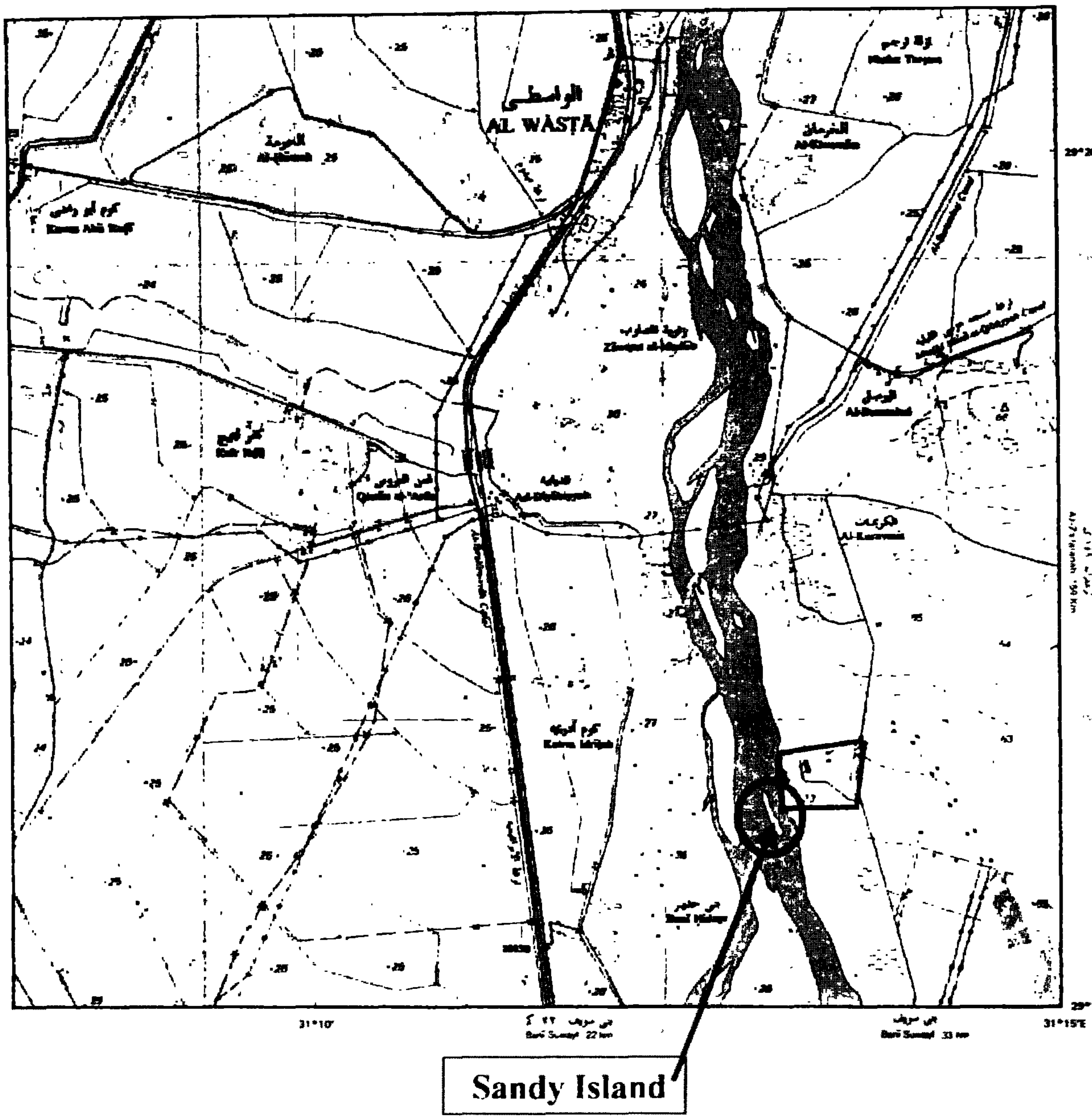
Information on soils, geology, hydrogeology and topography was obtained from the following sources:

- review of the 1:50,000 scale and 1:500,000 scale Geological Maps; produced by the Egyptian Geological Survey and Mining Authority (EGSMA);
- discussions with the Department of Natural Sciences, Institute of Environmental Studies and Research, Ain Shams University;
- discussions with the National Authority for Remote Sensing and Space Sciences, State Ministry of Scientific Research and Technology;
- review of the Hydrogeological Map of Egypt;
- observations made during the site visits, by E&E in December 2003 and February 2004;
- "Geotechnical Soil Report" of the ISCC Kuraymat Power Plant site (Geotechnical Investigation and Foundation Recommendations for the Site of Solar and Heating Power Station, El-Kuraymat/Beni-Sueif), performed by "Struc. & Geotec. Research Center (SGRC)", February 2001;
- Baseline Study on the "Physical Environmental Setting of the Proposed Site of Kuraymat Integrated Solar Combined Cycle power project, conducted by "Enviro-Pro", April 2004.

The general topography of the area is shown in *Figure 5-7 (A)* and site specific topographic contour lines are shown in *Figure 5-7(B).*

Figure 5-7 (A)

General Topography of the Project Area



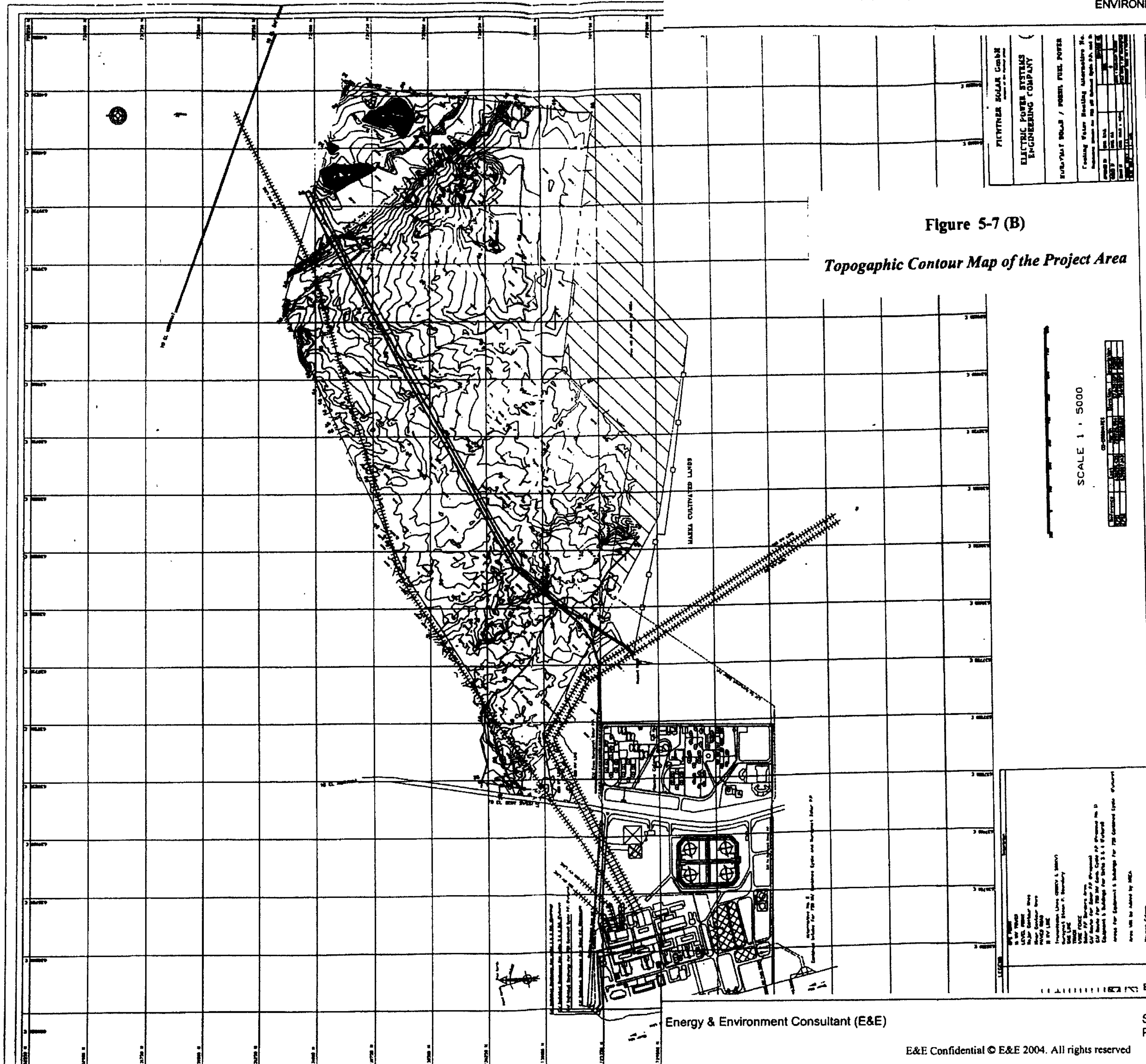


Figure 5-7 (B)

Topogaphic Contour Map of the Project Area

5.2.2 General Physiography

Although the Nile Valley and the Delta occupy about 3.5% of the total area of Egypt, they represent, from the geographic point of view, the most important region in Egypt. This is because most of Egypt's population, most of the cultivated land, most of the water resources and most of the socio-economic manifestations are concentrated in such a small area. In fact, the development of the Nile Valley since about six million years was the most significant geomorphologic event that shaped not only present-day geomorphology of Egypt but also its other geographic aspects.

The project fenced area covers 2,772,000 m^2 located on the east bank of the Nile river, about 95 km south of Cairo and 30 km north of Beni-sueif.

This selected site is located at the northern extremity of the Eastern Desert, on the eastern side of the Nile Valley, obout 2 km distant from the Nile bank, and lies just south-east (about 3.5 km) of the Kuraymat irrigation pumping station and the Kuraymat village (some 3.0 km). The site is located at the northn latitude of 29° 16' and the eastern longitude of 31° 15'.

The planned site can be reached by Es-Saff/ Beni-sueif road which is linked directly by Ciro/ Tebbin road. The site can, also, reached by Giza-Badrashein road which passes El-Wasta to Beni-sueif via Upper Egypt agriculture road along the west bank of the Nile river. It crosses the Nile at Beni-sueif to the east bank and follows Beni-sueif desert road to the north till the main entrance of the power plant site. This reach is about 60 km longer than the previous one.

5.2.3 Geomorphology

Topographically, the area is characterized by moderate relief in its eastern part and undulating low land along the margin of the Nile Valley (*Figure 5-8*). The low land (plain) extends to the upper part of the pediplain (foot slopes) of the eastern plateau. The maximum elevation in the area reaches 101m at the extreme eastern part.

The present area is a part of the western margin of the Maaza plateau, which occupies the central and northern parts of the Eastern Desert.

Geomorphic Units:

The landscape of the study area and surroundings is divisible into three main geomorphic units, namely: (a) the elevated plateau, (b) undulated pediment, and (c) Nile flood plain. Following is a brief description of these units:

- <u>The elevated plateau</u> attains a relief ranging between 23 and 434 m above sea level (*Figure 5-9*). Generally, the elevation of the plateau increases eastward (*Figure 5-10*). The plateau surface is corrugated and cluttered with isolated mesas (flat-topped hills) and buttes (cone-shaped hills) of limestones of different geological units (*Figure 5-11*). The western edge of the plateau has an elevation ranging from 220 to 435 m (a.s.l.). This scrap extends in an undulating fashion running northerly to northeasterly. The basic configuration of this scrap is structurally controlled by two major fault sets trending NNW-SSE and N-S. The plateau surface is dissected by a dense and well-developed drainage net, flowing west towards the Nile. Major wadis dissecting the plateau are long and deep (incised), and in many sectors they are flanked by nearly vertical rockwalls (cliffs) and are developed into canyon-like drainage channels.

- The pediment is a slightly undulated plain, that exists at the footslope of the retreated front of the elevated plateau. The junction of the pediment with the front of the plateau is marked by a gradual break in slope. It forms an elongated plain with a regional N-S extension and a gentle slope generally towards the west. Near the Nile flood plain this pediment is crossed by the Cairo-Beni Sueif highway and is occupied by villages and other human activities (*Figure 5-12, 5-13 & 5-14*). The area is crossed by the lower reaches of a few main wadis, issuing from the upland plateau. The western rim of the pediment is short, irregular in outline and merges imperceptibly westward into the Nile flood plain.

- The Nile flood plain is almost flat and occupies a narrow strip north and south of the area of study. This area is covered by Holocene Nile silt, which composes the fertile cultivable soils of the Nile Valley (*Figure 5-15*).

Drainage Network

The drainage basins bounding the power plant site and surroundings are: W. Ramlyyah in the east to north and W. Matin El-Bahri in the south. These two basins are elongate, run approximately east-west and debouch into the flood plain of the Nile river.

Lithologically, the upper reaches of the basins are carved in the Eocene rocks and their lower reaches are carved in younger formations (Pliocene-Quaternary) (*Figure 5-20*)

The map in *Figure 5-18* shows that the drainage pattern of this net is predominantly dendritic in the northern basins and is dendritic to sub-parallel in the southern basins due to structural controlled by the NW and E-W fault systems. Some of the main wadis of these southern basins run east-west (*Figure 5-18*).

The proposed power plant site lies south-east of the outlet of W. Ramlyyah occupying an elevated land. On the other hand, the suggested pathways of the proposed new Cairo-Kuraymat Highway that tends to avoid traffic congestions along the Nile Valley agricultural land cuts across the lower reaches of all these basins as it runs virtually perpendicular to the direction of flow of the basins. In the light of this, special design measures need to be considered. In the same way, connecting the proposed power plant to the electrical transmission network, should be carefully considered in the light of the different prevailing geomorphic units of the region.

Figure 5-8

Panoramic View (Looking South) Exhibiting the Site of the Existing Kuraymat Power Plant (→), Surrounding Inhabited Area, and Quarries Located North of the Plant Site

Figure 5-9

Topography of the Site of the Proposed Kuraymat Power Plant

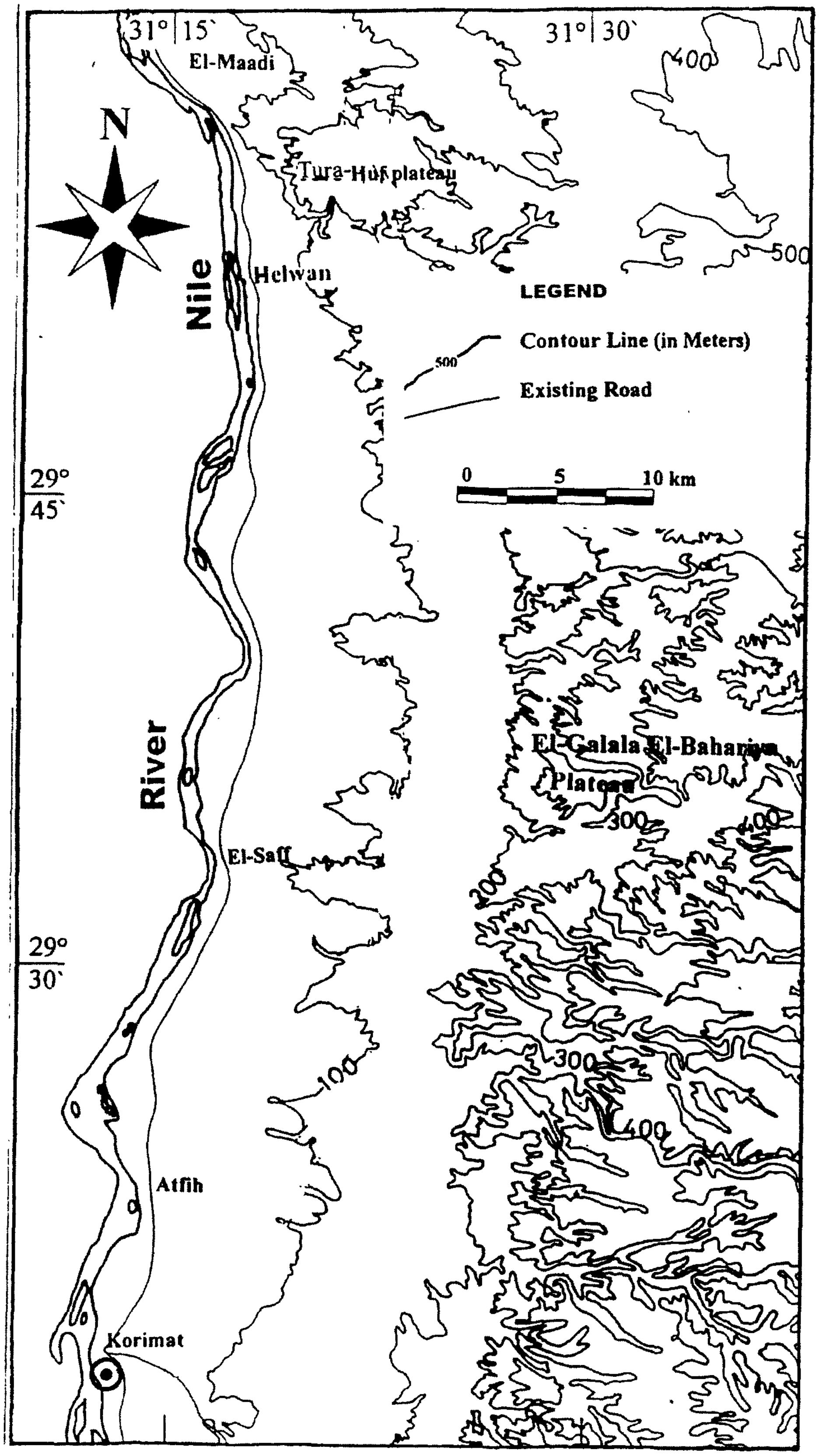


Figure 5-10

Topographic Map of Helwan – Kuraymat Area Showing North-South Oriented Margin of the Eastern Plateau

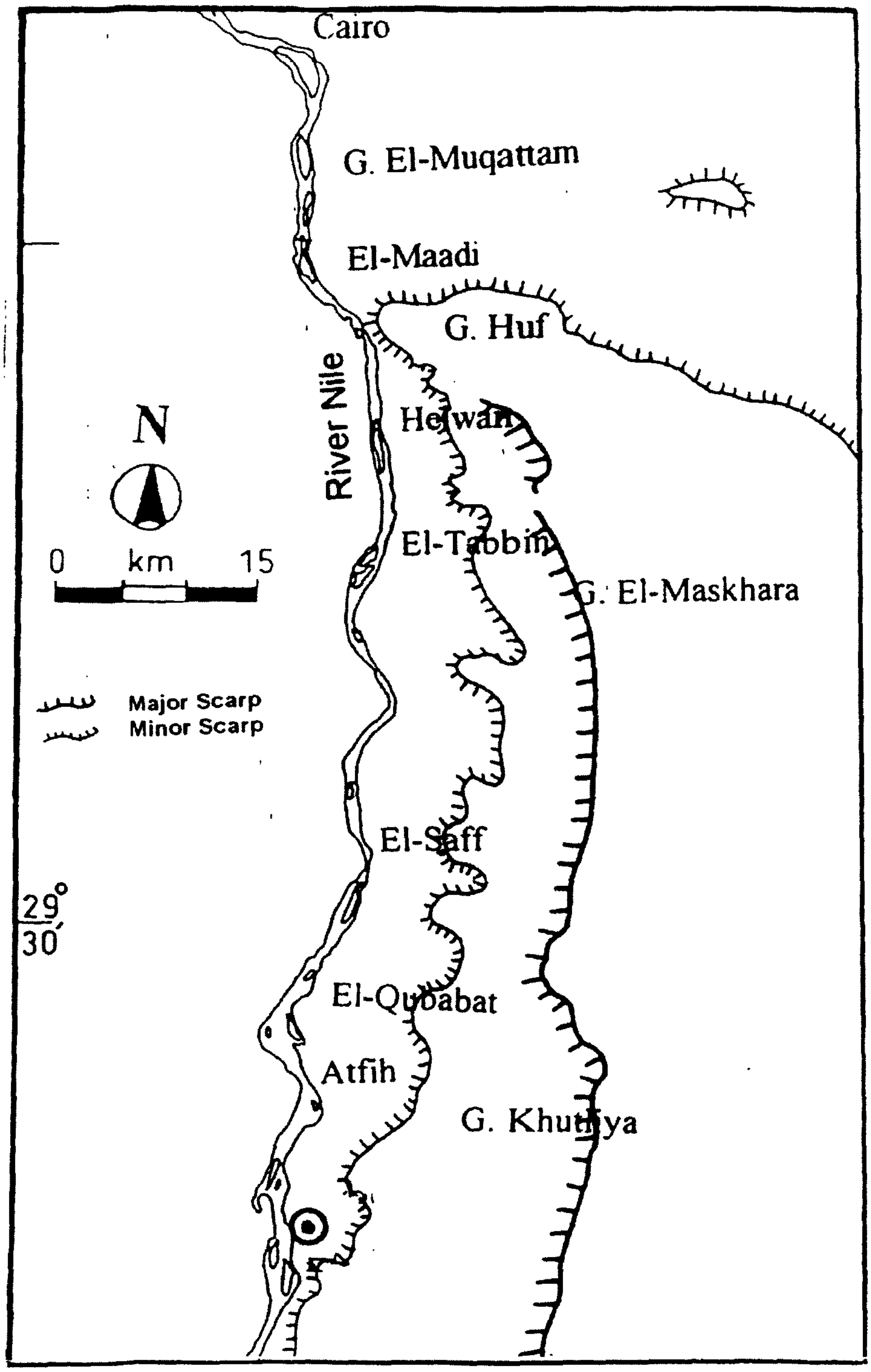
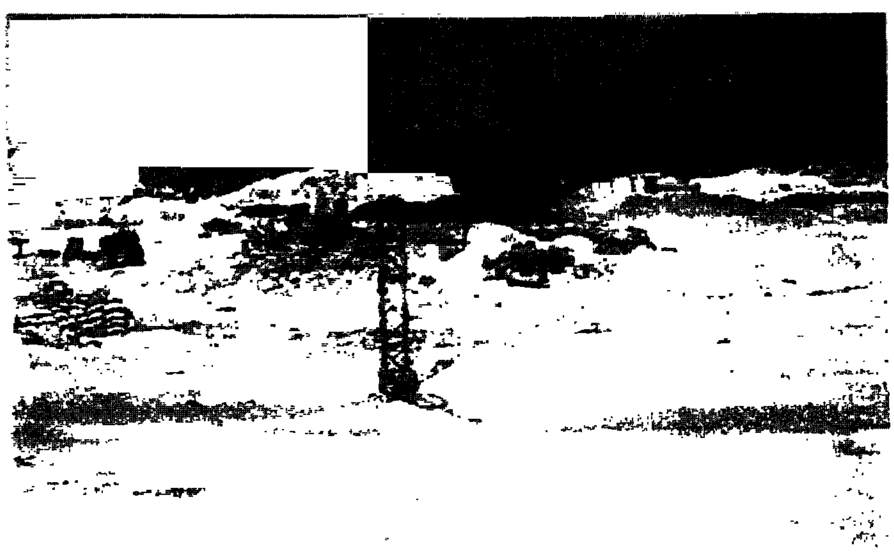


Figure 5-11

A. Corrugated Edge and Surface of the Western Limestone
B. Quarry of Chalky Limestone

A



B

Figure 5-12

Natural Drainage Channel Trending West Towards the River Nile with U-Shaped Cross Section

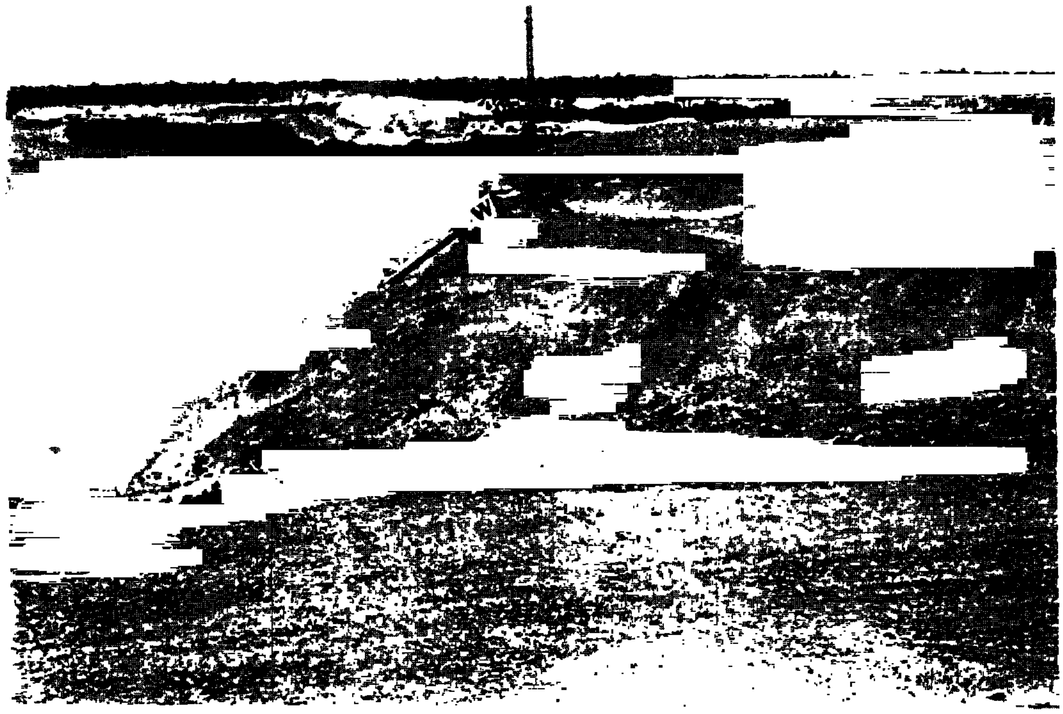


Figure 5-13

Cairo / Beni-sueif Highway Extends Along the Western Margin of the Plateau (Upper Part of the Pediplain)

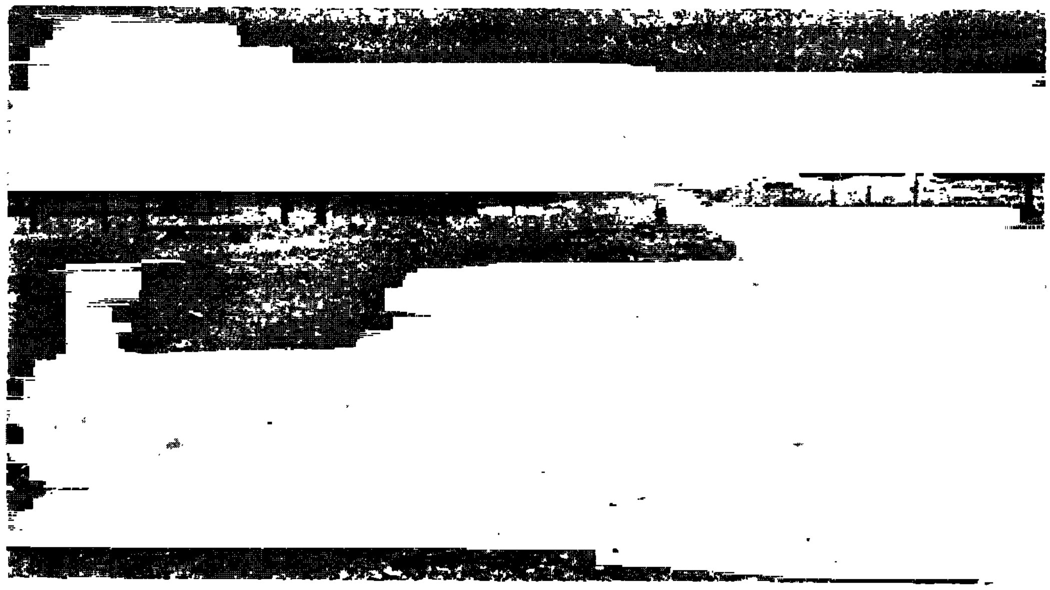


Figure 5-14

Existing Kuraymat Power Plant at the Western Margin (Pediplain) of the Plateau

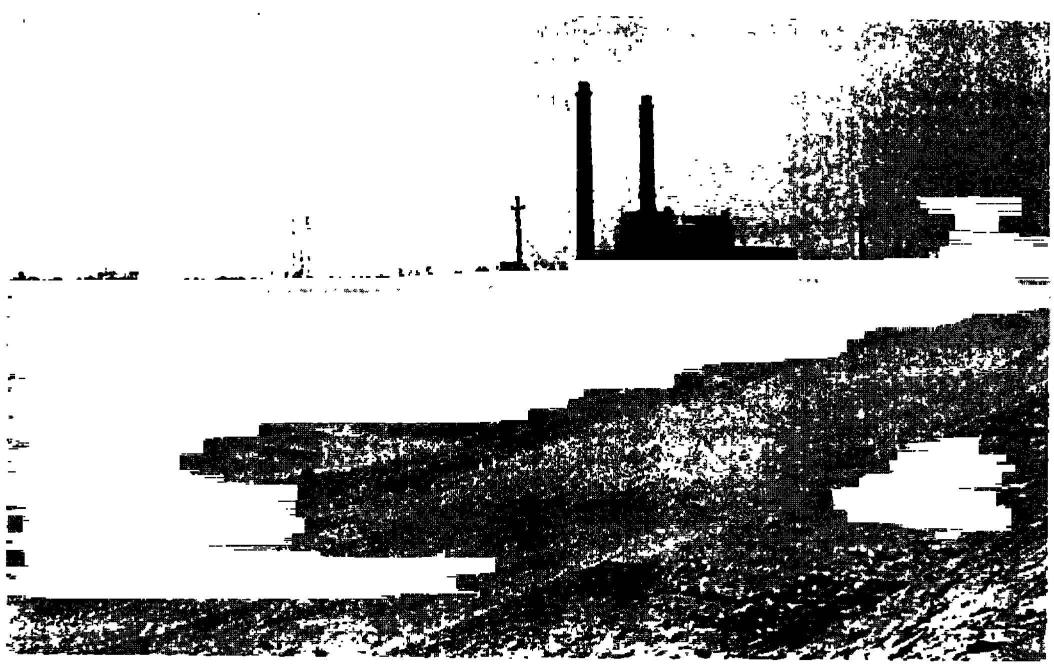


Figure 5-15

The Cultivated Land at the Outreach of a Drainage Wadi Just South of the Fenced Site of the Existing Power Plant Near the Eastern Margin of the Nile Floodplain

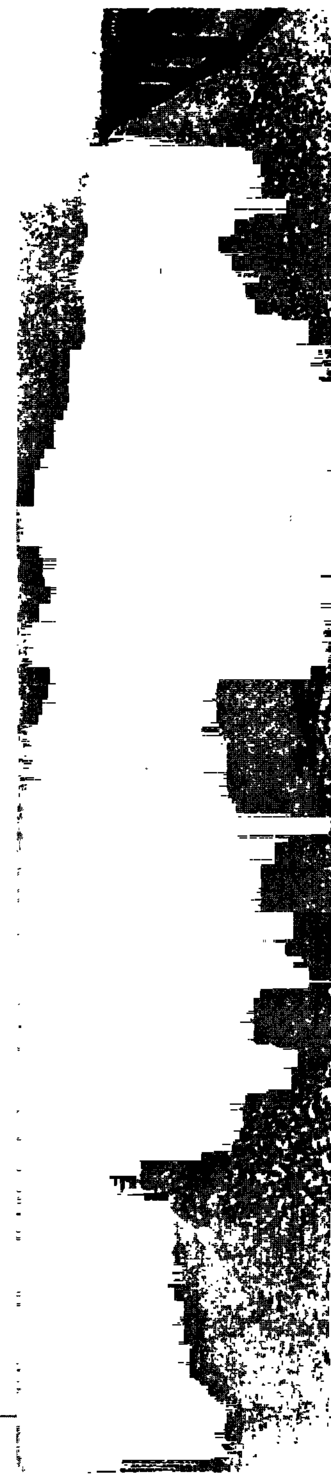


Figure 5-16

Drainage Basins of the Cairo/Beni-suif Stretch
The Proposed Site of the Power Plant Designations :
1. W. Digla, 2. W. Hoof, 3. W. Halawna,
4. W. Garawi, 5. W. Al Hera, 6. W. Al Haya,
7. W. Al Naghumia, 8. W. Al Warag, 9. W. Al Rashrash,
10. W. Atfih, 11. W. Ramlaya 12. W. Matin El Bahri
13. W. Matin El-Quibli, and W. Sawada.

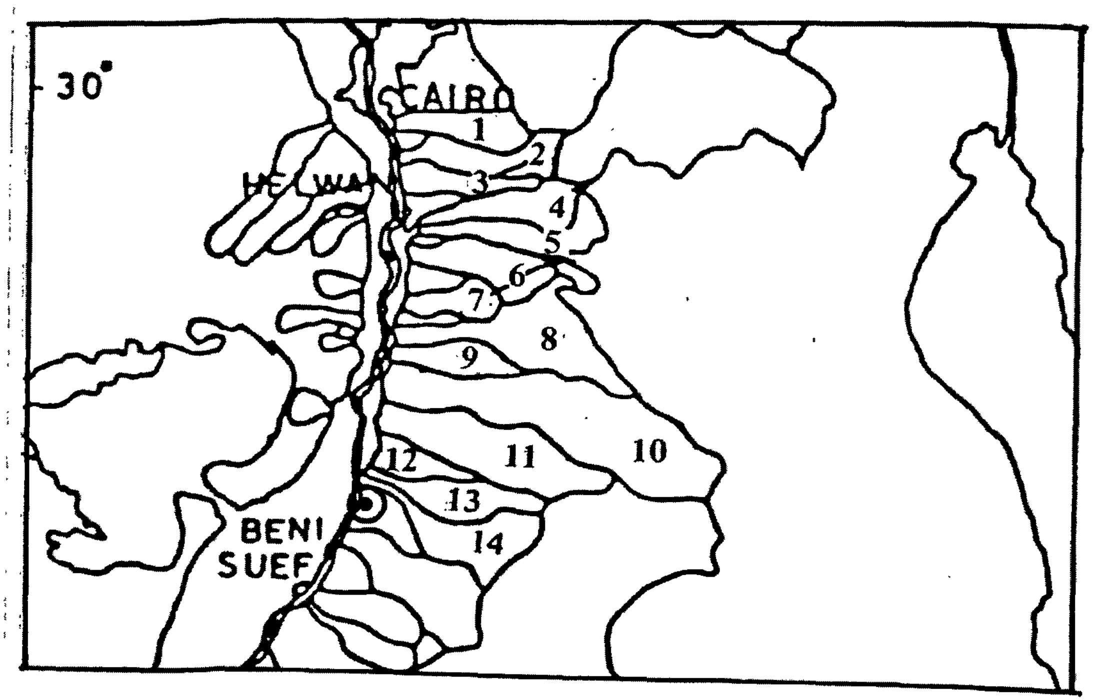


Figure 5-17

Drainage Network of the Cairo/Beni-sueif Stretch at the Proposed Kuraymat Power Plant Site

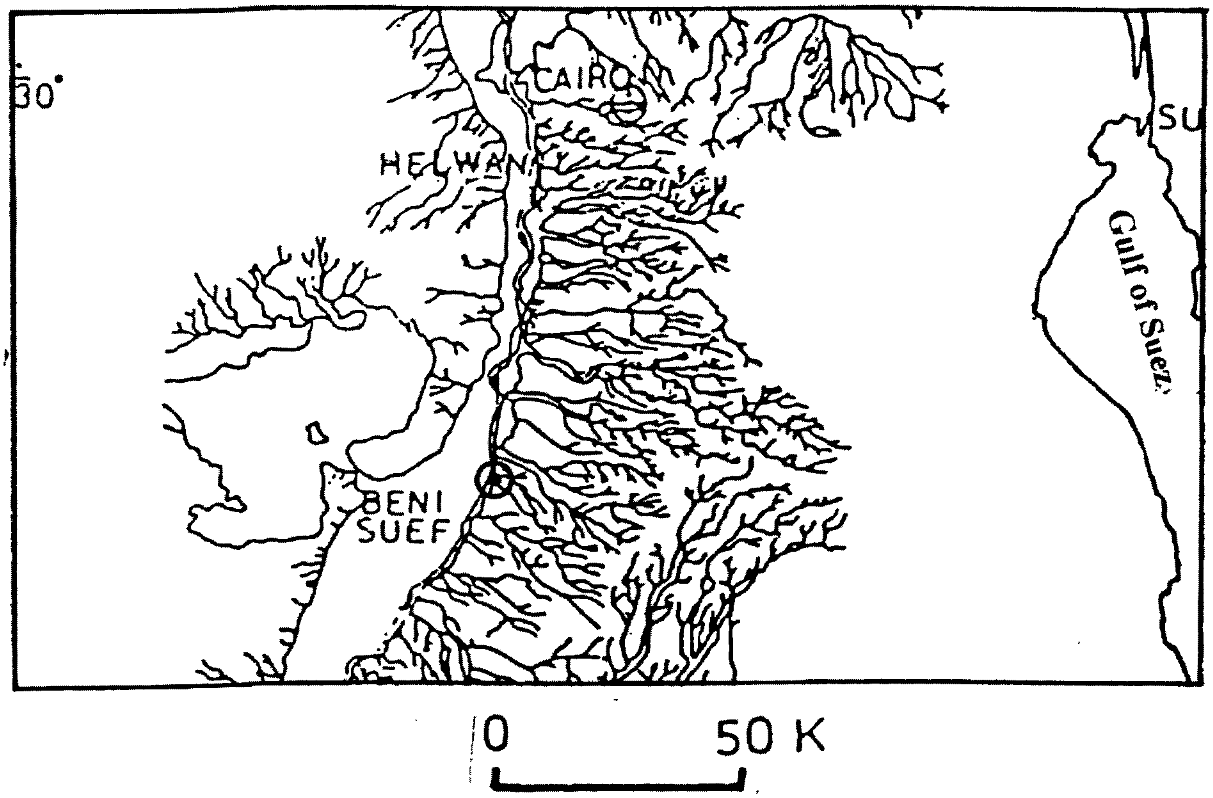
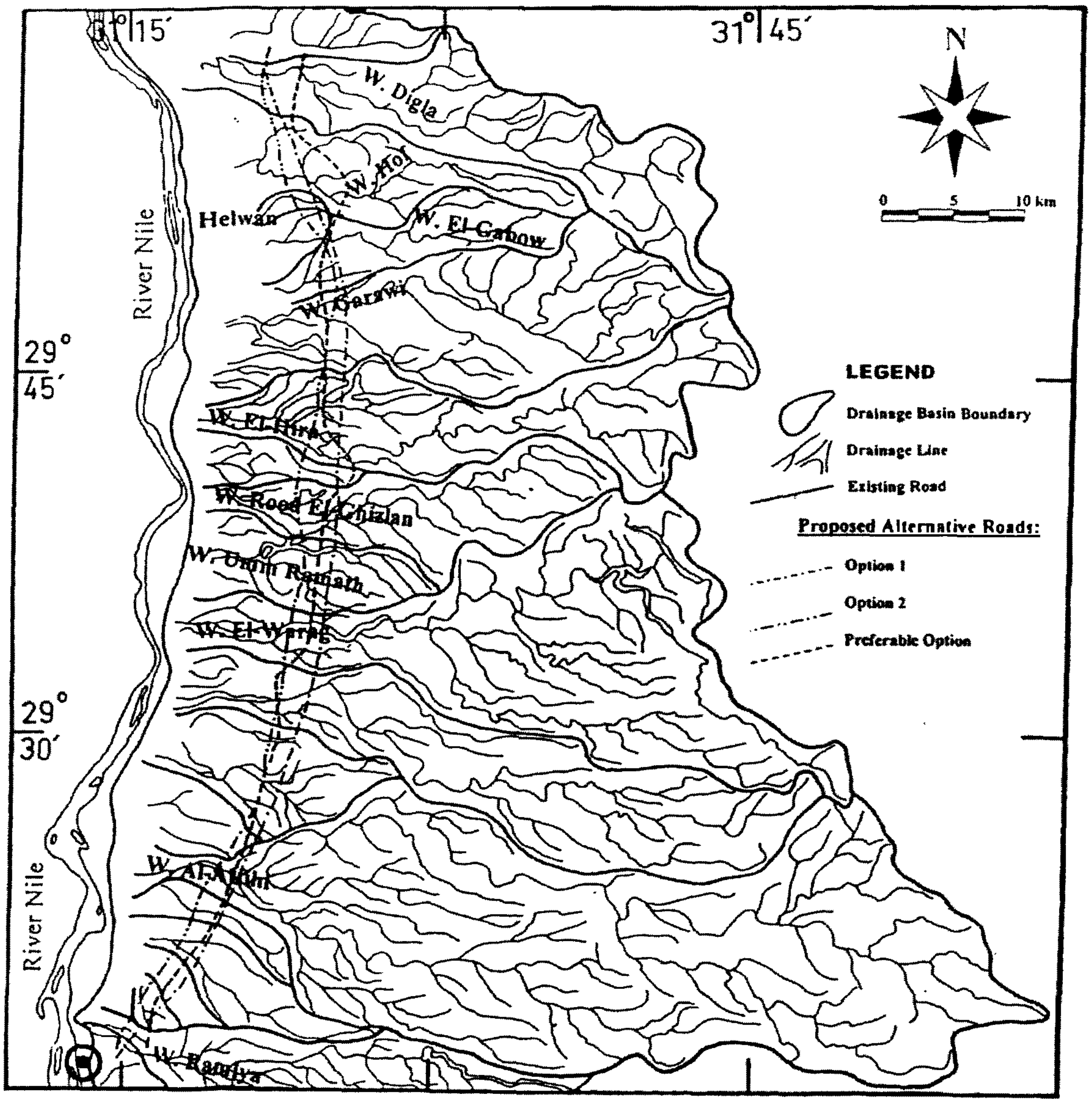


Figure 5-18

Dendritic to Sub-parallel Drainage Network and Basins Near the Proposed Kuraymat Power Plant Site



5.2.4 Geology

Stratigraphic Setting

The rocks that crop out in the investigated area are all sedimentary and pertaining in age to the Eocene (55 - 38 million years b.p.), Pliocene (5 - 2 million years) and Quaternary (2 million years-Present) (*Figure 5-19*). The Eocene units represent the oldest outcropping rocks and form a plateau land. Carbonates (predominantly limestone) with varying amounts of shale are the main rock types (Conoco Coral, 1978). They are differentiated into four Formations. These, from oldest to youngest, are:

- W. Rayan Formation (limestone intercalated with shale and sandy shale).
- Beni-sueif Formation (shale, marl and limestone).
- Observatory Formation (bedded limestone).
- Maadi Formation (shale and limestone intercalated with sandstone).

The first three formations belong to the middle Eocene, and the youngest one (Maadi F.) is considered to be late Eocene (Hermina et al., 1998).

The Pliocene rocks crop out at the footslope of the front edge of the elevated plateau. They form a long strip, intervening between the scrap face of the limestone plateau on the east and the Nile flood plain (Nile Valley) on the west. The Pliocene rocks are mainly composed of sandstone and limestone (*Figure 5-20*).

Quaternary deposits include wadi alluvium, fanglomerates and Nile silt.

The site of the proposed power plant is underlain by the Pliocene rocks / the Quaternary Nile sediments.

Structural Setting

The main structural elements in the study area are faults and folds. East-west, NW-SE, north-south and NE-SW faults control the main topographic features (*Figure 5-21*).

Faults of the east-west set form the northern boundaries of the high plateaux of the study area and surroundings. e.g., the northern margin of El-Galala El-Bahariya plateau and the northern side of the Tura-Huf plateau (*Figures 5-9 and 5-21*).

The north-south faults mainly characterize the eastern escarpment of the Nile Valley. For the majority of these faults, the down throw side is westward toward the Nile Valley (Abd-Allah, 1988). The Nile itself may be running along a north-south lineament (inferred fault) in this sector. Shallow (gentle) folds are recorded particularly in the southern sector with axes trending NW and form a series of plunging anticlines and plunging synclines (*Figure 5-21*).

5.2.5 Natural and Man-Induced Hazards

Although the potential natural hazards of earthquakes, flash floods, landslides, and ground subsidence will be considered, the most significant, with respect to the proposed ISCC Kuraymat power plant is seismicity. Man-induced problems/hazards include Nile siltation in the vicinity and accumulation of Water Hyacinth.

Natural Hazards

Earthquakes:

In Egypt, the distribution of epicenters of moderate to large and small to micro-earthquakes indicates that earthquake activity tends to occur along three main seismic active trends as follows (Kebeasy, 1990) (*Figure 5-23(A)*).

- Northern Red Sea - Gulf of Suez - Cairo - Alexandria - Clysmic Trend: This trend is major and active in Egypt and extends along the northern Red Sea, Gulf of Suez, Cairo and Alexandria as well as along the northwestern part of the Mediterranean Sea (*Figure 5-23 (A)*). It is characterized by the occurrence of shallow, micro, small, moderate and large earthquakes. Activity foci are limited within the crust. The activity along this trend is mainly attributed to the Red Sea rifting as well as several other active faults.

- East Mediterranean – Cairo – Fayoum Pelusiac Trend: This trend extends from east Mediterranean to east of the Nile Delta to Cairo and the Fayoum region (*Figure 5-23(A)*). Along this trend, small to moderate earthquakes are recorded and their foci are confined within the crust.

- Levant- Aqaba Trend: This trend is a continuation of the Levant active fault and extends along the Gulf of Aqaba and further southwest into the Red Sea. It bisects the clysmic trend at about 27° N and 43.6° E (*Figure 5-23 (A)*). Earthquake occurrences are found mainly at both ends of the Gulf of Aqaba. Only shallow small-size earthquakes are detected along this trend.

  The Project area and adjoining region are situated near the intersection of the first two trends (*Figure 5-23 (A)*). A small number of local micro-earthquake (<3 on Richter scale) epicenters are located in the general vicinity (*Figure 5-23 (A)*).

  Figure 5-24 substantiates the above mentioned statement (Kebeasy, 1990) that earthquakes along the East Mediterranean-Cairo-Fayoum Pelusiac trend range from small to moderate in magnitude. To augment this, a moderate earthquake (magnitude 5.7 on Richter scale) struck the area near Cairo on October 12, 1992. Its center was located some 20 km SW of Cairo (near Dahshour). It was felt in Cairo, Fayoum, Qaliobya, Giza, Beni-Sueif and vicinity.

In the light of this, precautionary measures should be taken against potential moderate earthquakes of magnitude 5 – 6 (Richter scale) in the design of the proposed power plant

Flash Floods:

The study area is characterized by quite low mean annual precipitation (< 10 mm). However, heavy stormy rainfall may take place accidentally in winter and may cause temporary hazardous flash flooding. Recorded events in the vicinity of the proposed site during the period 1974-1989 include:

- 22/2/1975: Strong flash floods that affected Beni-sueif, Minia, Assiut and Sohag Governorates. In Markaz Ihnasia (Beni-sueif G.) 500 feddans were drowned and buildings in 12 villages were partly destroyed.
- 23/2/1982: Moderate flash floods that affected Markaz Es-Saff, south of Helwan, particularly Qababat village. Some 180 houses were destroyed, substantial cultivations were damaged and about 1500 persons were displaced.
- 25/12/1978: Weak, flash floods that affected Markaz Es-Saff particularly Arab El-Hisar village. Damage to houses and farms was reported.

Explicitly no flash flooding was reported during this period at the site of the present and proposed ISCC Kuraymat power plants which is located just to the west and south of Wadi Ramlyyah (*Figure 5-18*). Protective measures were taken near the existing Kuraymat plant site, which is located on an elevated undulated ridge of the pediplain, induding a diversion canal, demarcation of channel and stone lining of the sides (*Figures 5-12, 5-15 and 5-22*). Similat protective measures will be undertaken for the ISCC project proposed site.

Landslides:

The site is not close to the precipitous slopes and so, potential landslides that may affect the project, are unlikely to occure.

Ground Subsidence:

The site of the proposed plant is underlain by the Pliocene rocks and is adjacent to the Quarternary Nile sediments. The Pliocene rocks include clastic sandstone and chemical limestone. The latter is commonly vulnerable to dissolution particularly by acid water (e.g., sewage). Dissolution may result in underground vugs and cavities that may later collapse, causing ground subsidence. The effect, however, is not that serious and the suggested protective measure involves avoidance of sewage leakage at the site or in its vicinity.

If a surface-cooling pond is to be designed at the site to receive hot effluents of the Station, the pond should be lined with an appropriate impervious material (e.g., cement) to prevent the downward infiltration of the hot water to the solution-prone limestone component of the bedrock.

Man-Induced Hazards

Siltation:

It is reported that the water intake tunnel of the present power plant was suffering of silting. At the present rate of sedimentation, the situation is manageable by periodic mechanical removal of silt by drag-line type shovels. However, if the situation is aggravated more in the future, the whole course of the Nile in the vicinity should by hydraulically studied to manage the diversified local directions and rates of flow of the water as a function of the scattered Nile islands near to the site.

Water Hyacinth:

The excessive growth of Water Hyacinth (Ward En-Nile) is a problem of national dimension because of the nutritive-nature of the Nile water due to excessive fertilizing of the agricultural land. Mechanical collection of the floating plant and its disposal on land is the common national remedial practice. The water intake tunnel of the present Kuraymat power plant is suffering of the accumulation of this Water Hyacinth.

5.2.6 Natural Resources

Mineral Resources:

In the study area and adjoining region numerous quarries are present (*Figure 5-25 and Table 5-1*). Their main commodity is building and construction raw materials such as limestone, clay, sandstone, gravel, and sands, beside decorative stones such as Egyptian alabaster and crystalline limestone.

Figure 5-19

Geology of Cairo/Beni-sueif Stretch at the Area of the Proposed Kuraymat Power Plant Site

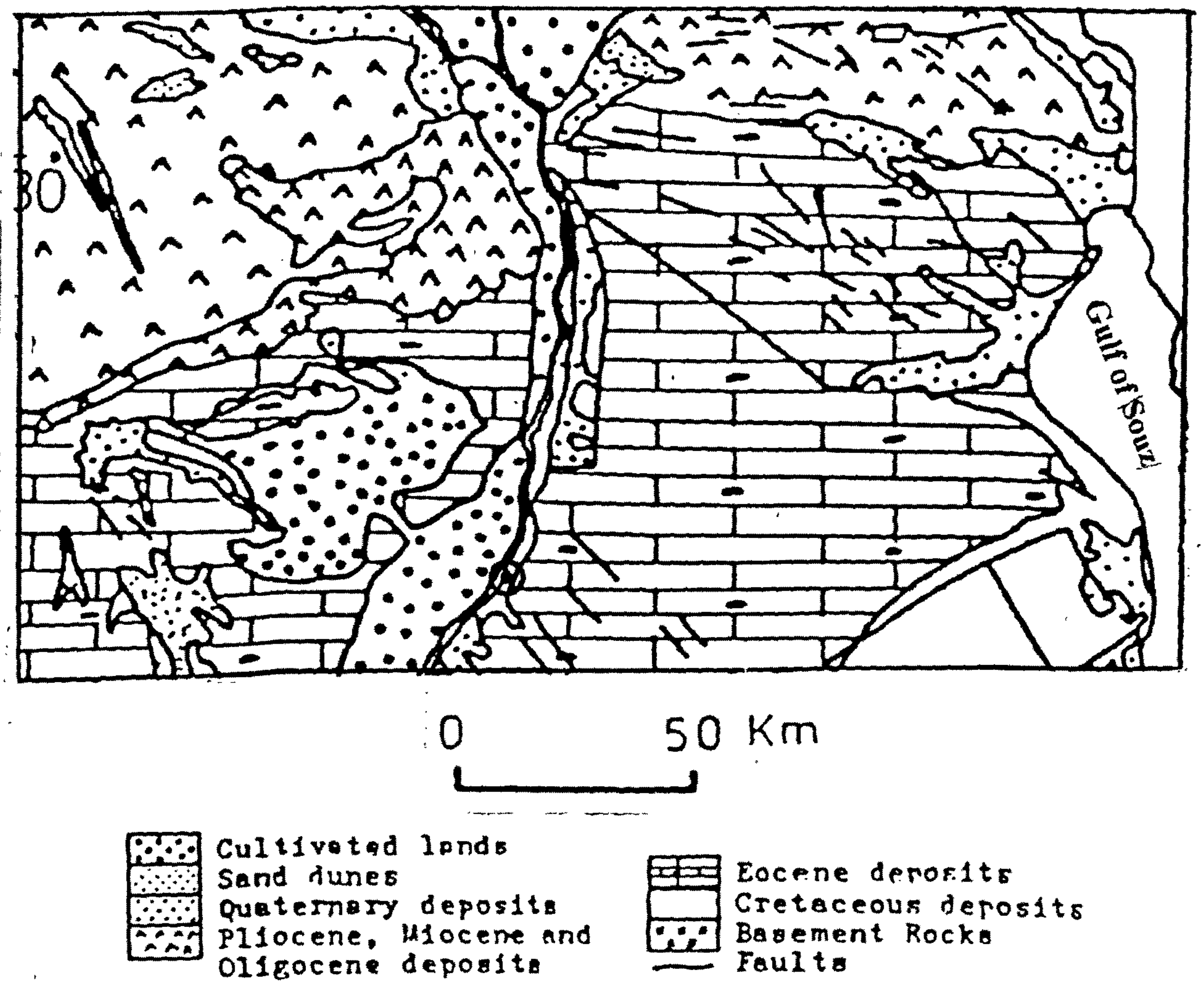


Figure 5-20

Main Lithologic Units (Conoco Coral, 1978) of the Cairo/Beni-sueif Stretch Including the Propsoe Kuraymat Power Plant Site

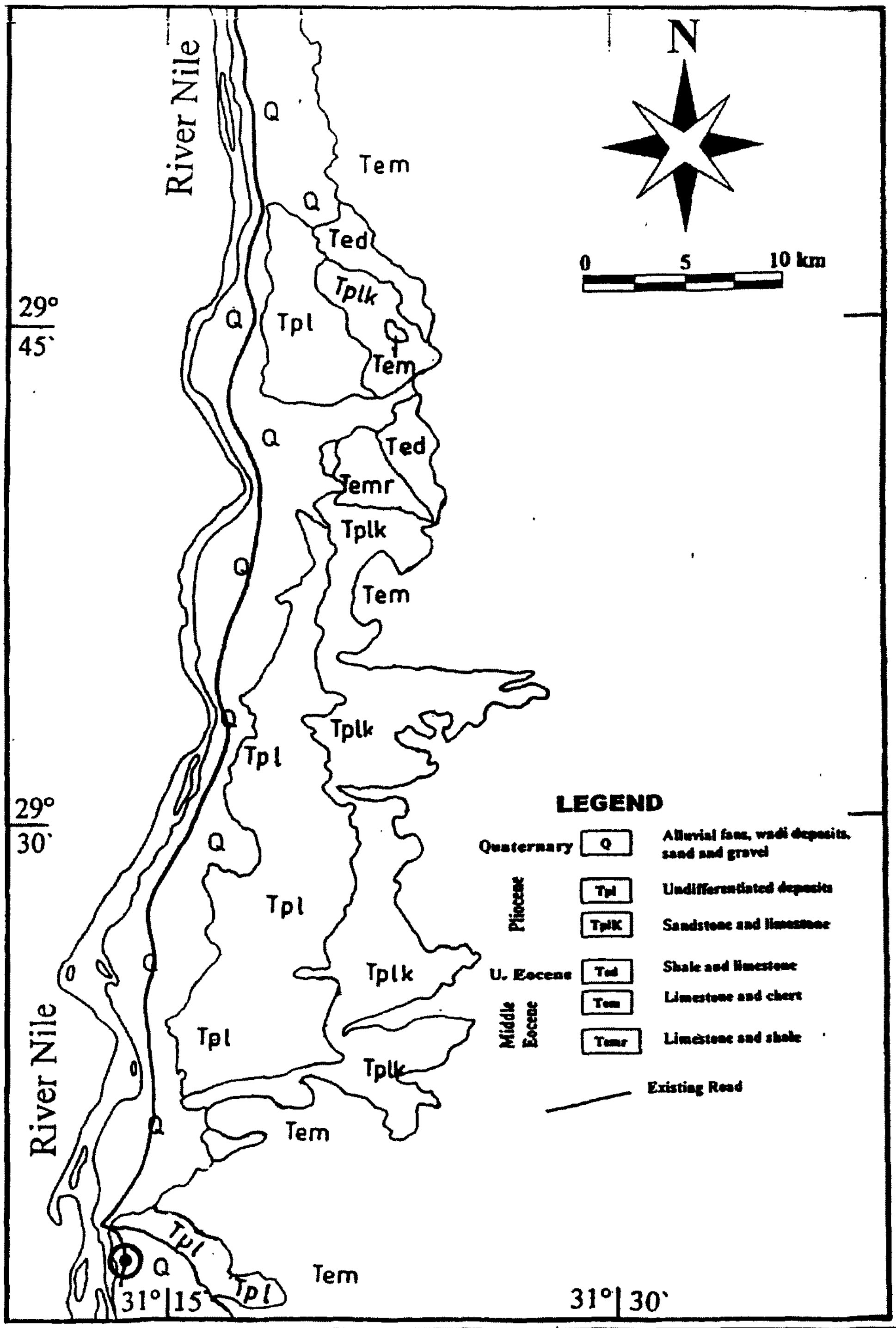


Figure 5-21

Structural Geology of the Cairo/Beni-sueif Stretch at the Area of the Proposed Kuraymat Power Plant Site

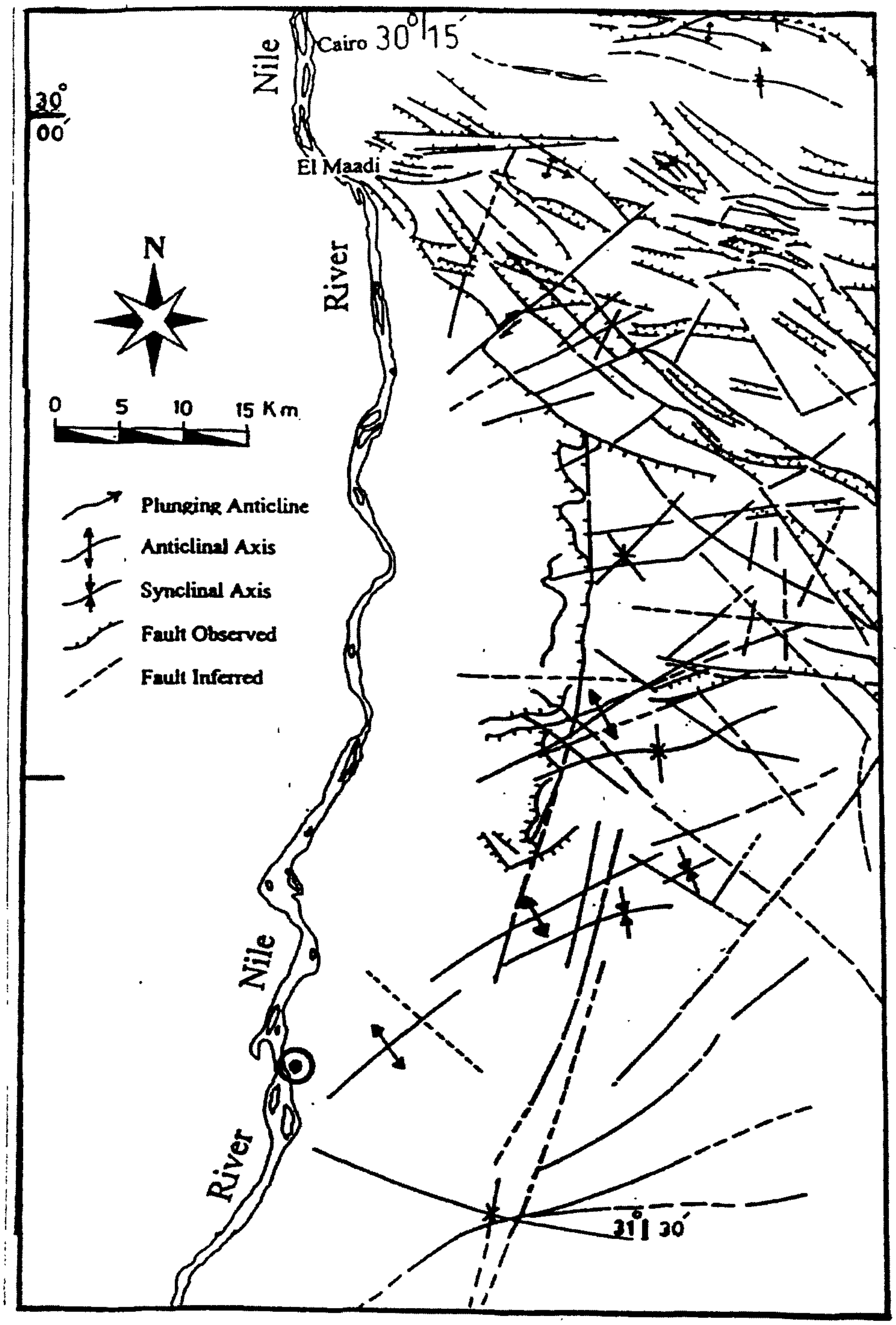


Figure 5-22

Man-made Dug Flood Channel Along a Wadi Course Around 3 Km North-West of the Proposed Kuraymat Power Plant Site

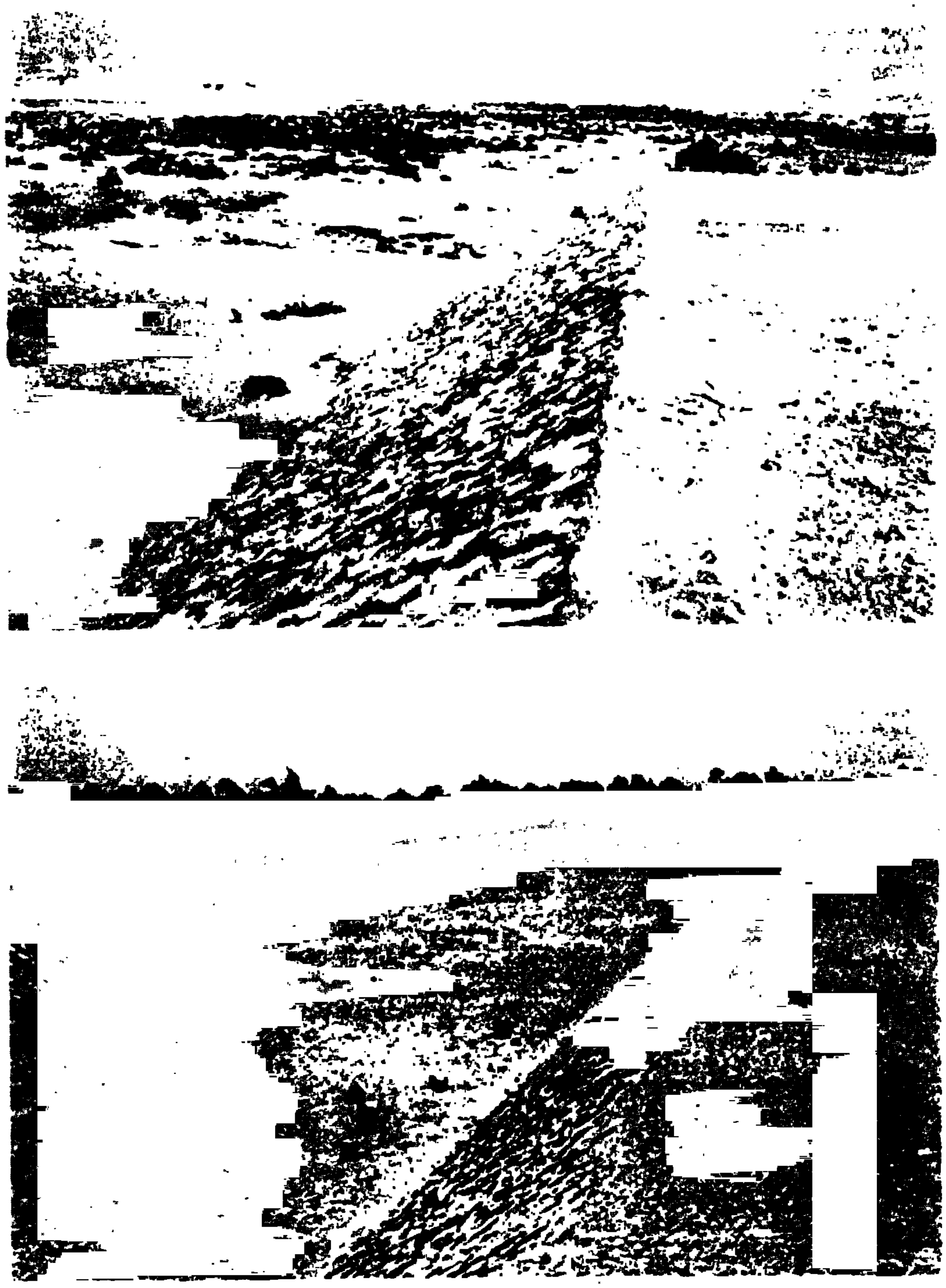


Figure 5-23

A) Epicentral Distribution of Earthquakes, Focal Mechanisms of Principal Ones and Active Seismic Trends (after Kebeasy 1990).

B) Enlarged View from (A) Showing Distribution of Micro-Earthquakes in the Study Area

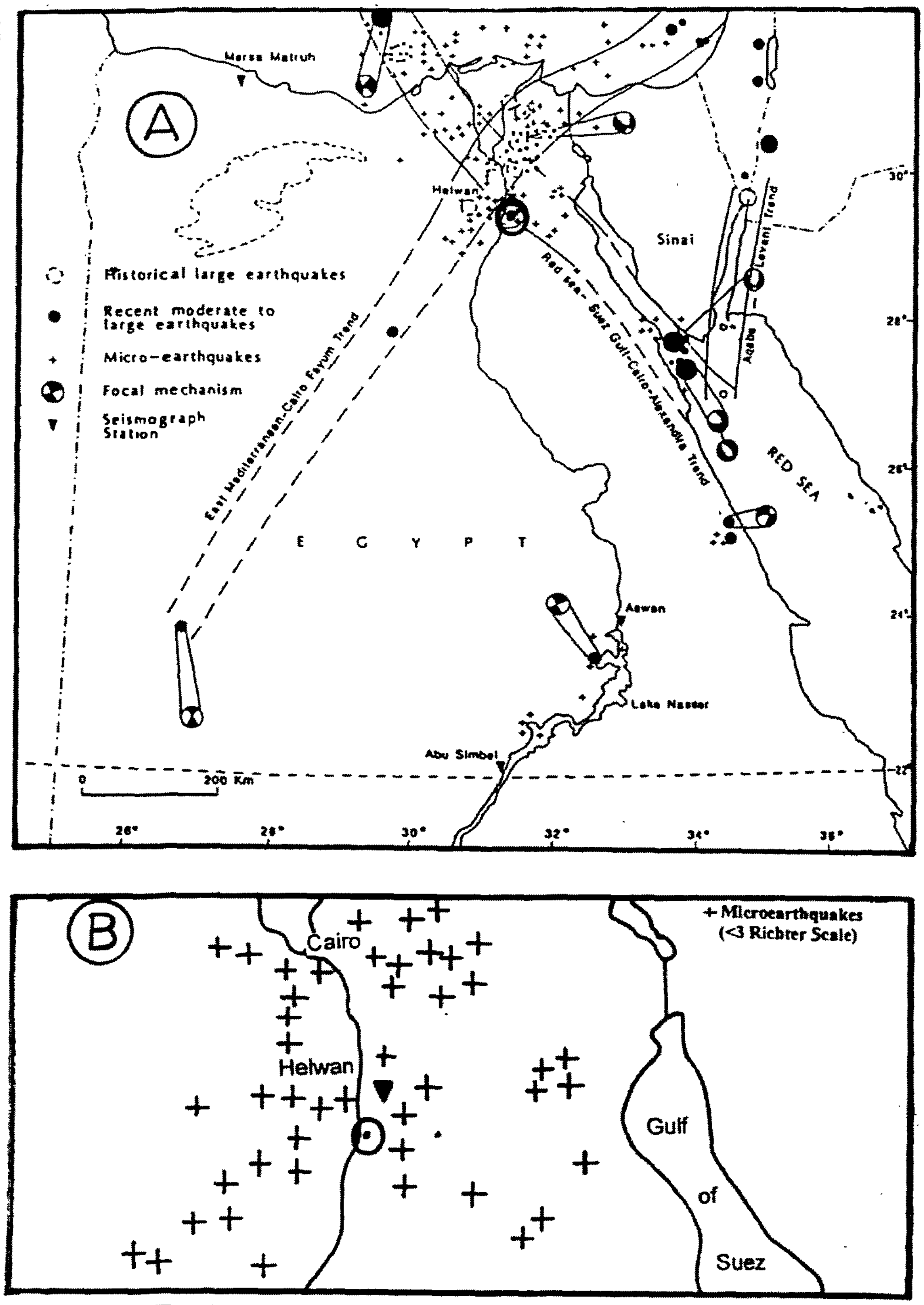


Figure 5-24

Seismicity of the Region of the Proposed Kuraymat Power Plant Site
(After Sieberg, 1932)

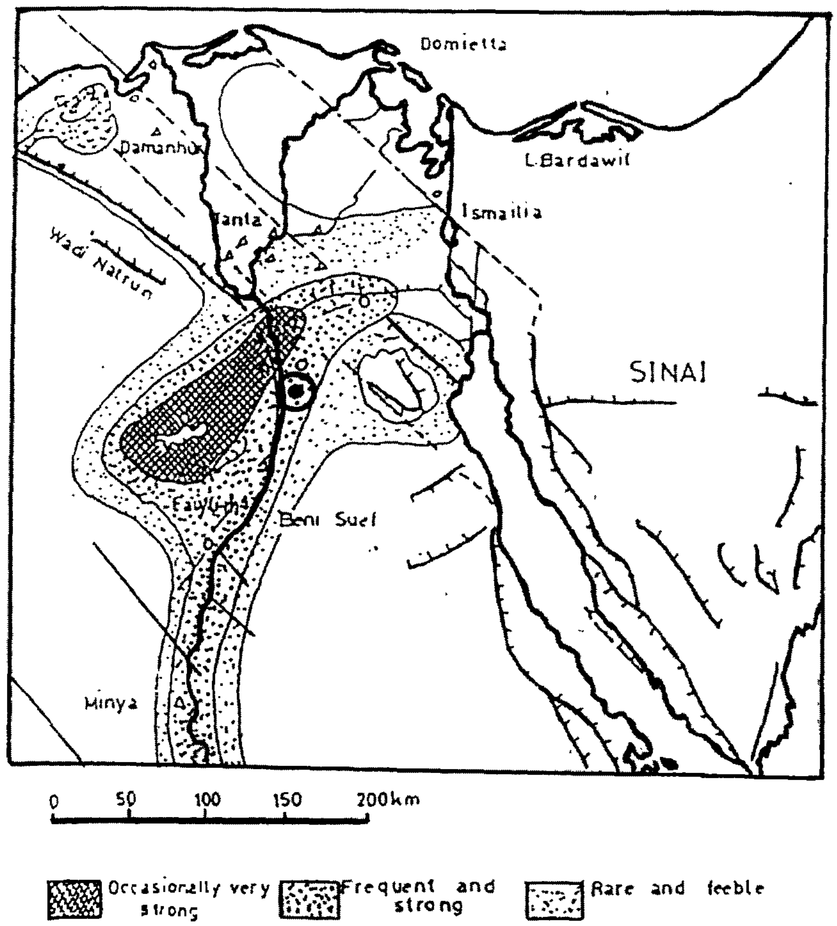


Figure 5-25

Quarry of Chalky Limestone Near the Western Margin of the Plateau, Just North of the Fenced Site of the Present Kuraymat Power Plant

Table 5-1

Mineral and Stone Resources in the Study Area and Adjacent Region
(After the Egyptian Geological Survey, 1994).

No	Name of locality	Deposit (occurrence)	Comment
1	Maasara	Clay	
2	Helwan	Limestone	Under exploitation
3	Helwan	Gypsum	Under exploitation
4	Kafr El-Elw	Clay	Estimated reserves 24.5 mi. tons for cement industry.
5	E. of Helwan	Alabaster	
6	Es-Saff	Limestone	
7	G. Tarboul	Limestone	
8	Kuraymat	Alabaster	Occurrences away from the site of the planned power station
9	Kuraymat	Gypsum	Occurrences away from the site of the planned power station
10	Humret Shybon	Limestone	Crystalline
11	Kuraymat-Zaafrana road	Limestone	Crystalline

Water Resources

The water resources are of prime importance for the development projects in drylands, as there is generally a shortage in both surface and groundwater resources. The area of Helwan-Kuraymat, however, has a promising potential for future development projects (*Figure 5-26*). Beside the direct access to the Nile water the following is a general view about the groundwater potential of the region.

Previous regional studies indicated that the main water bearing formations are those belonging to Pleistocene, Miocene, Oligocene, Eocene and lower Cretaceous (Diab, 1984).

It is to be noticed that the Nile river acts as an enormous water body to the west of the study area and hydrogeologically, is of probable effect on groundwater recharge, particularly near its course.

The constructed regional idealized columnar section (*Figure 5-27*) of the stratigraphical (rock) units and hydrogeological characteristics, shows that the rock units of hydrogeological interest are:

- The Pleistocene (2 million - 10.000 yrs) water-bearing units.

- The Miocene (25 - 5 million yrs) water-bearing units.
- The Oligocene fluviatile (38 - 25 million yrs) water-bearing units.
- The Eocene (65 - 38 million yrs) calcareous water-bearing units.
- The Cretaceous (144 - 65 million yrs) (Nubian) water-bearing units.

The ages given between brackets are those of the rocks of the aquifers but the ages of the waters are inherently much younger.

Brief explanation of the different hydrogeolocal conditions of the mentioned water-bearing and water-confining lithological successions follows. The available data are collected from: natural springs, drilled wells, dug wells and boreholes (Diab, 1984, El-Gindy et al., 1999, Misak et al., 1989).

The Pleistocene Water-Bearing Units:

The groundwater of this succession exists in the alluvial deposits of the main wadis dissecting the area. These deposits are composed of sands, gravels and thin streaks of sandy clays. The water of this aquifer is present under unconfined conditions.

In areas away from the Nile, the aquifer is of low potential because of reduced thickness of the succession. Adjacent to the Nile basin, however, the Pleistocene sediments are considered as the main aquifer (*Figure 5-28*). They are composed of coarse, massive and thick sands and gravels. Occasionally, the Prenile sands and gravels are interbedded with clay lenses of various thickness and extension which may reduce the permeability and effective porosity of the aquifer. The Pleistocene aquifer, lies unconformably beneath the Holocene (10,000 yrs - present) agricultural silt layer of the fertile land of Egypt and it overlies the Pliocene (5 - 2 million yrs) clay.

The maximum thickness of the sediments of this aquifer in the study area amounts to 200 m in the areas adjacent to the Nile Valley. The saturated thickness of this aquifer is about 50 m at the latitude of Helwan. Generally, this aquifer gradually thickens northward. The Prenile aquifer unit covers the whole area of the old cultivated land, and is extended, in its major part, to the west of the Nile river. There is a large number of water wells tapping this aquifer and are distributed throughout the study area. The groundwater exploited from this aquifer is used as a supplement source beside the Nile surface water, for both domestic and agricultural purposes. However, most of the wells tapping this aquifer are of partial penetration conditions. The groundwater occurs under semi-confined conditions, where the sediments of this aquifer are mostly overlain by a clay cap which acts, in many cases, as an impermeable to semi-permeable layer. The groundwater of this aquifer attains a depth that ranges between 2 - 6 m. The thickness of the clay cap varies widely between a few centimeters near the cliffs of the limestone plateau and 20 m at the areas adjacent to the Nile (El-Gindy et al., 1999). The hydraulic connection between this aquifer and older aquifers in the study area is not unexpected because of structural (fault) control. However, the wide range in water salinity (301-2200 mg/l) indicates that this aquifer acts as a transitional medium between the fresh surface water and the brackish groundwater of the older Quaternary aquifers.

The Miocene Water-Bearing Units:

The thickness of the Miocene aquifer is about 20 m and is composed of sands, sandstones, and gravels with marl interbeds.

The groundwater occurrences within the Miocene succession are directly recharged through faults, fractures and cracks in the down dip direction of the different wadis that originate from the mountainous and plateau regions further east. The salinity of the Miocene water is tested (5-35 gm/liter) at Habashi well (Diab, 1984).

It is to be pointed out that there is no regularity neither in depth of the Miocene groundwater nor in its salinity.

The Oligocene Water-Bearing Units:

The Oligocene rooks are of fluviatile nature (sandstone, sands and gravels).

The following is Kurlov's formula of the chemical characteristies of the Oligocene groundwater at some localities:

$$S1790\quad \frac{Cl49\qquad HCO332\qquad SO419}{Na40\qquad Mg39\qquad Ca21}\quad pH\ 7.4$$

The present study area is not known to have outcropping Oligocene sediments.

The Eocene Water-Bearing Units:

The aquifer occupies the area lying to the south of the Cairo-Suez road. The Eocene water-bearing succession is mainly formed of two components, each has its own water characteristics, namely:

- The upper part which consists of fissured and even-cracked limestones.
- The lower part which is composed of sandstones and coarse conglomerates with gypsum layers. To the north of El-Ayyat and up to Giza, the Eocene limestone is highly fractured and is probably subjected to a network of deep-seated faults (Abdel Daiem, 1971). Therefore, the Eocene limestone at Helwan and vicinitiy is considered as a good groundwater aquifer. The groundwater of this aquifer occurs under unconfined conditions.

The Eocene upper aquifer is made up of hard snow white, and highly fossiliferous limestone with shale and marl intercalations. Tamer et al. (1975) mentioned that the limestone and marl series has a thickness of about 500 m in the wells drilled at Beni-Sueif.

In January 1992, a number of springs naturally issued in the Helwan district. Each is characterized by a constant discharge of about 90 m3/hr and a temperature of 30°C. The constant discharge and temperature of these springs point to a deep-seated origin of water and that it comes to the surface by upward leakage through faults and fractures under high artesian pressure (*Figure 5-27*).

Salinity ranges between 600 ppm at Tebbein and 12,000 ppm at Turah. The following are Kurlov's formulae for some groundwater analyses of the Eocene aquifer:

$$\text{Bir Youssef} \quad \frac{\text{S41.500} \quad \text{SO465} \quad \text{Cl33} \quad \text{HCO32}}{\text{Na60} \quad \text{Ca21} \quad \text{Mg19}} \quad \text{pH 8}$$

$$\text{Bir Maadi} \quad \text{S1.600} \; \frac{\text{SO445} \quad \text{Cl37} \quad \text{HCO312}}{\text{Na62} \quad \text{Ca91} \quad \text{Mg19}} \quad \text{pH 7.7}$$

$$\text{Bir Tebbein} \quad \text{S0-.1600} \quad \text{Cl51} \; \frac{\text{SO426} \quad \text{HCO323}}{\text{Na50} \quad \text{Ca29} \quad \text{Mg21}} \quad \text{pH 7.3}$$

$$\text{Nile at Helwan Water} \quad \frac{\text{HCO375} \quad \text{SO413} \quad \text{Cl13}}{\text{Ca41} \quad \text{Na36} \quad \text{Mg23}} \quad \text{pH 8}$$

It is clear that the springs at Cairo (Helwan Spring, Helwan Sulphur Spring, and Ain Es-Sira Spring) are of the $MgCl_2$ type. These waters appear to have penetrated to a sufficient depth to encounter sea-water and that they have risen to the surface through faults. The chemical characteristics of some deep-seated springs in the study region are shown in *Table 5-2*.

Regionally, the groundwater moves from south to north. In the study areas the value of the Total Dissolved Solids (TDS) of the surface water ranges between 242 and 918 mg/1, whereas in the groundwater it ranges widely between 301 and 26560 mg/1. The salinity increases considerably towards the area east of the Nile river, where the Pleistocene and the Eocene aquifers are mainly represented (maximum recorded value 26500 mg/1, at Kuraymat).

The Nubian Sandstone Water-Bearing Units:

The Nubian Sandstone is found to be water-bearing at the places of its occurrences (Es-Sukhna well). The succession is mainly composed of sandstone intercalated with marls, uncemented sands, dolomitic beds and hard dolomitic limestone. The occurrence of these intercalations retards groundwater movements and at the same time is responsible for the piezometric head, characterizing the Nubian aquifer at many places.

Table 5-2

Chemical Characteristics of Some Deep-seated Springs in the Study Region

Name of water point	T (°C)	Ca2 + (mg/1)	Mg	Na+ (mg/1)	K+ (mg/1)	Cl-	HDO-3	So2-4	TDS mg/1	PH
Ain El-Selein	21.7	101.80	66.37	105.75	2.74	52.82	413.70	211.34	955	7.33
Helwan New Spring	26.7	246.09	127.91	733.37	18.77	1423.08	128.14	766.49	4148	7.75
Helwan sulfur Spring	28.9	281.96	151.54	1382.38	29.33	2302.67	272.14	845.34	7048	7.11
Ain Sukhna	32.2	479.36	262.81	1997.81	52.79	3614.43	159.87	1325.65	9472	7.87
Ain Sukhna	32.8	479.36	255.03	1643.31	44.97	3462.34	162.31	922.19	8992	7.04

However, no deep drilled wells exist along the Cairo-Suez road except for the Es-Sukhna well at which the Nubian aquifer has been found to be under artesian pressure (Diab, 1969 Abdel Daiem, 1971) (*Figure 5-28*). The groundwater of Ain Helwan and Ain Es-Sukhna are of evidently mixed origin and are not pure Nubian water. *Figure 29* shows a regional hydrogeological map of the northern part of Upper Egypt and the Nile delta (Res. Inst. Ground Water, 1988).

Water for the Proposed ISCC Kuraymat power plant

The water needed for operation (cooling and service purposes) is comfortably provided by the surface water of the Nile river. Supplementary ground water sources, however, are to be found, if need arises, in shallow wells tapping particularly the Pleistocene aquifers.

The water table is at least a few meters below the surface of the proposed power plant. No significant water clogging problems are foreseen to cause severe impact on the power plant foundation.

Figure 5-26

Location Map of Ground Water Wells in the Cairo-Kuraymat District

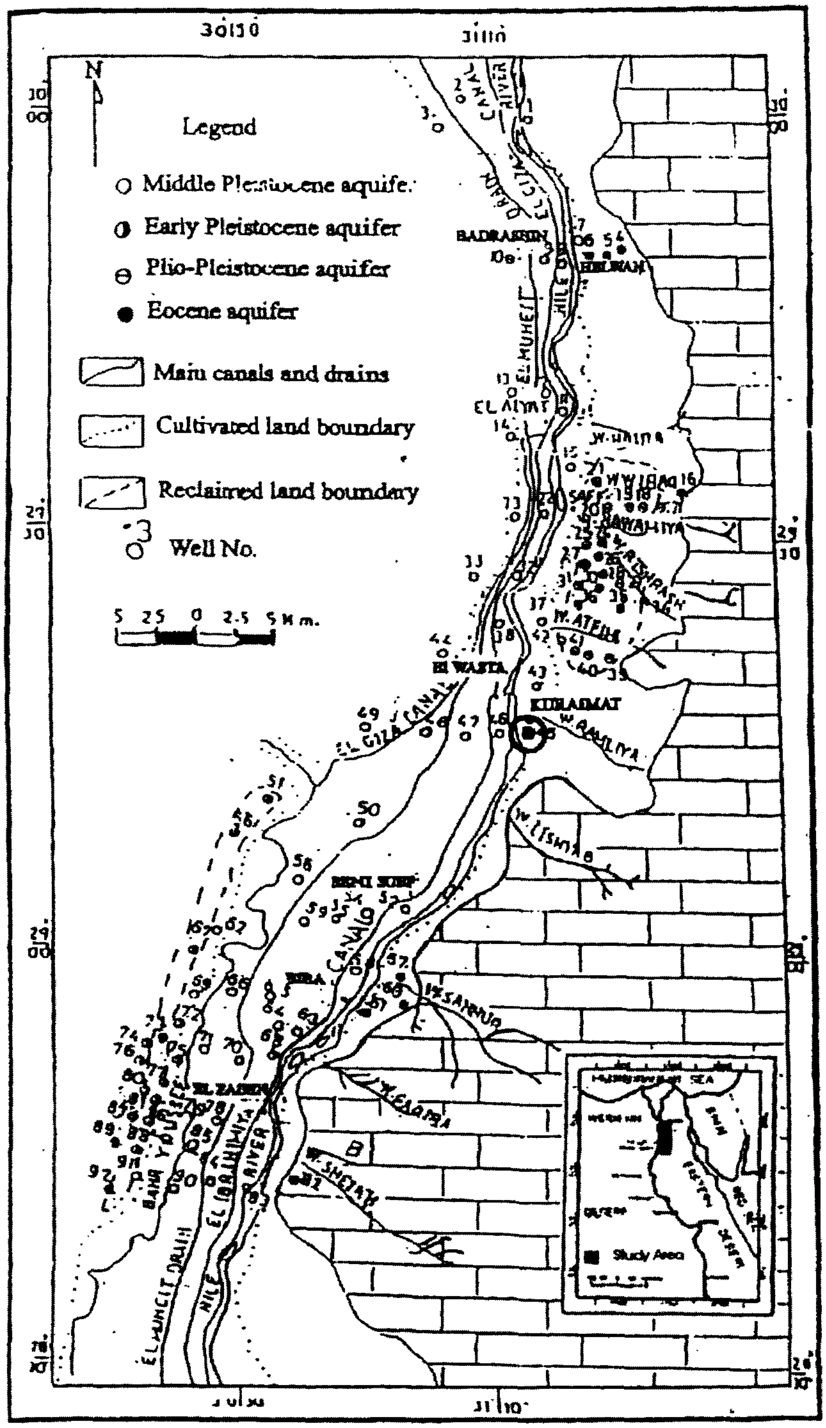


Figure 5-27

Geological Columnar Section with Hydrogeological Characterization of the Area Between Cairo and Suez

(After El-Gindy et al., 1999)

Era	Age	Thick. (m.)	Log	Lithology	Hydrogeology
Quaternary	Pleistocene			Yellowish mudstone, marl, grit, breccia and conglomerate	Fluviatile aquifer, tested to be water bearing near Cairo, near Suez Town and along Cairo-Suez Road at Wadi El-Qurn (Heliopolis basin), Wadi El-Ful, etc. The salinity of groundwater amounts 600 ppm near Cairo, 1500 ppm near Dar el-Beida, 3000 ppm near Suez (W. El-Shona).
Cenozoic	Miocene	175		Green marl, sandy marl gravel, sandstone, marly limestone and white sandy limestone with grits	Sandy gravel aquifer of regional extension and of about 50 m. thickness at Habashi well. The salinity of Miocene water at this well is about 5000 ppm.
	Oligocene	90		Basalt flow, fractured, sand, grit and gravel	The fluviatile and basaltic formations are tested to be water bearing, the salinity of water is 1700 ppm at Abu Zaabal and 3000 ppm at Habashi and 2400 ppm at Akf Well (300 Km. from Cairo).
	Eocene	490		Hard marl, marly and argillaceous limestone with flinty silt, conglomeratic facies at bottom	The Eocene fractured limestone is water bearing at Helwan, Maadi, Tora, Tebbin, Abu Sultan, and Ataqa. The Eocene water is of salinity amounts to 7000 ppm at Abu Sultan and 6500 ppm at Helwan.
Mesozoic	Upper Cretaceous	720		Hard dolomitic limestone with some silicified chalk, green marls, limestone and dolomitic beds	Not tested for Groundwater occurrences
	Nubia Sandstone (Lower Cretaceous)			Soft, violet sandstone and grits with intercalation of uncemented sands	The Nubian aquifer tested to be under pressure at Ain El-Sukhna Well and at Helwan Spring localities. The salinity is high, 6500 ppm at Helwan 10 000 ppm at Ain El-Sukhna.

Figure 5-28

Hydrogeological Cross-section Depecting the Hypothetical Origin of Water in Helwan Area (Eocene and Nubia Sandstone Mixed Aquifers)
(After El-Gindy et al., 1999)

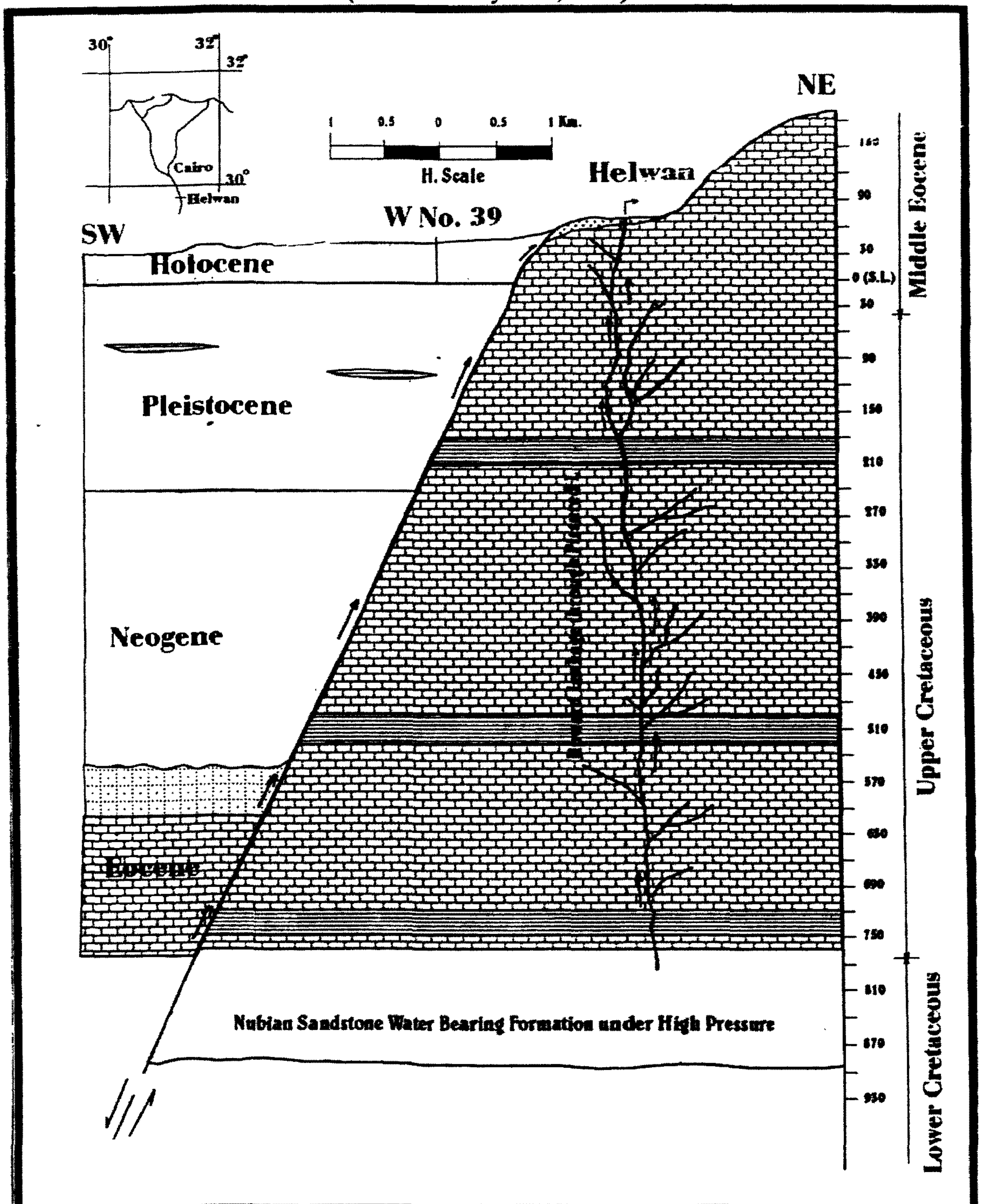


Figure 5-29

Hydrogeological Map of the Nile Delta Area
(Hydrogeological Map of Egypt, 1988)

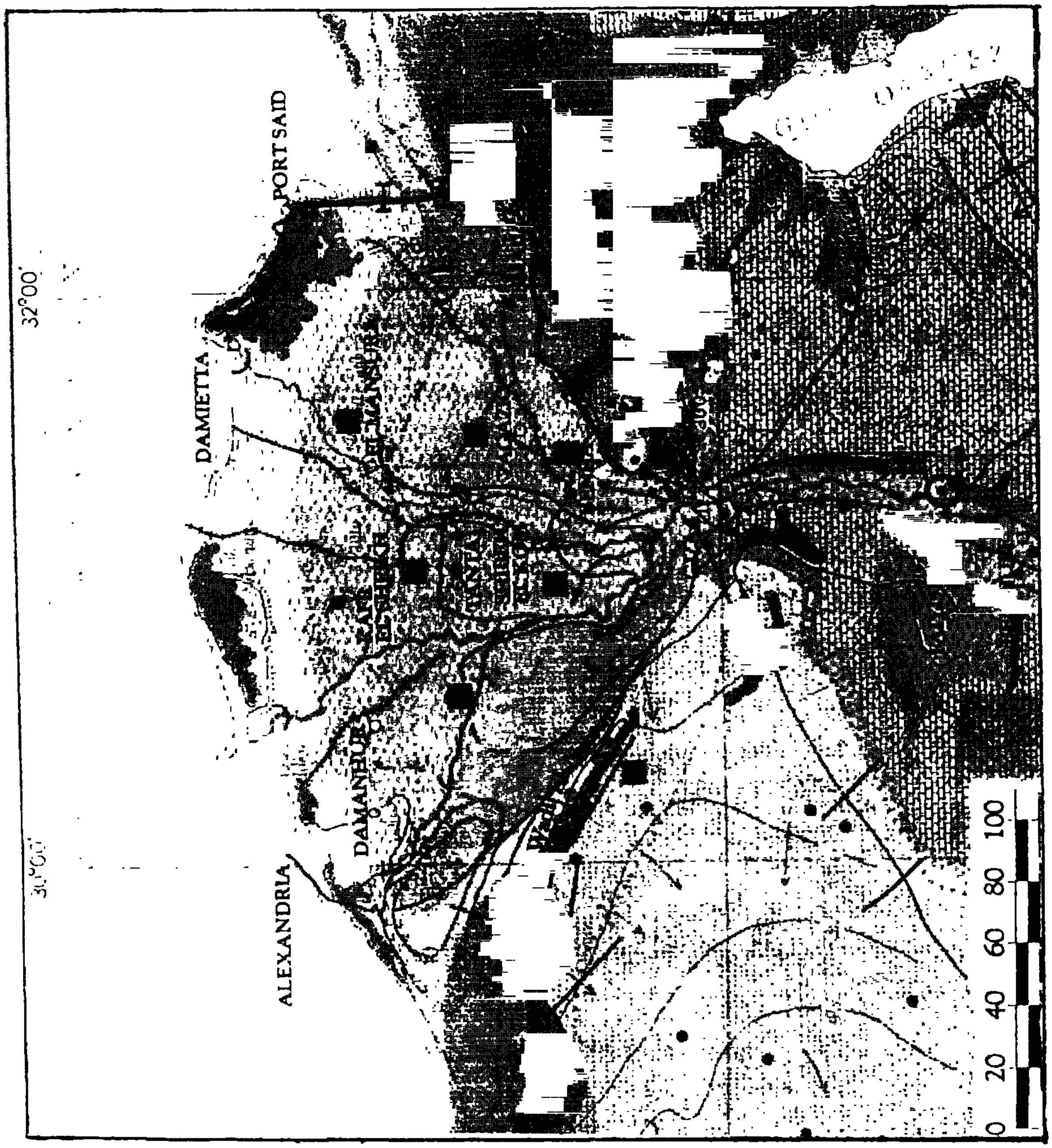


Figure 5-29 (Contd.)

Legend for the Hydrogeological Map of the Nile Delta Area (Hydrogeological Map of Egypt, 1988)

LEGEND

I. HYDROGEOLOGICAL UNITS

GRANULAR ROCKS

- Extensive and highly productive aquifers, continuous surface recharge from irrigation or from the Nile
- Local and moderately to highly productive aquifers; occasional surface recharge from rainfall, from surface run-off or from irrigation water
- Local and low to moderately productive aquifers; insignificant surface recharge; limited sub-surface recharge, deeper, highly productive aquifers not excluded
- Extensive and low to moderately productive aquifers; insignificant surface recharge; sub-surface recharge from adjacent aquifers
- Extensive and moderately to highly productive aquifers; containing mainly fossil water; essentially no surface recharge; locally sub-surface recharge from adjacent aquifers

KARSTIFIED AND FISSURED ROCKS

- Extensive and moderately to low productive aquifers with paleo-karstified features; containing fossil water; essentially no surface recharge; locally sub-surface recharge from adjacent aquifers
- Local groundwater occurrence in fissured and weathered zones in hard rocks

ESSENTIALLY NO GROUNDWATER RESOURCES

- Non aquiferous clays and shales; generally underlain by deeper, more productive aquifers

III. GEOLOGICAL AND TOPOGRAPHICAL INFORMATION

A—A'	Location of hydrogeological profile
——	Fault ; defined
- - -	Fault ; inferred
	Axis of anticline
	Axis of syncline
300	Topographical contour line ; elevation in m relative to sea level
1715 •	Elevation point ; elevation in m relative to sea level
——	Main inland desert road
— · —	National boundary
Quseir	Significant town
IDFU	Capital of Governorate
SINAI	Significant geographical name
NILE	Name of river, lake or sea

IV. SURFACE WATER FEATURES

- Perennial stream with direction of flow
- Intermittent stream (wadi)
- Paleo stream (pre-historic wadi)
- Main surface water divide
- Secondary surface water divide
- Inland drainage basin
- Lake with fresh or brackish water ; TDS less than 5000 ppm
- Lagoon or lake with saline water ; TDS higher than 5000 ppm
- Coastal sabkha ; large flat area occasionally flooded and generally acting as a discharge area for groundwater
- Inland sabkha ; small depression which acts as a discharge area for groundwater

Figure 5-29 (Contd.)

Legend for the Hydrogeological Map of the Nile Delta Area (Hydrogeological Map of Egypt, 1988)

II. LITHOLOGY

QUATERNARY

Lithology	Age
fine sand ; sand dunes	Holocene (Q4)
mixed salt, gypsum and clay ; sabkha deposits, locally under reclamation	Holocene (Q3)
silt and clay ; cultivated Nile deposits	Holocene (Q2)
coarse sand, mixed sand and gravel, mixed sandy loam, gravels and rock fragments	Pleistocene (Q1)

TERTIARY

Lithology	Age
clays and sands (marine deposits), gravelly sand (non marine deposits) and limestone and travertine (fresh water and spring deposits)	Pliocene (Tpl1)
limestone, clastics and gypsum, shallow marine and lagoonal deposits	Miocene (Tm2/Tm3)
coarse sands and gravel with limestone interbeds ; fluvio-marine and fluviatile deposits	Miocene (Tm1)
volcanics, mainly basalt	Oligo-miocene (Tv)
gravel sheets and conglomerates (terrestrial deposits) and interbedded sand and clay (fluvio-marine deposits)	Oligocene (To)
limestone with chert ; shallow marine deposits	Eocene (Te)
shale with few bands of limestone ; shallow marine deposits	Paleocene (Tp)

MESOZOIC

Lithology	Age
limestone, chalk, dolomites and phosphates ; shallow marine deposits, becoming more clastic in the South and the East	Cretaceous (Ku)

PALEOZOIC-MESOZOIC

Lithology	Age
sandstone , epicontinental deposits, becoming more marine in the North	Mesozoic/Paleozoic (K1/Pz)

PRE-CAMBRIAN

Lithology	Age
igneous, metamorphic and volcanic rocks	Pre-Cambrian (B)

V. MAN MADE FEATURES

- Main irrigation canal ; dashed if under construction
- Main drain
- Main navigation canal
- Pipeline for water supply from surface water
- Pipeline for water supply from groundwater
- Barrage or dam
- Tunnel or syphon
- Sluice
- Oasis ; cultivated
- Groundwater abstraction from wells ; discharge more than 15 million m^3/yr; indicated per Governorate or per oasis
- Groundwater abstraction from wells , discharge less than 15 million m^3/yr; indicated per Governorate or per oasis
- Selected deep well with information about lithology, water level or salinity ; data in accompanying note
- Water logged area due to accumulation of surface water or groundwater.
- Area of groundwater pollution

VI. GROUNDWATER FEATURES

- Contour line of piezometric head of Quaternary aquifer (1985) in the Nile Delta and Valley in m relative to sea level;dashed where uncertain
- Contour line of piezometric head of Nubian Sandstone aquifer (1985) in the Western Desert , in m relative to sea level;dashed where uncertain
- Contour line of piezometric head of Marmarica limestone aquifer ; in m relative to sea level
- Direction of groundwater flow
- Spring ; discharge > 25 m^3/day
- Thermomineral spring - temperature more than 30 degrees Celcius
- Isosaline of 1,000 ppm in the Nile Delta aquifer
- Isosaline of 1,000 ppm in the Nubian Sandstone aquifer
- Boundary of saline groundwater in the Nile Delta aquifer
- Boundary of saline groundwater in the Nubian Sandstone aquifer
- Hinge line between discharge and recharge in the Nile Delta aquifer

5.3 CLIMATE AND METEOROLOGY

5.3.1 Introduction

Both local and regional climatic characteristics play an important role in the dispersal of pollutants in the atmosphere. To understand the potential impacts from a given industrial source, both local and regional climatic conditions and short and long term meteorological factors must be considered. The principal meteorological parameters, which affect the dispersal of airborne pollutants, are the following:

- wind speed, direction and temporal distribution;
- atmospheric stability;
- mixing height (the height below which there is significant mixing within the atmosphere), and
- precipitation (which affects the deposition of the pollutants).

Both micro and macro meteorological factors affecting the general climatic conditions in the region of the proposed site have been examined in this assessment.

5.3.2 Regional Climatic Conditions

This section describes regional climatic conditions in the Kuraymat area. *Tables 5-3, 5-4 and 5-5* summarize climatic information available for the area using 35 year monthly average data.

The Egyptian General Meteorological Authority (EGMA) does not locate meteorological station at/or near the Kuraymat Site. Therefore the onsite sequential hourly meteorological data are not readily available at this time. The twice-daily mixing height data also are not available near the plant site. The alternative is to find the suitable data for use in the dispersion analysis. The proposed site is located about 90 km south of Cairo, and about 30 km north of Beni-sueif. Hourly meteorological data that are required by the dispersion modeling are available at either site. To select a more representative site, climatological data of Janaklis, near Kuraymat (Meteorological Climate Summary, 2001) and of Cairo have been utilized.

Accordingly, the Kuraymat site, as considered for Beni-sueif and Cairo weather conditions, is characterized by a sub-tropical desert climate with predominantly very hot summers, mild winters, and generally dry and sunny conditions. Rainfall events are rare and occurrences of gales, thunderstorms, and dust storms are occasional.

The climate of the region is caused primarily by the sub-tropical high pressure belt that is prevalent in this area, leading to clear skies for most of the time. The prevailing winds are northerly and can become strong during the winter. The northerly winds are caused by a sub-tropical high pressure cell in the western desert of Egypt during the winter months and by the western edge of a huge Asiatic low over northwestern India during the summer. The sparse rainfall in this area usually falls in the form of showers during the cold season (December, January, February) while the region is under the influence of cold upper level troughs to the north. The highest temperature generally occurs in June through August when tropical continental air masses arrive from western Syria and Iraq on northeast winds while the lowest temperatures are recorded in December, January and February as polar continental air masses to the north are dragged down in the rear of winter Mediterranean depressions. Relative humidities remain low for most of the year reaching a maximum in November, December and January and a minimum in April and May.

Summaries of climatic variables for the site region are available from meteorological data collected at Beni-sueif and Cairo. The Beni-sueif data furnish wind speed, wind direction, temperature, pressure, precipitation and relative humidity information that are considered to be representative of the Kuraymat site. Atmospheric stability information is also available from the Shoubrah El-Kheima Phase II Report based on data collected at Cairo.

A 35-year Beni-sueif data base (1967-2002) indicates a northerly wind at the site (63 percent from north quadrant) with a maximum of winds from the North-West quadrant (9 percent) followed by North-North-West winds (22 percent) and winds from the North-West-West quadrant (5 percent) and Westerly winds (3 percent) and then North-North-East winds (12 percent). Calm and variable winds occur approximately 20 percent of the time. Wind speeds and directions measured for 2001 at Beni-sueif Station and measured for 1997 at Bahtim Station are shown on the Wind Roses in *Figures* 5-30 and 5-31. Wind speeds are generally light to moderate with an annual-average speed of approximately 4.9 meters per second and rarely exceed 10 m/sec. (*Table 5-4 and Table 5-6*). The wind pattern affects the direction of stirred-up sands and sandstorm. The wind derives these sands which accumulate in the western desert far from the project site and its vicinity. The source of these sands is generally located further west in the Western Desert (*Figure* 5-32). The temperature data collected at Beni-sueif for a 35 year period indicate a maximum monthly-average temperature of 37.4°C in July and a minimum monthly-average temperature of 5.8°C in January. Summer time high temperatures average 37°C while winter lows reach 7.2°C. The annual-average temperature is 22.3°C with record high and low temperatures of 47.7 and -0.2°C, respectively. Rainfall at Beni-sueif averages 6.12 millimeters per year occurring mostly during the winter months (December-March). Relative humidity remains fairly low throughout the year, maximizing at 63 percent for December and reaching a low of 38 percent in May (*Table 5-3*). The dryness of this climate is further demonstrated by the fact that nearly 80 percent of possible sunshine is received during the year.

The atmosphere stability information derived from the Shoubrah El-Kheima Phase II Report indicates that unstable and neutral conditions occur more frequently (63 percent) than stable conditions (37 percent). However, very stable conditions (Class 7), occur most frequently of the seven stability classes at a frequency of 24 percent. These data alongwith the climatic information generally suggest poor dispersion conditions during the nighttime hours.

There are old air quality monitoring stations in the site vicinity (since 1991) from which a background air quality characterization can be made. But due to numerous malfunction events, credibility of these monitoring stations is questionable. However background air quality data has been collected at site by the National Research Center during September 2003 which demonstrated acceptable background air quality. Site observatrions also have demonstrated that there are no major sources of air pollutants in the area. Based on the existance of the present significant industrial source of the Kuraymat thermal power plant in the vicinity of the proposed site, besides numerous quarries scattered in the surroundings, in addition to many underground mazout-fired brick-kilns across the Nile, on the west bank of the river, and the fact that Cairo and Beni-sueif are approximately 95 km and 30 km to the north and the south respectively, it is assumed that the air quality of this region is characteristic of a moderate-industrialized setting with some anthropogenic sources of air pollution. Preconstruction ambient air monitoring, which would be conducted during the project development, would verify the background air quality characteristics.

Table 5-3

Temperature, Humidity and Rainfall Information for the Proposed Site, (35-year monthly average)

(Based on Weather Monitoring at Beni-sueif Station)[1]

Month	Av. Temperature (°C)				Relative Humidity (%)	Rainfall	
	Av. Monthly Max.	Av. Monthly Min.	Highest Daily Max.	Lowest Daily Min.		Total Montly (mm/month)	Max. in Single Day (mm/day)
January	19.6	5.8	30.4	-0.2	59	1.0	7.8
February	21.5	7.0	34.4	0.8	54	0.8	3.5
March	24.8	9.7	3[illegible].0	2.5	49	1.9	8.2
April	30.3	13.8	43.3	0.2	40	0.2	4.1
May	34.2	17.6	47.7	9.5	38	0.1	1.3
June	37.1	20.4	46.8	13.6	40	0.0	0.0
July	37.4	21.9	45.5	18.0	46	0.0	0.0
August	36.9	21.8	44.2	18.4	50	Trace[2]	0.1
September	34.9	20.2	43.8	9.0	51	0.0	0.0
October	31.3	17.1	39.9	10.6	53	0.02	0.8
November	25.4	12.0	36.1	4.5	57	0.9	20.0
December	20.9	8.8	29.9	0.8	63	1.2	8.4
Annual-average	29.53	15.16	-	-	50	6.12	-

Notes:

(1) This data is extracted from Beni-sueif meteorological station Records, and it covers area of 50 km radius.

(2) Trace = T < 0.1 mm.

Table 5-4

Wind Speed Information for the Proposed Site (Knots)[(1)], (35-year monthly average)

(Based on Weather Monitoring at Beni-sueif Station)

Month	Av. Monthly Speed (Knots[(1)])	Highest Av. Hourly Speed (Knots)	Highest Sudden Plast of Wind (Speed/ Knots Direction) [(2)]	Date of Occurrence [(2)] (Day/Year)
January	5.9	36	45/240	17/18
February	7.4	28.5	50/220	3/92
March	9.6	33.5	50/180	22/85
April	9.2	37	49/340	12/71
May	11.6	31	54/290	2/97
June	12.2	26	35/240	13/71
July	12.0	20	27/010	9/84
August	11.1	20	23/360	29/69
September	11.6	20	33/020	11/71
October	9.8	27.5	33/240	23/76
November	8.2	31.5	38/220	24/76
December	5.9	31.5	45/260	14/77
Annual-average	9.54			

Notes:

(1) Knot = 1.85 km/hr.

(2) Available from Bahtim station, around Cairo.

Table 5-5

Fog, Mist and Storms Information for the Proposed Site (No. of days), (35-year monthly average)
(Based on Weather Monitoring at Beni-sueif Station)

Month	Fog (no. of Days)	Mist (no of days)	Stirred up Sands/ Sandstorms (No. of days)	Thunderstorms (No. of days)	Gales (No. of days)
January	13.0	10.7	3.2	0.0	0.0
February	4.0	6.9	1.1	0.0	0.0
March	3.0	6.5	0.6	0.0	0.0
April	0.0	2.3	0.1	0.0	1.0
May	0.0	0.9	0.0	0.0	1.0
June	0.0	1.3	0.0	0.0	0.0
July	0.0	4.4	0.0	0.0	0.0
August	0.0	8.6	0.2	0.0	0.0
September	0.0	8.6	0.3	0.0	0.0
October	3.0	7.3	0.7	0.0	0.0
November	3.0	11.1	1.8	0.0	0.0
December	3.0	11.8	3.6	0.0	0.0

Table 5-6

Temperature, Humidity, Wind Speed and Rainfall Information for the Proposed Site (Year 2001 Monthly Average)

(Based on Weather Monitoring at Beni-sueif Station)

Month	Av. Temperature (°C)				Relative Humidity (%)	Average Monthly Wind Speed (Knots)[2]	Rainfall	
	Average Monthly Max.	Average Monthly Min.	Highest Daily Max.	Lowest Daily Min.			Total Monthly mm/month	Max. in Single Day mm/day
January	21	6.5	24.8	2.8	67	6	Trace	Trace
February	21.5	6.2	27.4	3.8	59	6	0.0	0.0
March	29.2	12.7	37.6	9.8	53	10	0.0	0.0
April	29.2	15.0	38.6	11.2	47	12	0.0	0.0
May	34.8	18.1	44.6	13.8	42	13	0.0	0.0
June	37.1	20.3	43.0	17.2	45	15	0.0	0.0
July	38.2	22.4	41.4	20.2	51	12	0.0	0.0
August	38.2	23.5	41.4	21.8	51	11	0.0	0.0
September	35.9	21.2	40.0	19.0	53	12	0.0	0.0
October	30.3	17.2	33.4	12.5	58	9	0.0	0.0
November	25.7	11.3	30.4	6.8	60	7	0.0	0.0
December	21.0	7.7	23.2	3.6	62	7	0.2	0.1
Annual Average	30.2	15.2	-	-	54	10	0.2	-

Notes:

(1) This data is extracted from Beni-sueif meteorological station records, and it covers area of 50 km radius.

(2) Knot = 1.85 km/hr

(2) Available from Bahtim station. Around Cairo.

Figure 5-30

Wind Rose of Kuraymat Zone
(Beni-sueif Station, 2001)

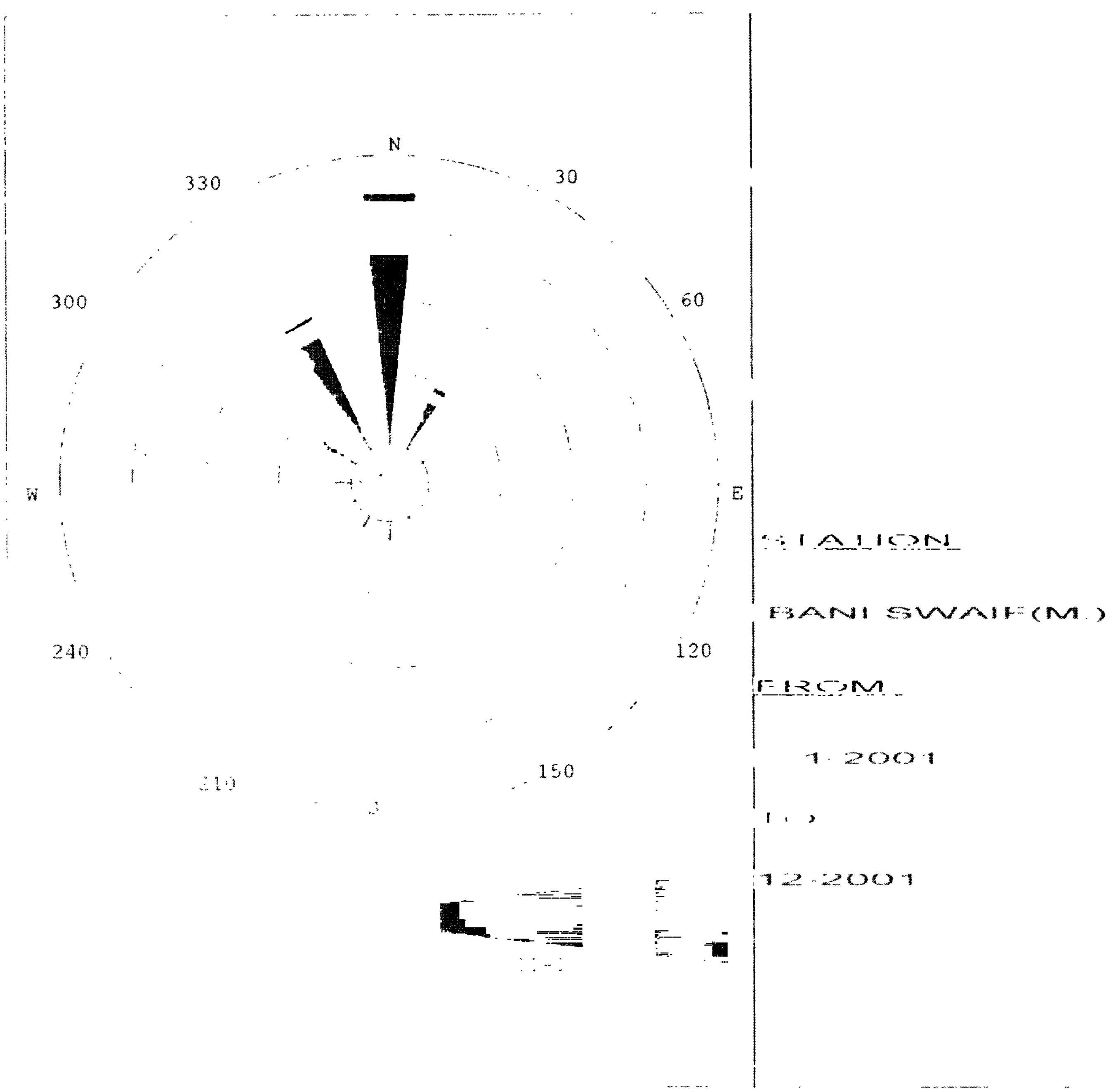


Figure 5-31

Wind Rose of Cairo Zone
(Bahtim Station, 1997)

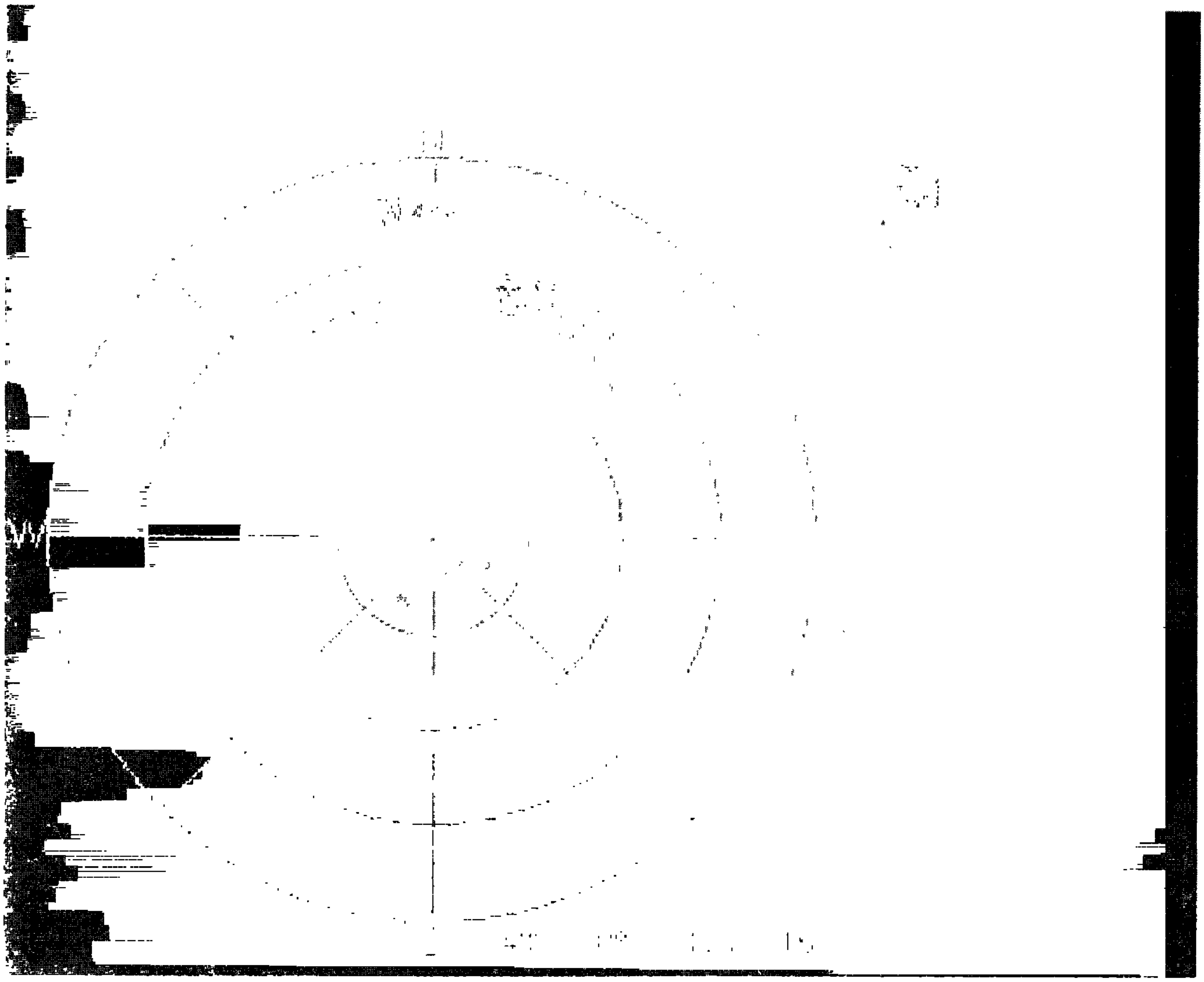
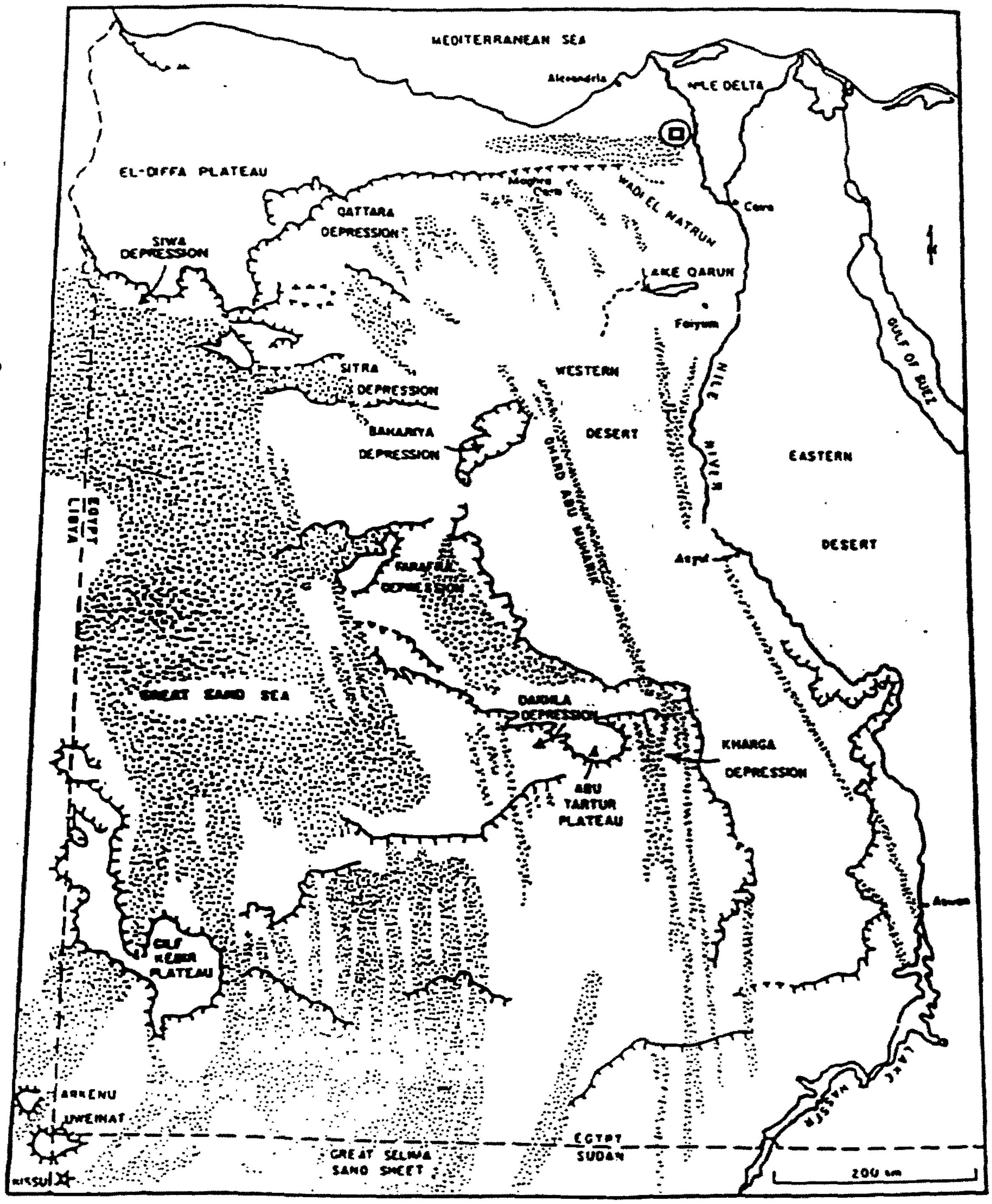


Figure 5-32

Depressions and Sand Dune Fields of the Western Desert



5.4 AMBIENT AIR QUALITY

5.4.1 Ambient Air Quality Data

Introduction

Concentrations of ambient pollutants vary according to both time and location. They are affected by many factors, the most significant being the size, number and location of emission sources and the prevailing weather.

Nitrogen dioxide is the only significant pollutant emitted to the atmosphere from a gas fired power plant, with respect to human health effects. The other combustion products of natural gas are CO_2 and H_2O. When fuel oil is burnt, SO_2 and particulate matter become significant emissions of concern.

Monitoring at the Site

National Resech Center, air pollution preclusion unit, undertook air quality monitoring at the proposed site during March 2004. Monitoring took place at five monitoring points located at the center of the proposed site and the other four points at around the present Kuraymat power plant complex and its residential community as shown in *Figure 5-33*.

Continuous measurements, over a period of 24 hours, were taken for nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), sulfur dioxide (SO_2), aldehydes (HCHO), hydrogen sulfide (H_2S), smoke and total suspended particulates. The results of this monitoring are shown in *Table 5-7 and Table 5-8* below. Comparisons with Egyptian Threshold Limit Values (TLVs) (as stipulated in Law 4/1994) show that the concentration of gaseous pollutants in ambient air at the proposed site were well below the TLVs for 24 hour averages.

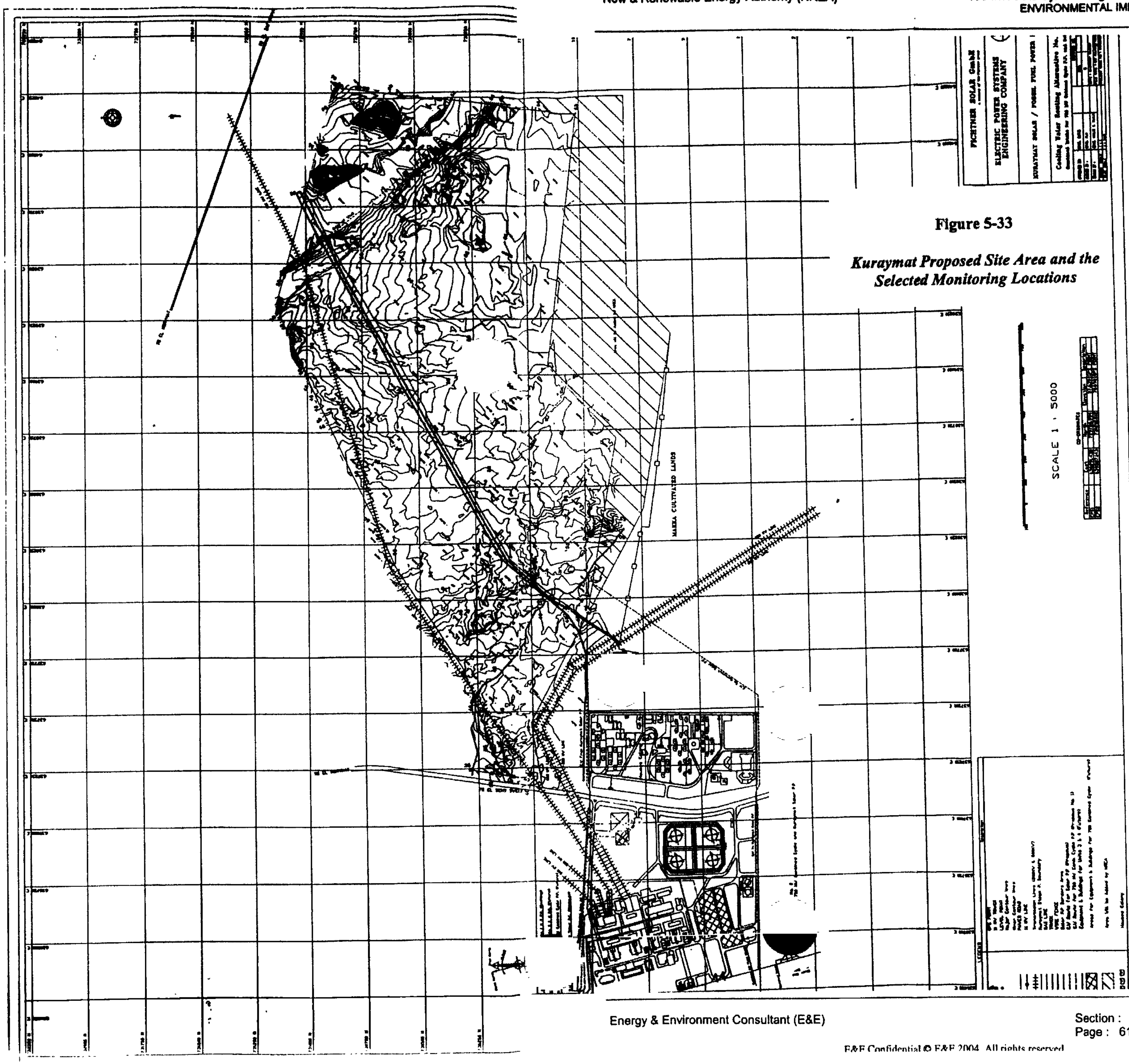


Figure 5-33

Kuraymat Proposed Site Area and the Selected Monitoring Locations

Table 5-7

Mean Concentration of Gaseous Air Pollutants at the Proposed Project Site
(24 hour average)

Site No.	CO (mg/m^3)	CO_2 (mg/m^3)	SO_2 (µg/m^3)	NO_2 (µg/m^3)	HCHO (µg/m^3)	H_2S (µg/m^3)
1 (Center)	0.71	403	32.6	22.5	20.2	30.9
2 (North-1)	1.57	680	103.8	130.2	43.3	58.9
3 (North-2)	2.19	1100	50.8	46.3	50.9	44.9
4 (South-1)	4.43	950	67.6	94.5	42.0	52.1
5 (South-2)	2.18	800	86.6	62.0	48.7	48.9
Mean	**2.22**	**786.6**	**68.28**	**71.10**	**41.02**	**47.14**
EEAA TLV(1)	10(2)	-	150	150	-	-

Notes:

(1) Egyptian Standard for Threshold Limit Value (TLV) for Ambient Air Quality(24 hour means)as stipulated by the Law 4/94.

(2) 8 hour mean.

Table 5-8

Mean Concentration of Non-Gaseous Air Pollutants at the Proposed Project Site
(24 hour average)

Site No.	TSP (µg/m^3)	Smoke (µg/m^3)
1 (Center)	371.5	8.7
2 (North-1)	950.5	20.6
3 (North-2)	873.9	28.7
4 (South-1)	689.8	30.8
5 (South-2)	835.5	24.8
Mean	**744.2**	**22.72**
EEAA TLV*	**230**	**150**

Notes:
* Stipulated by the Law 4/94.

The high level of particulate matter, which reached mean value of 744.2 $\mu g/m^3$, exceeded the Egyptian standards for maximum 24 hour mean concentration at the Kuraymat power plant area. Exceedences are likely to be due to emissions of particles from the quarries as well as dry surface at the surroundings and vehicle exhausts along the Kuraymat / Beni-sueif road. This level is likely to decrease as the ISCC Kuraymat power plant construction and plantation program is implemented.

The level of smoke at measurement points are likely to be due to traffic, especially heavy trucks.

5.4.2 Existing Sources of Atmospheric Pollutants

The key existing sources of atmospheric pollution in the project area comprise the following:

- existing operating gas/oil fired power plant of capacity 2x627 MW;
- numerous quarries scattered in the surroundings;
- underground mazout-fired brick-kilns across the Nile, on the west bank of the river; and
- vehicles using the two-lane road along the eastern edge of the proposed site.

On the basis of the limited monitoring data available for the proposed site and from our observations at the site, the air shed around the project site is likely to have the general characteristics of moderate-industriatrialized area air shed.

As a result, air pollution in Kuraymat Zone is appropriately below health standards for major pollutants.

Ambient concentrations of TSP and PM_{10} are high, and are not complying with the WB/IFC guidelines for determining air sheds of good quality. However, the share of the existing Kuraymat power plant of this TSP and PM_{10} concentration does not exceed 4% of the value measured and so will do the new proposed power plant project. Also, the share of the proposed ISCC project will not exceed 2% of the value measured. Short term monitoring of ambient air quality at the site (and as given in *Table 5-7*), suggests that ambient concentrations of all other pollutants are well below WB/IFC moderately degraded air shed guidelines.

5.4.3 Particulate Matter Constituents

Use of gas turbines needs a special concern on constituents of particulate matters that exist within the air shed around the project site.

For providing an adequate database on this information, an analytical study was undertaken during May 2004 by the National Research Center. The main outcomes of this study are summarized as follows.

Smoke

The smoke particle size ranges, on the average, between 0.07 µm and 0.1 µm at the proposed site. Due to this very small size, smoke behaves in many ways like a gas and has the same penetration power as the gas. Also, smoke does not remain in the atmosphere for a long time. The average time of remaining in suspension was estimated to be 1-2 days.

Suspended Dust

Tables 5-9 through 5-14 give useful information on dust size.

Table 5-9

Average Concentration (in µg/m^3) and Percentage of Suspended Dust at the Proposed Site

Dust Size	Concentration (µg/m^3)	Percentage (%)
≤ 0.2 µm	315.6	45.09
0.2-10µm	428.6	54.91

Table 5-10

Water-Soluble and Insoluble Chemical Constituents of Suspended Dust at the Proposed Site, Percentage

Dust Size	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.	Com.M	Ash
≤ 0.2 µm	3.89	4.92	4.17	0.15	0.01	3.33	16.52	61
0.2-10µm	2.46	5.82	1.89	3.02	0.55	3.14	26.44	49.3

Notes:

Org. M. = Organic Matter

Com. M. = Combustible Matter

Table 5-11

Metals in Suspended Dust, Percentage

Dust Size	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)
≤ 0.2 μm	1.50	1.90	0.01	0.028	0.44	0.015
0.2-10μm	0.45	1.96	Trace	0.020	0.43	0.005

Dustfall

Table 5-12

Average Rate of Dustfall (in gm/m^2/month) and Percentage of Different Sizes (in μm) at the Proposed Project Site

Dustfall Rate (gm/m^2/month)	Dustfall Size (%)				
	≥ 90	90-80	80-63	63-45	≤ 45
14.84	16.90	12.70	9.93	49.32	11.15

Table 5-13

Water-Soluble and Insoluble Chemical Constituents of Dustfall at the Proposed Project Site, Percentage

Dustfall Size (μm)	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.	Comb.M.	Ash
≥ 90	2.58	3.13	0.40	0.45	0.0003	0.27	28.19	50.79
90-80	3.89	2.54	0.31	0.60	0.0006	0.29	30.85	49.57
80-63	2.55	2.41	0.37	0.67	0.0006	0.33	27.33	52.38
63-45	1.49	2.67	0.24	0.42	0.0010	0.16	19.06	57.64
≤ 45	2.76	3.35	0.40	0.68	0.0014	0.36	19.71	58.87

Table 5-14

Metals in Dustfall, Percentage

Dustfall Size (μm)	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)
≥ 90	2.06	0.64	0.18	0.004	0.88	Trace
90-80	3.77	1.04	0.27	0.006	1.05	Trace
80-63	3.03	1.39	0.34	0.005	1.03	0.0001
63-45	3.53	1.39	0.38	0.006	0.76	0.0002
≤ 45	5.60	2.09	0.53	0.007	1.31	0.0003

Examining the above tables gives useful conclusions as follows:

- Smoke particulates range in size between 0.07 and 0.1 μm on average.
- The ≤ 0.2 μm suspended dust reaches on average 45.09% which is high when taking into consideration its limited range which lies between 0.2 and 0.1 μm.
- Dustfall contains both small and big sizes with high different percentages; more distribution of larger sizes and less distribution of smaller sizes.
- The concentrations of chlorides, ammonium and ash increase in ≤ 0.2 μm fine suspended dust.
- The concentrations of combustible matter increase in 0.2-10 μm suspended dust.
- The cocentrations of sulphates, ammonium, nitrates, nitrites, organic matter and ash increase with decreasing size of dustfall to reach the highest concentrations in the ≤ 45 μm fraction.
- The concentrations of combustible matter have no fixed trend for increasing or decreasing with particle size of dustfall.
- The concentrations of calcium, sodium, potassium, iron and lead increase with decreasing particle size of either suspended dust or dustfall, This confirms the locality nature of the dust sources in the site area.

All information above should be of great importance in the engineering of gas turbine filters.

5.5 AQUATIC ENVIRONMENT

5.5.1 Introduction

The data on the existing aquatic environment has been assimilated from discussions with the Hydraulics Research Institute, the National Research Center and a review of relevant literature, which comprised:

- Prof. Dr. M. T. K. Gaweesh, I. A. El-Desouky, Dr. Samy Abdel-Fattah, Dr. Entesar A. El-Ghorab & Eng. Abdel-Azim Aly (July, 2003); ***Hydraulic Model Design for ISCC Kuraymat power plant***, Report 1, Hydraulics Research Institute;
- Prof. Dr. M. T. K. Gaweesh, Ibrahim El-Desouky, Eng. M. I. Roushdy & Eng. A. M. Amin (July, 2003); ***Kuraymat Power Station: River Morphological Model Studies, Report 2, Hydrographic and Hydrometric Survey***, Hydraulics Research Institute;
- Prof. Dr. M. T. K. Gaweesh, I. A. El-Desouky & Dr. Samy Abdel-Fattah (June, 2004); ***Kuraymat Power Station: River Morphological Model Studies, Report 3, Sediment Load Transport Measurements***, Hydraulics Research Institute;
- Prof. Dr. Osama A. Aly (June 2004); ***Assessment of Water Quality Along Selected Site for the Construction of Electric Generation Station at El-Kuraymat***, National Research Center.

5.5.2 Bathymetric Survey

The Kuraymat water body is that segment of the Nile river which passes before the power plant site. The Nile river flows from upper Egypt to the Mediterranean sea passing the Kuraymat site at approximately km 811 downstream Aswan High Dam, and just downstream Kuraymat Island. The Kuraymat Nile river is bordered by flat land which typically composed of agricultural lands.

Nile segment along the western edge of the site of the present thermal power plant has been investigated and bathymetric survey carried out covering a river reach of 9.0 km (6.5 km upstream the intake structure of the power plant and a reach of 2.5 km downstream it. The bathymetric survey was carried out in cross sections normal to the flow directions, the distance between each two cross sections was approximately 50 m and around 15m before the power plant location.

The bathymetric of each cross-section was carried out using the Differential Geographical Positioning System (DGPS) in order to measure the global coordinates of the measuring points and Echo Sounder (DSF-600 Digital Survey Fathometer) to measure the water depths at the measuring points.

The bathymetric of each cross-section was carried out through two methods: manually using staff gauge and the total station system for the Nile banks and up to water depth of 0.5 m; and Echo Sounder (DSF-600 Digital Survey Fathometer) installed in a rubber boat for the rest of the cross-section.

The contour level map of 0.5 m intervals of the whole area is shown in *Figure 5-34.*

5.5.3 Nile Flow

The Nile flow and water level at the plant site are mainly controlled by the Kuraymat Head regulator. The Nile flow reaches its maximum of about 184.71 million m^3/day in September, while minimum discharge occur in January with about 46.27 million m^3/day (*Table 5-15*). *Figure 5-35* depicts the river flow rating curve at the Kuraymat power plant site. According to the Ministry of Water Resources & Irrigation, the Nile river flow conditions are given below:

- Minimum discharge = 535.53 m^3/sec for level of 21.20 m MSL.
- Maximum discharge = 2137.85 m^3/sec for level of 23.48m MSL.

5.5.4 Flow Velocity

Flow velocity measurements has been carried out at eight cross-sections. The measurements were taken at approximately 13 vertical uniformly distributed along the width of each cross section at 3 points along each vertical, at 0.2, 0.5 & 0.8 of the water depth at each location measured from the bottom level. The location of the cross sections is shown in *Figure 5-36.*

The results of the velocity measurements at the mouth of the Kuraymat Island and previous the intake structure of the existing Kuraymat power plant are presented in *Tables 5-16 (A) and (B).*

5.5.5 Surface Current

The pattern of the surface current was traced using floats in three different areas:

- Upstream Kuraymat island.
- Upstream the power plant island.
- Downstream the power plant island.

The submerged part of the floats was 1.0 m, to prevent the wind effect. Ten floats were used to trace the surface current pattern upstream Kuraymat island, five of them entered the east branch and the other five entered the west branch as shown in *Figure 5-37.* Six floats were used to trace the surface current pattern upstream the power plant island; two of them entered the east branch and the other four entered the west branch as shown in *Figure 5-38.* Six floats were used to trace the surface current pattern downstream the power plant island, four of them at the east branch and two at the west branch, only the nearest one to the east bank was trapped at the intake, the pattern of the surface current was plotted as shown in *Figure 5-39*.

5.5.6 Temperature Measurements

Temperature Measurements were taken at the outlet of the present power plant covering an area of 600m x 100m; the temperature was measured at the surface to define the mixing zone, an isothermal map was generated from the measured temperature as it is shown in *Figure 5-40*.

5.5.7 Changes of River Morphology Between 1992 and Present Measurements

A comparison between five selected cross sections has been made to monitor the changes of the river morphology between the year 1992 and 2003.

Location of 5 cross-sections were selected for this comparison. *Figure 5-41* depicts these changes at the 5th cross-section on the eastern branch of present power plant island at 160 m upstream it's end.

Figure 5-34

Bathymetry in the Kuraymat Segment
Along the Western Edge of the Existing Plant Site

Table 5-15

Kuraymat Nile Head Regulator
Water Levels and Discharge, September 2001 – August 2002

Month	Plant Site			Assuit	Kuraymat Guage	Laithy Guage
	Discharge (Million m3/day)		Water Level (m MSL)	Levels (m MSL[1])		
September 2001	Max.	184.71	24.07	47.80	23.48	20.98
	Min.	176.20	23.69	47.60	23.10	20.58
October 2001	Max.	178.75	24.03	47.66	23.45	20.98
	Min.	80.55	22.46	45.35	21.90	19.54
November 2001	Max.	96.96	22.10	45.74	21.50	18.97
	Min.	67.57	21.87	45.05	21.30	18.90
December 2001	Max.	95.05	21.48	44.85	20.90	18.43
	Min.	54.79	21.48	44.75	20.90	18.43
January 2002	Max.	95.26	21.48	45.70	20.90	18.45
	Min.	46.27	21.83	44.55	21.20	18.55
February 2002	Max.	91.00	21.57	45.60	21.00	18.60
	Min.	48.99	21.57	45.55	21.00	18.60
March 2002	Max.	118.69	22.14	46.25	21.53	18.95
	Min.	79.07	21.84	45.32	12.25	18.73
April 2002	Max.	129.34	22.69	46.50	22.10	19.62
	Min.	101.65	22.34	45.85	21.75	19.27
May 2002	Max.	183.44	23.69	47.77	23.10	20.62
	Min.	131.04	22.94	46.54	22.35	19.86
June 2002	Max.	183.86	23.79	47.78	23.20	20.69
	Min.	168.10	#VALUE !	47.14	23.20	-
July 2002	Max.	173.21	23.71	47.53	23.12	20.64
	Min.	160.43	23.57	47.23	23.00	20.57
August 2002	Max.	163.42	23.59	47.30	23.00	20.48
	Min.	145.10	20.88	46.87	20.75	2020

Notes:

(1) m MSL = meters above the Mean Sea Level

Figure 5-35

River Flow Rating Curve at the ISCC Kuraymat power plant Site

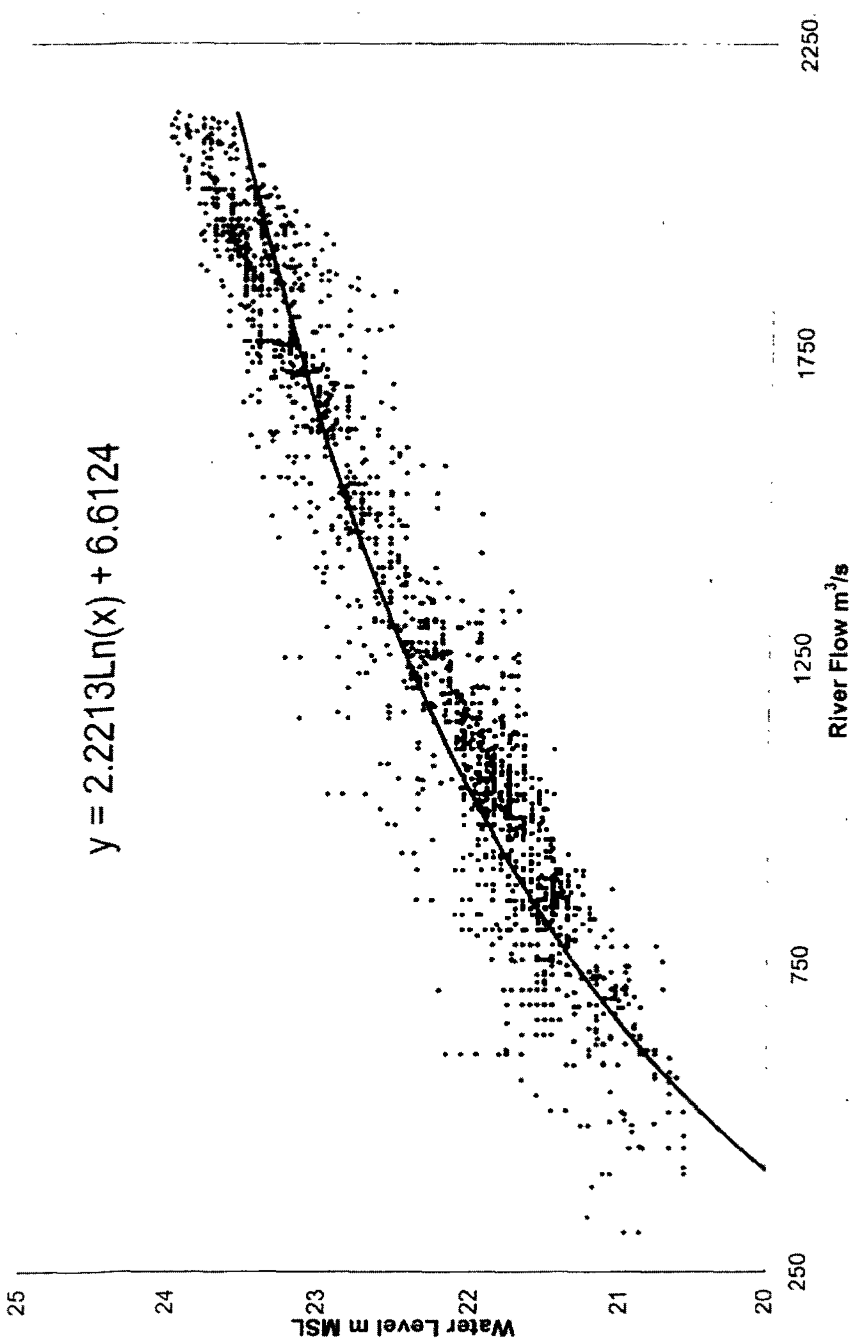


Figure 5-36

Locations of Velocity Measurement Cross-Sections

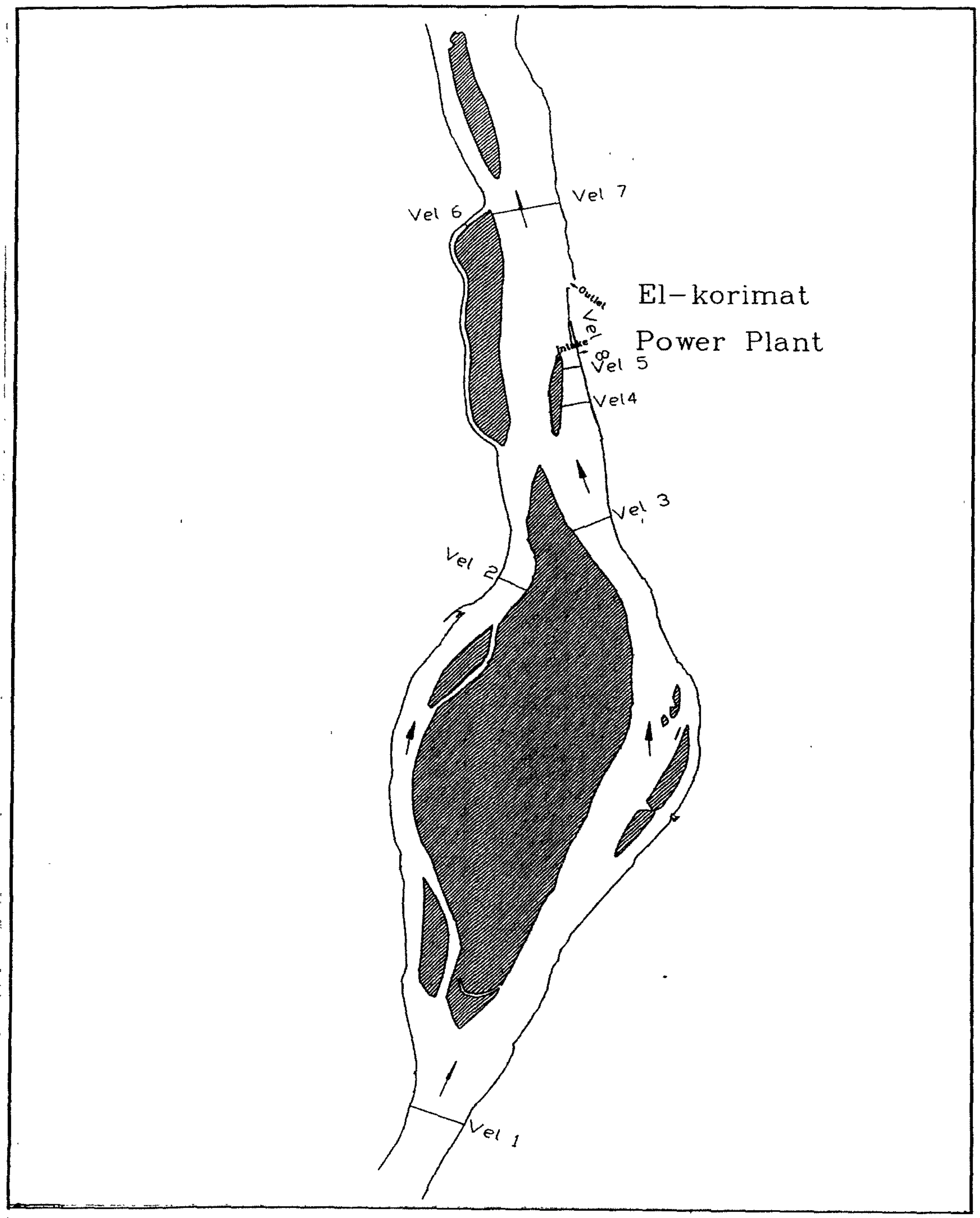


Table 5-16 (A)

Velocity Measurements at the Mouth of Kuraymat Island Cross Section No.1

Distance from Left Bank (m)	Depth (m)	Depth Ratio (-)	Velocity	
			Direction (o)	Vlaue (m/s)
17	1.1	0.6	355.50	0.32
48	1.7	0.2	0.87	0.45
		0.6	0.44	0.41
		0.8	1.90	0.38
91	3.4	0.2	3.73	0.77
		0.6	2.93	0.74
		0.8	4.15	0.65
143	4	0.2	5.67	0.91
		0.6	7.51	0.85
		0.8	6.80	0.80
201	4	0.2	10.39	0.89
		0.6	9.85	0.84
		0.8	14.35	0.75
257	4.5	0.2	10.80	0.79
		0.6	7.74	0.67
		0.8	8.96	0.64
310	4.5	0.2	14.75	0.83
		0.6	15.70	0.75
		0.8	19.05	0.67
381	3.5	0.2	20.75	0.63
		0.6	21.80	0.56
		0.8	16.75	0.54
418m	0	0	0.00	0.00
Discharge =		1014.00 m^3/s		

Table 5-16 (B)

Velocity Measurements Previous the Intake Structure of the Present ISCC Kuraymat power plant
(Cross Section No.5)

Distance from Left Bank (m)	Depth (m)	Depth Ratio (-)	Velocity	
			Direction (o)	Vlaue (m/s)
10	2.3	0.2	357.63	0.19
		0.6	354.54	0.29
		0.8	1.84	0.20
28	2.7	0.2	351.82	0.63
		0.6	352.75	0.56
		0.8	352.20	0.45
47	4.4	0.2	343.39	0.63
		0.6	339.50	0.57
		0.8	333.27	0.46
66	4.9	0.2	341.55	0.67
		0.6	339.10	0.65
		0.8	338.10	0.50
85	4.6	0.2	338.58	0.67
		0.6	337.60	0.60
		0.8	338.17	0.56
103	4.2	0.2	339.85	0.56
		0.6	339.24	0.55
		0.8	340.03	0.51
122	3.6	0.2	338.52	0.51
		0.6	342.04	0.49
		0.8	334.20	0.43
129	3.1	0.2	335.95	0.32
		0.6	341.55	0.32
		0.8	332.75	0.24
134	0	0	0.00	0.00
Discharge =		257.59 m^3/s		

Figure 5-37

Flow Pattern Upstream Kuraymat Island

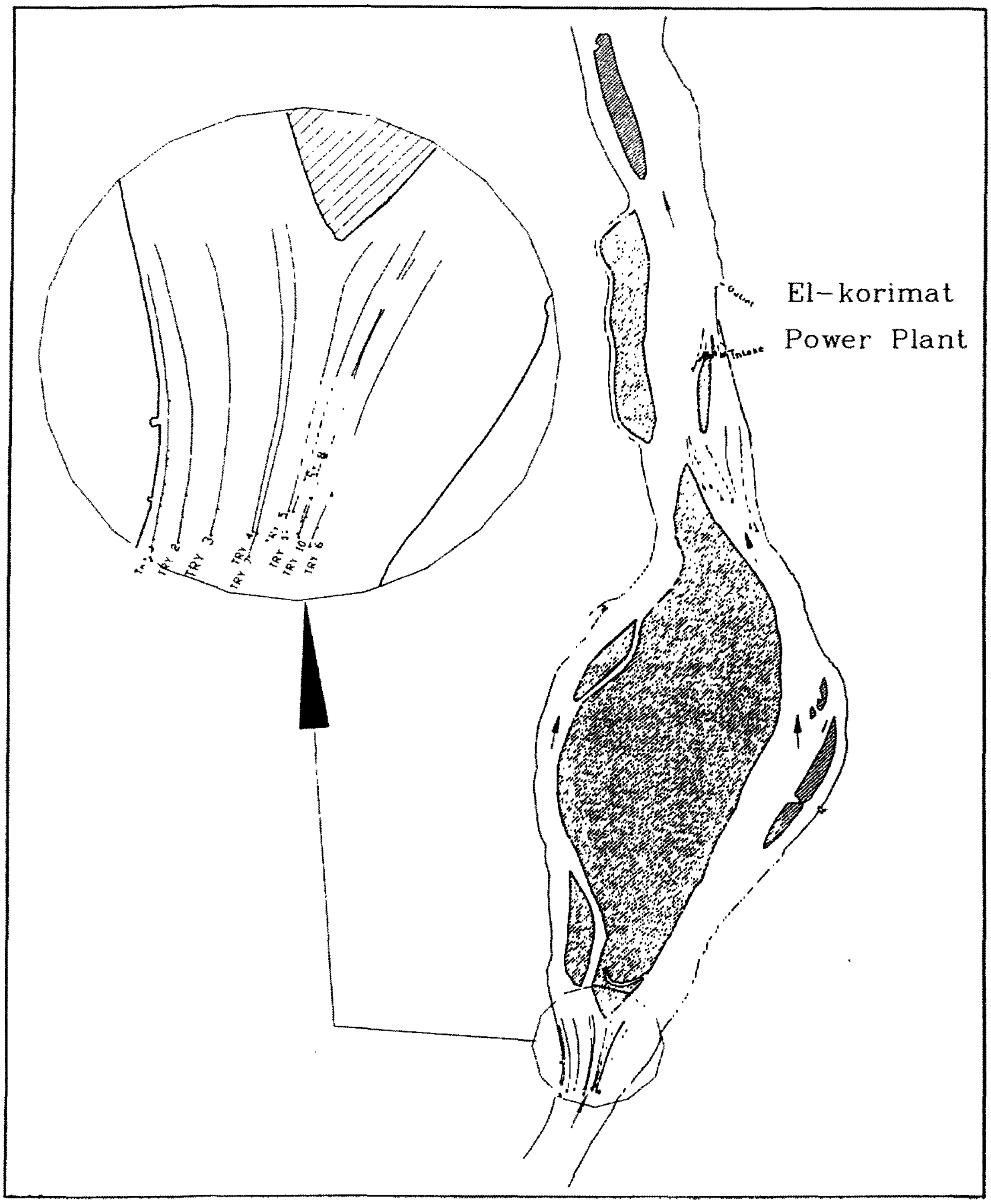


Figure 5-38

Flow Pattern Down Stream Kuraymat Island

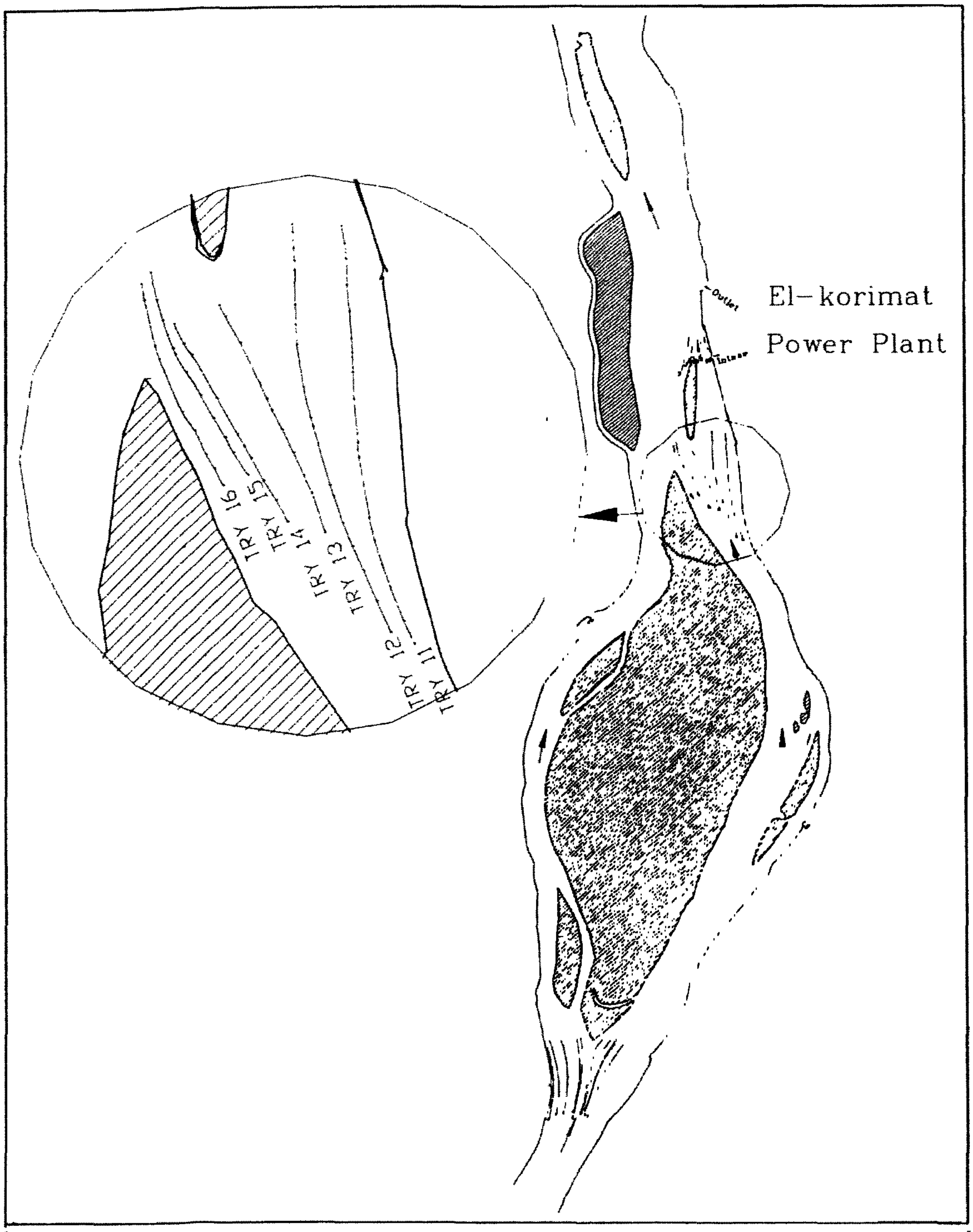


Figure 5-39

Flow Pattern Downstream Present Power Plant Island

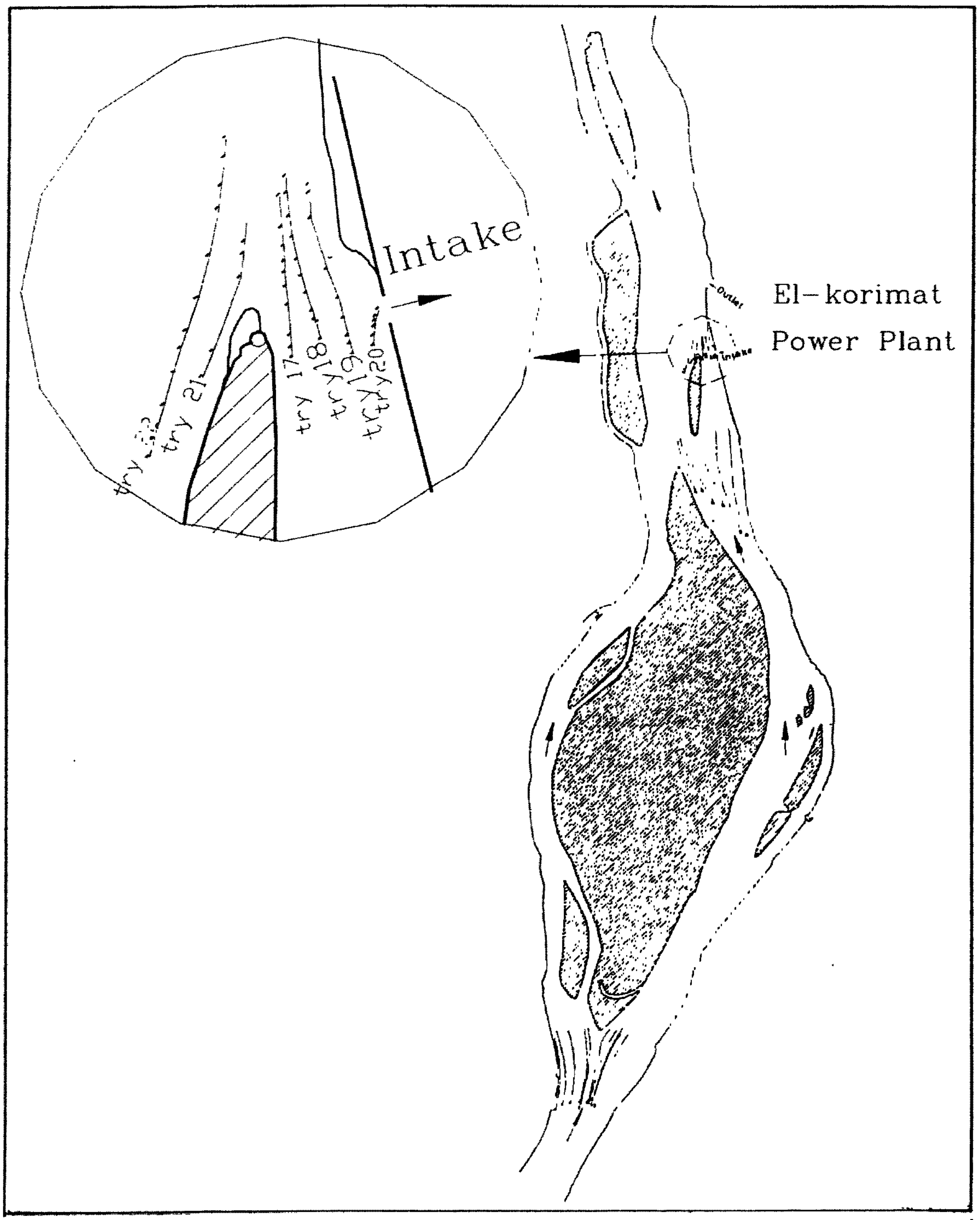


Figure 5-40

Thermal Distribution Downstream the Outlet of the Present Power Plant

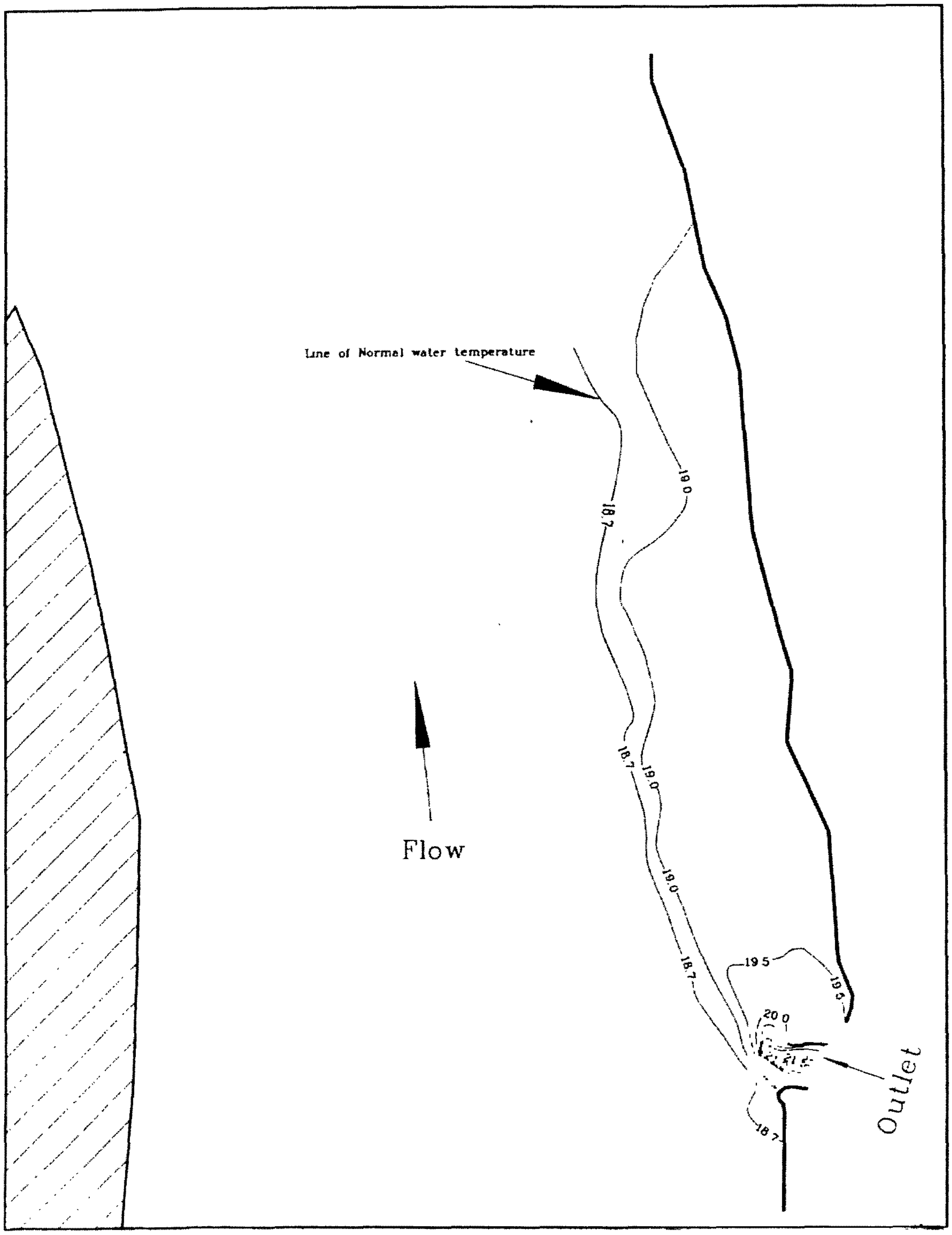
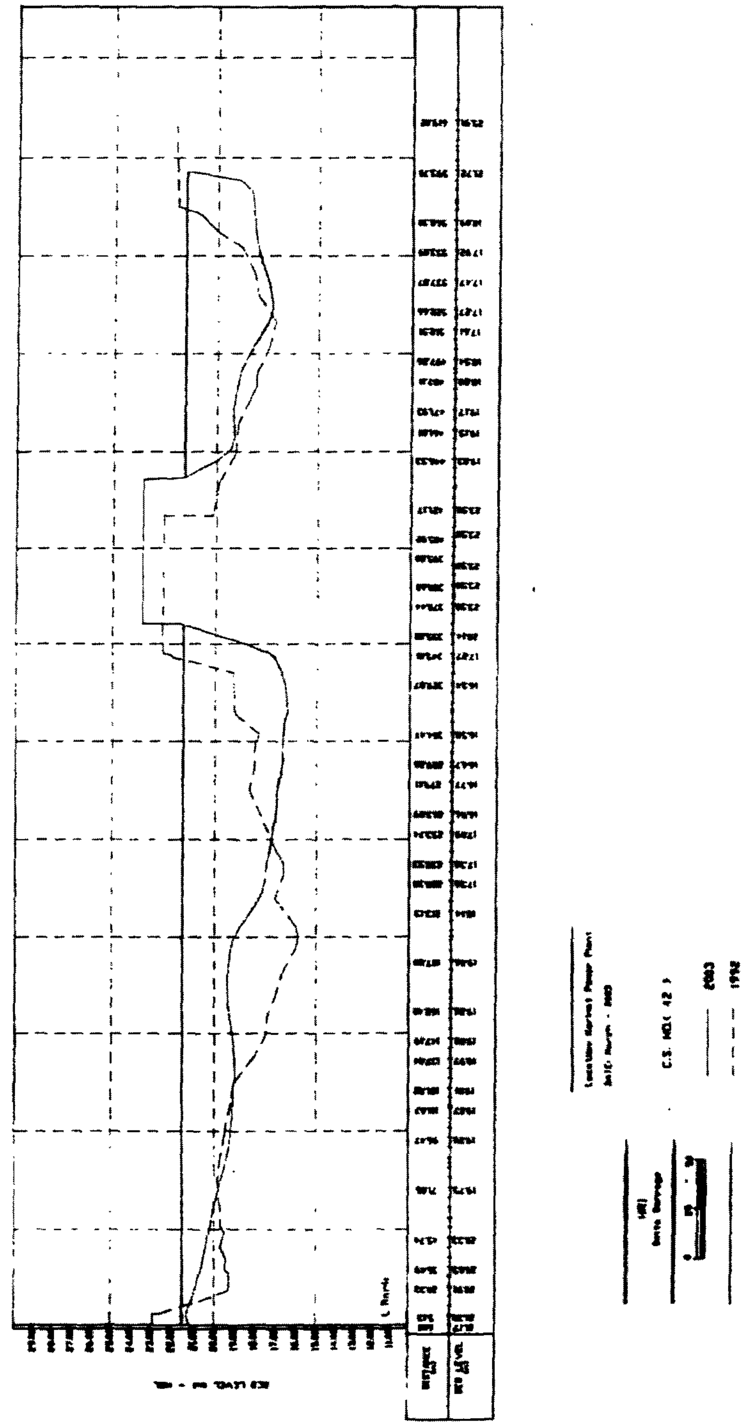


Figure 5-41

Changes on the Eastern Branch of Present ISCC Kuraymat power plant Island at 160m Upstream its End, Compared to 1992 Measurements



5.5.8 Sediment Transport Rate

Field sediment transport measurements were performed in the Nile river for obtaining required information about the current flow conditions before the Kuraymat existing power plant. This data is necessary for hydraulic modeling to solve the sedimentation problem at the intake of the present power plant.

The sediment load transport measurements were carried out at three cross sections at Kuraymat, located at 811 km (measured downstream the High Aswan Dam). Locations of the three measuring cross sections is shown in *Figure 5-42*. The first cross section is upstream the intake structure of the present Kuraymat power plant by a distance of 1300m. The second cross section was located in a distance of 1700m, and the third one was located by a distance of 600m.

The Delft-Niel Sampler which was operated from an anchored boat, was used in the measurements. This mechanical sampler was designed to measure, in contact to the bed, the bed load and the suspended load up to 0.5 m above the bed (the sampler height). Three small propeller meters were attached to the sampler to measure the current velocities at 0.18, 0.37 and 0.50m above the bed. The bed load transport is defined as the transport between the bed surface and the top of the intake opening of the bed sampler (about 0.055m). This application of this practical definition may result in some oversampling, as part of the suspended sediment is trapped. However, a special patch of 0.5 mm mesh size was used at the upper side of the bed load bag to allow the suspended sediment to leave the bag. The oversampling error was estimated to be on the order of 10% to 20%. The suspended sand transport is defined as the transport between the top of the intake opening of the bed load sampler and the water surface.

Grain Size Characteristics

The results of the sieve analysis for cross section 3 is presented in *Table 5-17*. Comparison of D_{10}, D_{50} and D_{90} values of bed material and the bed load samples shows that the overall average values of bed load samples are slightly smaller than those of the bed material samles.

Suspended and Bed Load Transport Rate

Time-averaged suspended sediment load transport rates measured at each cross section were obtained by integrating the suspended load transport over the cross section. The results are given in *Table 5-18*.

Time-averaged bed sediment load transport rates measured at each cross section were obtained by integrating the bed load transport over that cross section. The results are given in *Table 5-19*.

The total load transport rate at each cross section was obtained by summing up both suspended and bed load transport rates. The measured total load transport rates at each cross section are given in *Table 5-20*.

Sediment Transport Rate Before the Intake Structure

Sediment transport rate before the intake structure at the cross section located between the right bank and the small artificial island was obtained from the previous data as follows:

Suspended load transport over the cross section	= suspended load transport over the cross sections (1+2-3) = 10.0635 + 13.7022 – 21.0165 = 2.7492 kg/s = 90 m^3/day
Bed load transport over the cross section	= bed load transport over the cross sections (1 + 2 -3) = 1.5007 + 2.0115 – 3.1111 = 0.4011 kg/s = 13.1m^3/day
Total load transport over the cross section	= total load transport over the cross sections (1 + 2 -3) = 11.5642 + 15.7140 – 24.1275 = 3.1507 kg/s = 103 m^3/day

Figure 5-42

Location of Sediment Measurement Cross-sections

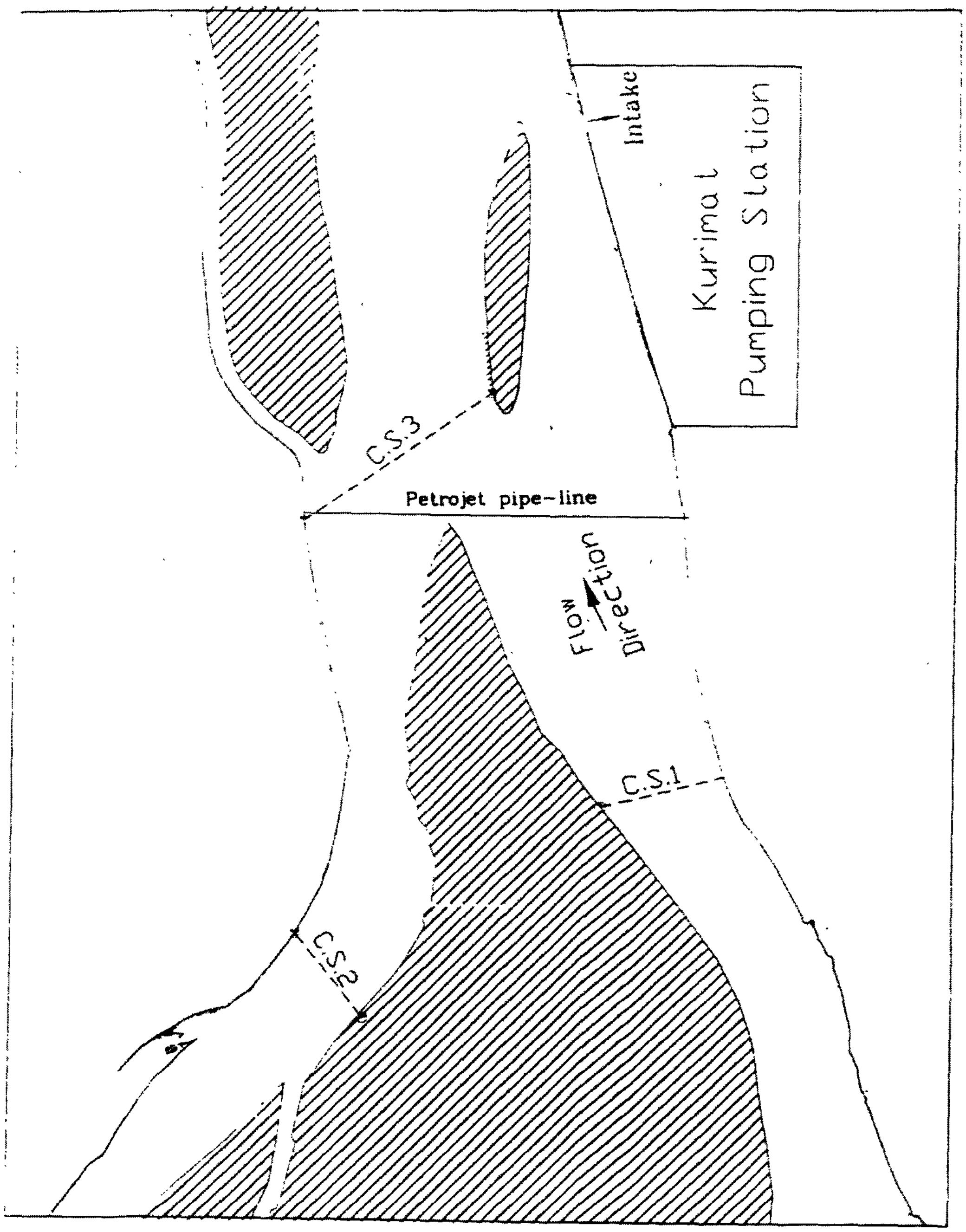


Table 5-17

Grain Size Analysis of Bed Material Samples and Bed Load Samples of the Nile River at Cross Section 3

Station	Grain Size (μm)							
	Bed Material Samples Collected by the Grab Sampler				Bed Load Samples Collected by the Delft Nile Sampler			
	D_{10}	D_{50}	D_{90}	δg	D_{10}	D_{50}	D_{90}	δg
1	214	355	686	1.659	210	315	534	1.396
2	296	474	860	1.436	283	460	848	1.477
3	219	362	665	1.647	216	350	844	1.619

Table 5-18

Suspended Load Transport Rates Measured at Cross Sections 1, 2 and 3

Cross Section	Station Number	Suspended Load Transport Rates (kg/m.s)	Station Width (m)	Transport Rates (kg/s)
1(1)	1	0.02766	86	2.3787
	2	0.04126	57	2.3518
	3	0.05333	100	5.3330
	Total Suspended Load Transport Rate Integrated Over the Cross Section (kg/s)			10.0635
2(2)	1	0.04376	82	3.5883
	2	0.06323	56	3.5408
	3	0.08016	82	6.5731
	Total Suspended Load Transport Rate Integrated Over the Cross Section (kg/s)			13.7022
3(3)	1	0.04966	172	8.5415
	2	0.03213	116	3.7270
	3	0.05400	162	8.7480
	Total Suspended Load Transport Rate Integrated Over the Cross Section (kg/s)			21.0165

Notes:
(1) Station 1 is at 110 m from the left bank.
(2) Station 2 is at 235 m from the left bank.
(3) Station 3 is at 340 m from the left bank.

Table 5-19

Bed Load Transport Rate Measured at Cross Sections 1, 2 and 3

Cross Section	Station Number	Bed Load Transport Rates (kg/m.s)	Station Width (m)	Transport Rates (kg/s)
1	1	0.000413	86	0.0355
	2	0.003547	57	0.2022
	3	0.012630	100	0.2630
	Total Bed Load Transport Rate Integrated Over the Cross Section (kg/s)			1.5007
2	1	0.010101	82	0.8283
	2	0.007500	56	0.4203
	3	0.009307	82	0.7632
	Total Bed Load Transport Rate Integrated Over the Cross Section (kg/s)			2.0118
3	1	0.006904	172	1.1874
	2	0.011346	116	1.3161
	3	0.003750	162	0.6075
	Total Bed Load Transport Rate Integrated Over the Cross Section (kg/s)			3.1110

Table 5-20

Measured Total Load Transport Rate in Cross Sections 1, 2 and 3

Cross Section	Suspended Load Transport Rate (kg/s)	Bed Load Transport Rate (kg/s)	Total Load Transport Rate (kg/s)
1	10.0635	1.5007	11.5642
2	13.7022	2.0118	15.7140
3	21.0165	3.1110	24.1275

5.5.9 Water Quality

Background

The pollution of surface water in the Nile river at the Kuraymat site is limited because the Nile river receives a continuous flow of fairly clean water from the lake Nasser and the Nile upstream, and the pollutants discharge into the Nile water are considerably diluted by this massive volume of water. No significant discharge of sewage into the Nile occurs at Kuraymat. Ambient concentrations of pollutants in the river and main canals do not exceed standard for acute, short-term exposures (DHV Consultants, 1996).

The concentrations of chemicals and bacteria in the Nile's water are well within acceptable standards for safe irrigation of food crops. The levels of chemical and microbial contaminants in the Nile are low because the Nile river at Kuraymat site receives constant influx of cleaner water.

Only limited pollution with fertilizers and pesticides originates at Kuraymat Nile segment water because of agricultural areas. Leaching and runoff are of little significance because of very limited rainfall.

Water Quality Measurements

Water Quality Measurements as well as sediment samples at five sample locations (intake, 300 m to the south of the Kuraymat existing power plant site, 150 m to the south, before the Kuraymat plant site, and 300 m to the north of the Kuraymat plant site) two samples were taken on 25th of May 2004 (National Research Center Study, June 2004). The results of water quality determination include chemical analysis of water samples (physico-chemical parameters, concentration of heavy metals and identification of organic content), microbiological analysis (bacteriological examination and algal counts) and chemical analysis of sediment.

Water Characteristics and Quality

- Physico-chemical Analysis

Table 5-21 presents the results of physico-chemical measurements of water samples collected at selected sites namely no. 1, 2, 3, 4 and 5. Values of water temperature, pH and dissolved oxygen content do not reveal the presence of any significant variation in-between the water samples collected at given sites and are found within normal range. In addition, Electrical conductivity of water ranges between 388 and 401 µmho/cm and water transparency at various sampling sites shows values range between 90 cm and 100 cm which is in agreement with the relatively low values of suspended solids which range between 9 mg/l (Site 4) and 18 mg/l (Site2 & Site 3). Values of COD were found relatively high especially at sites no. 3 and no. 4 while values of BOD were found relatively low.

Results of total solids (TS) and total dissolved solids (TDS) are within normal range for water derived from the Nile river, and no material differences exist in between water quality at various sites.

Values of total alkalinity are almost in the same range. These results are in agreement with the general trend of the pH values. Meanwhile, the concentrations of chlorides, sulfate and nitrates do not reveal significant change in water quality.

Concentration of sodium ions in the Nile waters is generally low and sodium contents of water samples approach each other. Variation in concentration of potassium do not show material differences along the 5 sampling sites and range between 4 and 6 mg/l. Concentration of calcium ions attain higher values compared to magnesium which is general characteristic of the Nile waters. The concentration and distribution of anions and cations in the water near the Kuraymat site are within the range of the Nile river water. Chemical Oxygen Demand (COD) shows values range between 26 mg O_2/l (Site 2) and 79 mg O_2/l (Site 3), and values of Biological Oxygen Demand (BOD) are very low at all sampling sites and do not exceed 6 mg/l.

- Organic Content of Nile Waters at Kuraymat

Results presented in *Table 5-22* reveal that water samples collected at all sites are almost free from phenolic compounds and chlorinated hydrocarbons. Total hydrocarbons show its high value of 21.2 µg/l at Site 3. Values of polyaromatic hydrocarbons, however, are relatively very low and range between 1.82 µg/l and 2.5 µg/l Oil and grease content of water samples is under the Law 48 of 1982 at all sampling sites and ranges between 1.9 mg/l (Site 1) and 3.6 mg/l (Site 3).

- Heavy Metals Content

Table 5-23 shows that iron and copper concentrations are not detected in water samples of Kuraymat Nile waters. The concentration of chromium amounts to <0.02 mg/l and zinc ranges between 0.024 and 0.047 mg/l. In general, heavy metals do not present any significant level in Kuraymat Nile waters.

- Bacteriological Examination

Results of bacteriological examination of water samples are given in *Table 5-24*. Bacteriological indicators of faecal pollution are detected in all samples. Total coliforms range between 1.7 x 10^2 / 100 ml (Site 4) and 5.0 x 10^2/100 ml (Site 3) and faecal coliforms reach maximum value of 51.1 x 10^2/100 ml at Site 2 and amount to 0.8 x 10^2 ml at Site 4. Total bacterial counts at 22°C range between 1.0 x 10^2 / ml (Site 4) and 3.0 x 10^2/ ml (Site 5), whereas counts at 37°C show a relative counter trend at Site 5 (2.5 x 10^2 /ml) as well as at

Site 4 (8.6 x 10^2/ml). It is seen that the highest values of bacteriological indicators of faecal pollution recorded at site no. 3 may be attributed to the close of site no. 3 to the Nile river bank.

- Algal Counts

The general distribution of algal groups and their counts in water samples are given in *Table* 5-25. In general, diatoms represent the higher counts and range between 4256 and 4360 organisms/ml. Green algal count ranges between 200 (Site 2) and 260 (Site 4) organisms/ml whereas blue-green algae represent the lowest algal population and range between 126 (Site 2) and 148 (Site 4) organisms/ml. In general, total algal count ranges between 4592 (Site 1) and 4768 (Site 4) organisms/ml. Algal counts and genera distribution matches the general trend to be found in the Nile river.

Sediment Characteristics

- Organic Content

Results given in *Table 5-26* reveal the general characteristics of sediments with respect to their COD, extractable organic matter, oil and grease, total hydrocarbons, chlorinated hydrocarbons and polyaromatic hydrocarbons. COD Values of sediments collected at Sites 3, 4 and 5 are very high indicating the presence of high organic content compared to Site 2 and Site 1 where the least value is attained (47620 mg O_2/l). Extractable organic matter ranges between 425 mg/kg at Site 1 and 755 mg/kg at Site 3. Values of oil and grease follow the general trend attained by extractable organic matter where the least value is recorded at Site 1 (328 mg/kg) and the highest value is 600 mg/kg at Site 3. Total hydrocarbons attain maximum concentration at Site 4 (53.8 mg/kg) and the lowest value at Site 1 (29.8 mg/kg). Value of polyaromatic hydrocarbons range between 2.53 ug/kg at Site 1, and 12.73 ug/kg at Site 4. The concentration of chlorinated hydrocarbons exhibit the lowest value of 4.13 mg/kg at Site 1 and the highest value at Site 3 (8.39 mg/kg). As a general trend organic content of sediments at Site 3 attains the lowest level compared to the other sites.

- Heavy Metals Content

Zinc is the major metal to be present in sediments of Kuraymat Nile waters. The concentration ranges between 2.0 mg/kg and 3.86 mg/kg as given in *Table 5-27*. The concentration levels of lead, chromium and nickel are relatively low and approach each other. Cadmium, however, is detected to be of the lowest concentrations among all. In general, the presence of heavy metals is attributed to the tendency of sediment to adsorb these components and other pollutants through a very long period.

5.5.10 Groundwater

Avalable information on groundwater quantity and quality are presented in Section 5.1 and Section 5.2.

Table 5-21

Physico-chemical Analysis of Water Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
pH	-	7.9	8.1	7.8	8.0	7.9
Water Temperature	^oC	27	26	26	26	26
Electrical Conductivity	μmho/cm	401	388	392	388	396
Dissolve Oxygen	mgO_2/l	6	7	7	6	6
Transparency	cm	100	90	90	90	100
Total Dissolved Solids (TDS)	mg/l	266	267	213	249	236
Suspended Solids	mg/l	13	18	18	9	15
Total Solids (TS)	mg/l	276	285	231	258	251
Total Alkalinity (as $CaCO_3$)	mg/l	154	148	150	150	150
Chloride(Cl^-)	mg/l	24	22	29	22	22
Sulfate (SO_4^{--})	mg/l	23	23	23	23	23
Nitrate (NO_3-N)	mg/l	0.04	0.07	0.06	0.06	0.06
Sodium (Na^+)	mg/l	25	29	25	26	30
Potassium (K^+)	mg/l	4	4	4	4	6
Calcium (Ca^+)	mg/l	36	34	33	34	36
Magnesium (Mg^{++})	mg/l	12	11	11	11	11
COD	mg/l	40	26	79	63	40
BOD	mg /l	6	5	4	4	4

Table 5-22

Organic Analysis of Water Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Phenol	mg/l	0.05	0.05	Nil	Nil	Nil
Oil& Grease	mg/l	1.9	2.0	3.6	3.3	2.5
Polyaromatic Hydrocarbons	μg/l	1.82	1.92	2.5	2.07	1.86
Total Hydrocarbons	μg/l	8.65	9.1	21.2	19.6	11.8
Chlorinated Hydrocarbons	μg/l	0.012	0.066	0.084	0.079	0.075

Table 5-23

Heavy Metals Analysis of Water Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Zinc	mg/l	0.025	0.024	0.047	0.041	0.029
Cadmium	mg/l	<0.002	<0.002	0.004	0.004	<0.003
Lead	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02

Table 5-24

Microbiological Analysis of Water Samples[1]

Site No.	Total Bacterial Counts (Cell cm^3)		Most Probable Number Index/100ml	
	At 22°C	At 37°C	Total Coliform	Faecal Coliform
Site (1)	1.6×10^2	4.9×10^2	3.0×10^2	1.1×10^2
Site (2)	2.7×10^2	2.8×10^2	3.0×10^2	51.1×10^2
Site (3)	2.4×10^2	4.4×10^2	5.0×10^2	2.5×10^2
Site (4)	1.0×10^2	8.6×10^2	1.7×10^2	0.8×10^2
Site (5)	3.0×10^2	2.5×10^2	2.3×10^2	1.2×10^2

Notes:

(1) Samples Delivery Date : 15/9/2003
Date of Analysis : 15/9/2003

Table 5-25

Algal Counts of Water Samples

Parameters	Counts (Organisms/ml)				
	Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Diatoms	4256	4270	4352	4360	4280
Green Algae	208	200	256	260	210
Blue-Green Algae	128	126	144	148	132
Total Algal Counts	4592	4596	4752	4768	4622

Table 5-26

Organic Analysis of Sediment Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
COD	mg/kg	47620	47760	51780	49592	49352
Extractable Organic Matter	mg/kg	425	461	755	676	698
Oil & Grease	mg/kg	328	366	600	530	540
Polyaromatic Hydrocarbons	µg/kg	2.53	3.46	12.12	12.73	10.45
Total Hydrocarbons	mg/kg	29.8	32.1	50.2	53.8	41.5
Chlorinated Hydrocarbons	mg/kg	4.13	5.31	8.39	8.21	5.6

Table 5-27

Heavy Metals Analysis of Sediment Samples

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Zinc (Zn)	mg/kg	2.0	2.05	0.95	2.38	3.86
Cadmium (Cd)	mg/kg	0.1	0.2	0.5	0.3	0.1
Lead (Pb)	mg/kg	0.28	0.25	0.86	0.70	0.54
Chromium (Cr)	mg/kg	0.42	0.40	0.63	0.61	0.56
Nickel (Ni)	mg/kg	0.44	0.50	0.71	0.68	0.52

5.6 AQUATIC ECOLOGY

5.6.1 Aquatic Flora

Background

The Nile river control structures built during this century and earlier caused certain changes in the water habitat: rates of water flow, silt load and hence turbidity and erosive power, and chemistry of water. The development of industry and human settlements, mostly within the inhabited Nile Valley and the Delta, caused excessive discharge of industrial and domestic effluents into the water bodies. These ecological changes caused changes in the flora of these water bodies. For instance the submerged plant *Myriophyllum spicatum* was not included in earlier records of Nile plants *(Simpson, 1932; Hassib, 1951; Tackholm, 1956 and 1974; Moursy, 1976; Tawadrous, 1981 and Fayed, 1985).* The evidently vigorous growth of other submerged species all over the Nile and its branches may be due to reduction of silt load (especially during the flood) and hence reduction of turbidity. It is also noted that the composite *Ceruana pratensis*, once a common plant along terraces and banks of the Nile and major irrigation canals, is now a very rare species, probably disappearing.

Within the complex of habitat types that may be grouped under this Irrigation Drainage Network category and its associated habitats, the following sets have been recognized (EEAA, 1993).

Aquatic Habitat Types

- Aquatic-Submerged (El-Fiky, 1974):
  This includes the following community types: *Ceratophyllum demersum, Potamogeton pectinatus, Potamogeton crispus, Elodea canadensis and Najas armata.*

- Aquatic Floating (rooted):
  This includes the following community types: *Nymphaea coerulea, Potamogeton nodosus, Echinochloa stagninum and Polygonum salicifolium.*

- Aquatic-Floating (free):
  This includes the following community types: *Eichhornia crassipes and Lemma gibba – Spirodela polyrrhiza.*

- Emergent Reed Swamp Vegetation:
  This group is associated with bank and island habitats, and includes the following community types: *Echinochloa stagninum (also group b), Typha domingensis, Phragmites australis and Leersia hexanra.*

Nile Bank Habitat Types (el-Sheikh, 1989)

- Vegetation of the Terrassements:
  This group includes the following community types: *Panicum repens, Imperata cylindrica and Desmostachya bipinnata.*

- Vegetation Types on both Terrassements and Bank Slopes:
  This group includes the following community types: *Cynodon dactylon-Rumex dentatus, Phragmites australis-Imperata cylindrical and Saccharum spontaneum.*

- Vegetation types on the Lower Levels of the Bank:
  This includes community types that are transitional with the aquatic vegetation and Include: *Polygonum salicifolium, Phagmites australis and Echinochloa stagninum.*

5.6.2 Aquatic Fauna

As the project area is located 2 km east of the Nile river, an overview of the aquatic fauna is given hereunder.

Rotifera

Rotifers are found in immense number and variety in freshwater lakes, ponds and streams. Wayside pools, drains, and even the dirty water are prolific sources of rotifers. The free-swimming members of the rotifers constitute a high percentage of the plankton, which is the main food for many young and adult fishes.

In Egypt, this group is well represented in freshwater ecosystems. Nearly 118 species of rotifers have been recorded in the River Nile (EEAA, 1995).

Protozoa

Flagellates which are capable of photosynthesis represent a basic link in the food chain of organisms. Our knowledge of the Egyptian protozoan fauna is not sufficient and the group is much less known than other faunal groups. The Subphyla Mastigophora, Sarcodina and Ciliphora are represented in Egypt. They are well distributed in the River Nile and its tributaries (EEAA, 1995).

Annelida (Earthworms & Leeches)

Freshwater annelids in Egypt include two families Obligochaeta and Hirudinea. The aquatic forms are nearly all confined to freshwater. Aquatic oligochaetes play an important role in reducing the great masses of aquatic vegetation to a finely comminuted condition. Some leeches, like glossiphoniid members are known to act as intermediate hosts for certain parasites. Others play an important role as a mean of biological control for the snail vector

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parasites infecting man and other mammals. Others provide food sources for insects, crustaceans, fish and birds. The leech species are limited and until now 19 leech species have been recorded (EEAA, 1995).

Crustacea

Cladocera constitute the largest group of freshwater crustaceans. They live chiefly among the weeds, clinging to plants and higher algae. Cladocera have great economic value. Together with the Copepoda, they constitute the chief agency for converting the smaller algae into a form edible by the carnivorous aquatic animals. They are themselves of great value as food for young fishes and there is a period in the life of almost every fish when it feeds exclusively on them. In Egypt, 43 species of Cladocera have been recorded in the River Nile and inland lakes (EEAA, 1995).

Acarina (Mites)

Freshwater mites compose an important part of aquatic fauna. The majority of water mites are parasitic. About 84 mite species belonging to 53 genera have been recorded in Egypt belonging to 37 families (EEAA, 1995).

Mollusca (Bivalves & Snails)

Mollusca species are well distributed along the Rive Nile and in inland and coastal lakes as well as irrigation channels. They prefer living among aquatic plants and in mud. On the other hand, 13 bivalve species have been recorded in the River Nile and its tributaries. The following species are recorded (EEAA, 1999):

Bellamya unicolor (common), *Lanistes carinatus* (common), *Valvata nilotica* (rare), *Gabbiella senaariensis* (common), *Melanoides tuberulata* (common), *Cleopatra bulimoides* (common), *Lymnaea natalensis* (common), *L. columella* (rare), *Biomphalaria alexandrina* (common), *Bulinus truncatus* (common), *Caelatura teretiuscula* (common), *Sphaerium hartmanni (common), and Pisidium amnicum* (rare and has been collected near the project site).

Much attention in this organisms was and still is given to the principal snail groups which transmit Schistosomiasis as *Bulinus* spp. and *Biompholaria* spp., *as* well as *Lymnaea* spp, which transmit fascioliasis (liver flukes) to animals and man.

Osteichthyes (Bony Fishes)

During recent decades, the River Nile ecosystem has been subjected to many ecological stresses that led to significant changes in the physico-chemical properties of the water, and consequently affected the biological ecosystem. Construction of High Dam in 1967, the presence of large impoundments and pollution of water by domestic, industrial and agricultural wastes are the most important factors that affect the River Nile environment, and its biodiversity The cessation of the flood destroyed many spawning and nursery grounds, naturally found during the flood, especially for the riverine fishes. In response to these changes, several fish species disappeared completely, while others began to show marked decline, especially in the down stream areas, where the water is almost lentic (EEAA, 1997).

Boulenger (1907) mentioned that Loat was the first who made a fish survey of the Nile and he recorded about 85 species, inhabiting the Egyptian Nile waters. The present number of recorded species is 70 included under 16 families and 49 genera. Three families (i.e. *Characinidae, Cyprinidae* and *Siluridae*) include about 70% of the species. Of the 85 species that were previously recorded at the beginning of the present century, 15 species are extinct and were not recorded during the last 50 years. Furthermore, due to the change in the River regime most riverine fish are becoming rare and these represent 51 species. Only 15 species are the most common and contribute to the freshwater production of Egypt. Cichlids (e.g. *Tilapia* spp.) especially *Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zillii* contributes to the highest percentage of freshwater production.

Reptilia & Amphibia

Aquatic reptiles and amphibians are not well represented in Egypt. Only 4 aquatic reptile species have been recorded in Egypt, belonging to 4 families. Three of them are considered rare species, while the fourth one (Nile-Turtle) has disappeared during the last 30 years.

Seven amphibian species have been recorded in Egypt, belonging to 3 families and 4 genera i.e. *Bufo, Rana, Hyla* and *Ptychadena*. Three species are common while the other 4 are rare (EEAA, 1995).

5.6.3 Aquatic Ecology of the Project Site

Fresh water molluscs

Species: *Lanistes carnatus*
Economic status: Common and considered as a vector of the nematode species *Cercaria puslla* and *Angiosrongylus cantonensis* (the rat lung Nematode).

Species: *Bellamya unicolor*
Economic status: Common and considered as a vector of the nematode species *Cercaria puslla* and *Angiosrongylus cantonensis* (the rat lung Nematode).

Species: *Cleopatra bulimoides*
Economic status: Common and considered as a vector of the nematode species *Gastrodiscus aegypticus* and *Prohemstomum vivax.*

Species: *Caelatura masranus*
Economic status: Common and serve as food for fishes and sometimes humans especially the large sized.

Species: Mutela dubia nilotica
Economic status: Common and serve as food for fishes and sometimes humans especially the large sized molluscs.

Species: Lymnaea natalesis
Economic status: Common and considered act as a vector of *Fasciola gigantica* and *Fasciola hepatica* (Liver fluke).

Species: Caelatura aegyptiaca
Economic status: Common and serve as food for fishes and sometimes humans especially the large sized.

Species: *Mutela singularis*
Economic status: Common and serve as food for fishes and sometimes humans especially the large sized.

5.7 FLORA AND FAUNA

5.7.1 Introduction

A landscape ecological approach was adopted for addressing flora and fauna within the wider area of the proposed site. It depends on the identification of the landscape structure and function then, determining the ecological relevance to the proposed project.

The landscape ecological approach begins with a broad scale covering the project hinterland ecological setting, then narrows down the scale to the project area and site. Satellite remote sensing and GIS were then the technologies of choice as they allow viewing both the broad and fine scales of the project ecological setting and delineating the area of influence (impact spatial dimension) of the proposed project.

Information and data on the project hinterland, area, and site were gathered from published material, reports and Internet search.

Field reconnaissance was carried out to identify area and site-specific ecological settings and their floral and faunal communities and habitats. Photographs were also taken to illustrate the environmental settings and to document the landscape within and around the project site.

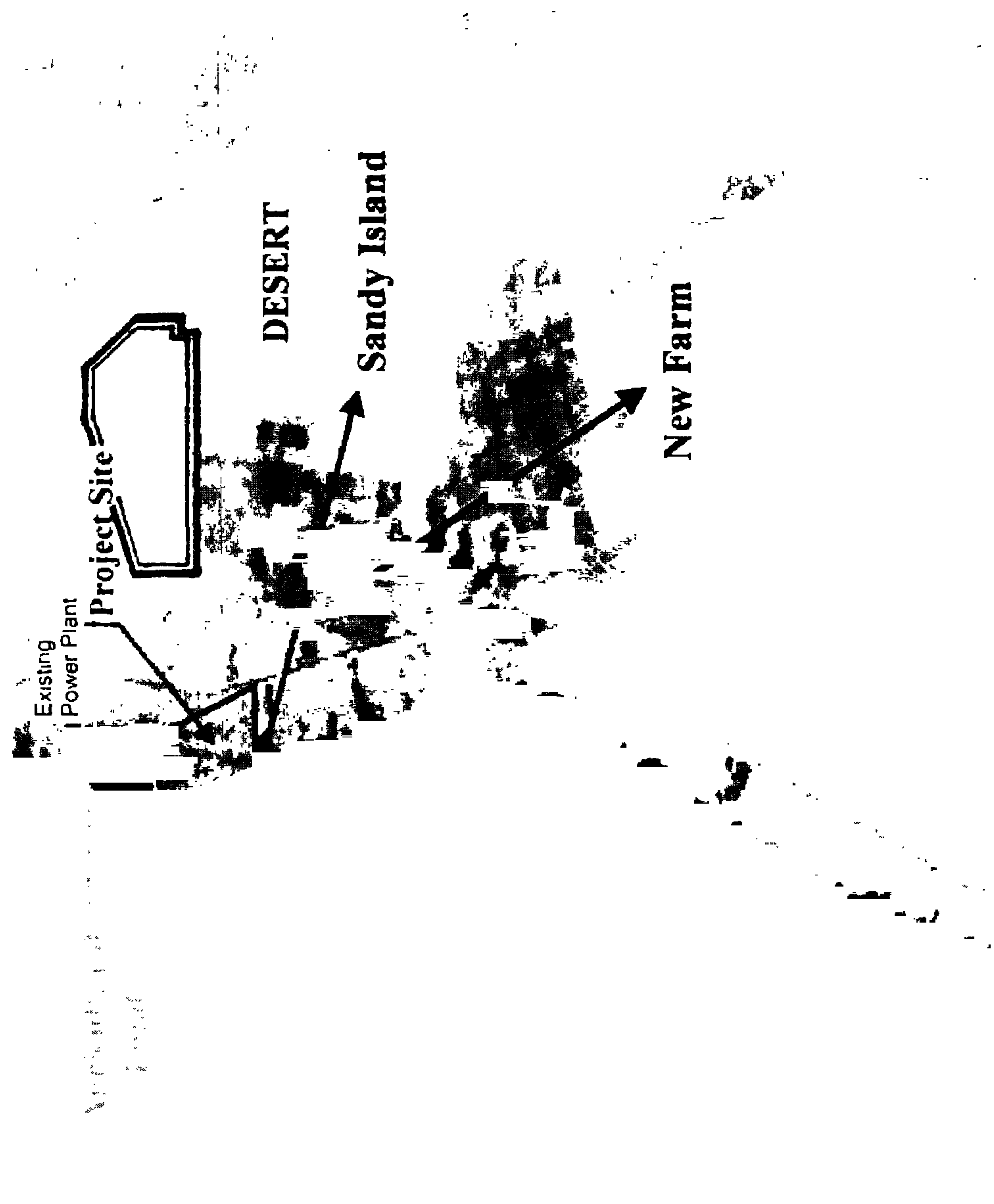
Interviews with the NREA and the proposed power plant officials and members of the surrounding community also were carried out to collect additional information.

Detailed topographic map (scale 1:50,000) of the project area was obtained to give a broader view of the environmental setting of the project area.

Satellite image (*Figure 5-43)* obtained by the Landsat TM in 2000 for the project area was acquired and processed to help identify the landscape and land use of the area. The image is multispectral and has a 28 X 28-m spatial resolution. Accordingly, this satellite image was digitally processed to delineate watercourses, urban/urbanized features and agricultural/vegetation units (*Figure 5-43*) with the aid of the map and ground surveys.

Figure 5-43

Landsat Satellite Image of the Area of the Proposed ISCC Kuraymat power plant Showing the Project Site and Adjacent Landscape



5.7.2 General Ecology of the Project Area

The project is located on the eastern side of the Nile river at the very south of Giza governorate.

Giza governorate has 3 main ecological sub-systems. It has some parts within the eastern desert, a major part within the western desert and central area, which is a part of the Nile Valley ecosystem (*Figure 5-43*). The project site is located on the eastern side of the Nile close to the road junctions leading to Zaafrana in the Red Sea (east) and to Beni-sueif to the south.

Similar to other areas of the same nature, the project area is considered as an "edge" habitat where two main ecosystems overlap. These two main ecosystems are the Nile Valley and the eastern desert. Thus, such an edge habitat may express characters of both ecosystems and ones of its own. The flora and fauna of this habitat is a mixture of valley and desert biodiversity.

Due to limited rainfall, natural vegetation cover is usually limited and very thin. Vegetation is distributed along the axes of the different drainage basins in the area. As a result of the limited vegetation growth in the eastern part of this habitat, faunal diversity is low. Along the western part of this habitat (Nile Valley), agricultural and man-made sub-systems prevail.

In the following sections, a general account of the flora and fauna of the three sub-systems of the project hinterland will be given, followed by a description of the biota collected and observed in the field.

5.7.3 Nile Valley Subsystem

Terrestrial Flora

The Nile valley forms a densely inhabited riverine oasis of farmlands and human settlements of all sizes (EEAA, 1993). These farmlands provide habitat for a variety of weeds and ruderal plants in the fields, canal and drain banks, road and railway embankments, fallow fields, etc. In addition, a large variety of field and economic crops are cultivated under agricultural controls.

Terrestrial Fauna

With most of the land area of Egypt being either arid or hyperarid (Ayyad and Ghabbour, 1986), the availability of water as the most critical resource (Noy-Meir; 1984), plays a decisive role in determining the habitability of the desert. Differences in rainfall as well as landform features which control the redistribution and availability of water from local or remote sources, are therefore of extreme importance in determining the nature, distribution and abundance of plant and animal life. Primary production, which is also greatly influenced by the water availability, determines the basic food and shelter resource on which the structure and functioning of animal communities depend.

Within any given habitat, animal species richness and diversity are mostly determined by the abundance and diversity of available resources, the extent that species use these resources, and the degree that these resources are shared (MacArthur and MacArthur, 1961; Pianka, 1967 and 1973).

An attempt to identify habitat types of land fauna in Egypt must therefore be based, not only on geographical, geomorphological and climatological features of the habitat, but also on the characteristics of its vegetation cover. Accordingly, the desert vegetation categories suggested by Kassas (1970) are used herein, with some modifications, to identify four basic habitat types. Each of these basic habitat types is represented by numerous examples at several geographical areas in Egypt. Every example, however, may be modified to a greater or lesser extend by local features which in turn, give each habitat its unique ecological characteristics. These characteristics are what determine the type of animal habitats that include the following:

- Run-on-habitats
- Diffuse habitats
- Accidental habitats
- Restricted habitats

The proposed project site is located within the "Restricted Habitat" type which are found in rainless country but depend on either groundwater, or water transported from remote sources. Restricted habitats based on water brought to a rainless area by rivers or perennial streams create river oasis with lush perennial vegetation (the project area). These river oases often allow the development of settled agricultural societies. The Nile Valley and Delta may be considered the largest river oasis in the world (Saleh, 1993).

This habitat type often has relatively diverse fauna as a consequence of the diversity of the available resources, as well as that of the vegetation structure. However, with many years of intensive human activities, the modern Nile Delta is essentially a man-made ecosystem. Animals now inhabiting the region are those that are able to tolerate human activities or those that can avoid contact with man. The intensive cultivation and the widespread use of agrochemicals have eliminated many of the native animals of the region.

Amphibians and Reptiles

Four species of amphibians and 34 species of reptiles are known from the Nile Valley and Delta. Characteristic amphibians include Bufo regularis, Ptychadena mascareniensis and Rana ridibunda. Common reptiles include Hemidactylus turcicus, Chalcides ocelltus, Coluber florulentus, Natrix tessellata, psammophis sibilans, Telescopus dhara, and Naja haje. Mabuya quinquetaeniata, Chameleo africanuus, Varanus niloticus, leptotyphlops cairi, Psammophis sibilans, Natrix tessellata, Dasypeltis scarbra, and are restricted to this habitat in Egypt (EEAA, 1995).

Birds

Common breeding birds of the Nile Valley and Delta include 66 species (Goodman et al., 1989). At least 14 of these are not known to breed outside that habitat. Characteristic species include Egretta ibis, Elanus caeruleus, Milvus migrans, Falco tinnunculus, Gallinula chloropus, Hoplopterus spinosus, Rostratula benghalensis, Streptopelia senegalensis, Centropus senegalensis, Tyto alba, Merops orientalis, Galerida cristata, Hirundo rustica, Motacilla flava, Prina gracilis, Corvus corone, Passer domesticus and others (EEAA, 1995; 1997).

The Nile Delta with their abundance of water and food available for birds, provide an important, relatively, easy and safe route for trans-Saharan, paleartic migration. Huge numbers of individuals of many species utilize this route during both spring and autumn migrations. The region also provides wintering habitats for large populations of many palearctic migratory species (Meinertzhagen, 1930; Goodman et al., 1989). However, the migratory routes don't cross over the project area.

Mammals

Forty mammalian species are known to occur in the Nile Valley and Delta (Osborn and Helmy, 1980; Wassif et al., 1984 and Qumsiyed, 1985) at the present time. Among these the most characteristic species are Hemiechinus auritus, Crocidura flavescens, Arvicanthis niloticus, Rattus rattus, R. norvegicus, Mus masculus, Canis aureus, Vulpes vulpes, Herpestes ichneumon and Felis sylvestris. Wild carnivores have suffered a great deal of decline in the recent years as a result of intense urban development and secondary poisoning with pesticides widely used to control Arvicanthis niloticus and other rodent pests (EEAA, 1995; 1993).

5.7.4 Eastern Desert Sub-system (Northern Limestone Plateau)

Flora

Plant life in this area subject of many studies: Schweinfurth (1901), Stocker (1926-27), Montasir (1938), Kassas and Girgis (1970,1972), Batanouny (1963) etc. These studies explain the close relations between landform and plant life. In this extremely arid territory (average annual rainfall in the Cairo area = 25 mm.; further south rainfall is much less). Landform controls the re-distribution of water. Plant growth maps area that receive runoff water, vigor and physiognomy relate to amount of available water; revenue depends on catchment area and storage depends on depth of surface deposits.

Successional development of wadi vagetation (Kassas and Girgis, 1965) seems to follow a six-stage sequence: barren rock surface (chasmophytes, *Stachys aegyptiaca*), shallow coarse deposits (succulents, *Zygophyllum* spp.) deeper mixed deposits (woody undershrubs, *Zilla spinosa)*, silt terraces (grassland growth, *Pennisetum dichotomum*), deeper terraces (scrub, *Lycium arabicum*), climax (*Tamarix* sp. on soft deposits; *Acacia* sp. on coarse deposits).
The boundary between the irrigated farmlands and the barren desert is often abrupt, except for sites menaced by the encroachment of blown sand.

- Inland Dunes: Plant life dominated by *Urgina maritima, Thymelaea hirsuta*, etc.

- Inland Ridges: Tadros and Atta (1958), Ayyad and Ammar (1973, 1974), Kamal (1982), Shaltout (1983), Kamal (1988) recognized the following habitat sub-divisions.
- Summits of ridges (rocky sites) with chasmophytes and lithophytes including
- *Thymus capitatus, Globularia arbica, Helianthemum lippii*, etc.
- Intermediate slopes with *Gymnocarpos decandrum, Reaumeria vermiculata*, etc.
- Lower slopes with *Plantago albicans, Asphodelus microcarpus. Salvia lanigera*, etc.

Fauna

This desert extends from the Red Sea mountains in the east to the Nile Valley in the west. The main groups of animals in this sub-system include:

- Reptiles: In wadis draining the limestone plateau in the northern sector of this desert, common reptiles include *Ptyodactylus guttatus, Acanthodactylus boskianus, Uromastyx aegyptius, and Cerastes cerastes.*
- Birds: Resident avifauna of this desert is composed of 15 species of true desert birds, such as *Cursorius cursor, Pterocles coronattus, Ammomanes cincturus, Corvus ruficollis and Emberiza striolata.*
- Mammals: *Lepus capensis, Gerbillus gerbillus and Dipodillus dasyurus.*

5.7.5 Western Desert Sub-system (The Middle Limestone Plateau)

Flora

This part of the Western Desert is extremely arid, practically rainless and perennial plant life is confined to, and associated with, the oases where water may flow to the surface under artesian pressure. Pools may be formed around some wells.

Outside the oases plant life, mostly ephemeral, depends on the chance occasion of cloud-bursts, incidents that may happen once in several years: accidental type of vegetation (Kassas, 1966).

Fauna

Reptiles: Information on the reptiles and amphibians of the western desert is almost non existent (EEAA, 1993). However, a few species of reptiles are regular dwellers of dry sabkhas such as *Acanthodactylus scutellatus* and *Varanus griseus.*

Birds: Birds are in greater numbers in the oases and depressions of the western desert. The main species include Phoenicopterus ruber, *Aquila rapax belisarius, Locustella naevia naevia* and *Oenanthe lugens.*
Mammals: twelve mammalian species have been recorded from this habitat type in Egypt, with the two *dipodils Dipodillus henleyi and D. amoenus* being the most characteristic

species. None of these species, however, is restricted to this habitat type. The Nile *Rat Arvicanthis niloticus* and the Jungle *Cat Felis chaus*, which are characteristic mammals of riverine habitats, are found in some of the salt marshes of the Western Desert.

5.7.6 Nature Conservation

No protected areas are found in the vicinity of the proposed development. The only natural protectorate in Giza as a whole is "El Hassanah Dome" along the Cairo-Alexandria desert road. It is protected for its unique geological structures but no ecological significance. In addition, no proposals of developing protected areas anywhere near the plant site.

5.7.7 Ecology of the project site

The site is located within an edge environ where 3 habitats overlap abruptly. These 3 habitats are the Nile, agricultural lands and the eastern desert. The site boundaries are: agricultural lands to the south, desert to the north and east, Helwan-Beni-sueif road to the west and the Nile to the west across the Helwan-Beni-sueif road (*Figure 5-43*).

The site is located within an area of mining and crushing of chalky limestone, characteristic of the geology/geomorpholoy of the area (*Figure 5-44*). Several of such activities are scattered around the site, a few are also considered near. To the western direction of the plant site located is a residential community. Further south-west is a new orchard field where a major flood catchment basin is running to its south (*Figure 5-45*).

To its far west, within the Nile, is a small sandy island where thin vegetation grows along its boundaries (*Figure 5-46*). The same figure also depicts the boom that is installed at the southern end of the existing plant close to the cooling water intake. The boom acts as a dissipater of the floating vegetation (*Eichhornia crassipes*) so they do not block the screens of the intake (*Figure 5-46*).

Flora

Apart from the man-made agriculture (palm trees, orchards, vegetable, etc.), no natural vegetation was detected except in the wadi (drainage basins) of flash floods. There are two main wadis one is running to the north and one is running to the south of the plant site. The southern wadi (*Figure 5-45*) has green vegetation mainly reed plants (*Typha* sp.). The wadi to the north west is bare dry and all vegetation is dead (*Figure 5-47*). Rodents' burrows were found in many locations around the western area with associated arthropod species.

The power plant site itself is a totally within the desert lands. It is suggested that it fully planted with ornamental plants for landscaping purposes including for example: *Mangifera indica, Ficus nitidia* and *Delonix regia as it is already existed in the present Kuraymat thermal power plant* (*Figure 5-48*).

Fauna

Animal species diversity in a given habitat is also directly related to the structural diversity of that habitat (Lack, 1944; MacArthur, 1958; MacArthur and MacArthur, 1961, Pianka, 1967 and 1986). Spatially complex habitats support richer biotic communities than structurally simpler areas. The more spatial heterogeneity there is, the more micro-habitats and the more potential resources-use niches into which species can differentiate and specialize and consequently more species can coexist (Pianka, 1986). As the plant cover can greatly affect the structural diversity of an area, animal species richness and diversity have been found to correlate with the structural and life form diversity of the vegetation. As wider surroundings of the project site are characterized as a man-made patch, its vegetation cover is considerably limited. In fact, this is reflected on its low biodiversity and faunal species richness.

The wider site surroundings contain different arthropods; mainly insect species; and birds. Insects include butterflies, grasshoppers, dragonflies, ants and aquatic insects. The avifauna includes sparrows (*Passer domesticus*), doves (*Streptopelia senegalensis aegyptiaca*), *Egretta sp.* and spur-winged plover (*Haplopterus spinosus*). Very few numbers of birds were observed, and no nesting or breeding was detected. In addition, very few numbers of rodent burrows were identified.

The highest number of species were those of the freshwater snails collected from the Nile edge at the water intake point of the existing Kuraymat power plant as well as the arthropod species collected from the area as a whole. *Table 5*-28 provides useful information on Arthropod species.

Table 5-28

Arthropod Species of the Project Site

No.	Species	Family	Order	Economic importance	status
1	*Artogia rapae*	Pieridae	Lepidoptera	Larvae feed on cabbage and related plants so it is a serious pest of cabbage	Harmful
2	*Thermobia* sp.	Lepismatidae	Thysanura	Feed on plants and animal matters including algae, fungi. Indoor species are considered as pest of books	Some species are beneficial while others are harmful
3	*Crocothemis erythraea*	Libellulidae	Odonata	Adults and naiads are predators, feed on mosquitoes and midges.	Beneficial insects
4	*Plathemis* sp.	Libellulidae	Odonata	Adults and naiads are predators, feed on mosquitoes and midges.	Beneficial insects

Table 5-28 (Contd.)

Arthropod Species of the Project Site

No.	Species	Family	Order	Economic importance	status
5	*Bruchythemis leucosticta*	Libellulidae	Odonata	Adults and naiads are predators, feed on mosquitoes, midges.	Beneficial insects
6	*Hemianax* sp.	Aeschnidae	Odonata	Adults and naiads are predators, feed on mosquitoes and midges.	Beneficial insects
6	*Euborellia annulipes*	Labiduridae	Dermaptera	Some species feed on plant roots while others feed on other insects	Harmful and beneficial according to feeding habits
8	*Cataglyphis lividus*	Formicidae	Hymenoptera	Feed on dead insects	Beneficial
9	*Cataglyphis niger*	Formicidae	Hymenoptera	Feed on dead insects	Beneficial
10	*Monomorium* sp.	Formicidae	Hymenoptera	Feed on dead insects	Beneficial
11	*Paratrechina* sp.	Formicidae	Hymenoptera	Feed on honey dew secreted by mealy bugs which they attend	In direct plant pest by protecting a serious plant pest as mealy bugs
12	*Pheidole* sp.	Formicidae	Hymenoptera	Feed on dead insects	Beneficial
13	Odynerus chlorosticus	Eumenidae	Hymenoptera	Parasite on caterpillar	Beneficial
14	*Sigara* sp.	Corixidae	Heteroptera	They feed on algae and other minute aquatic organisms	Beneficial
15	*Entomobrya* sp.	Entoomobryiidae	Collembola	They feed on organic matters present in the soil and have an important role in the decomposition of dead plants	Useful
16	*Empoasca* sp.	Cicadellidae	Homoptera	Pest on several types of plants. They feed principally on leaves resulting excessive reduction of plant sap	Harmful

Figure 5- 44

Mining Activities Near to the Project Site

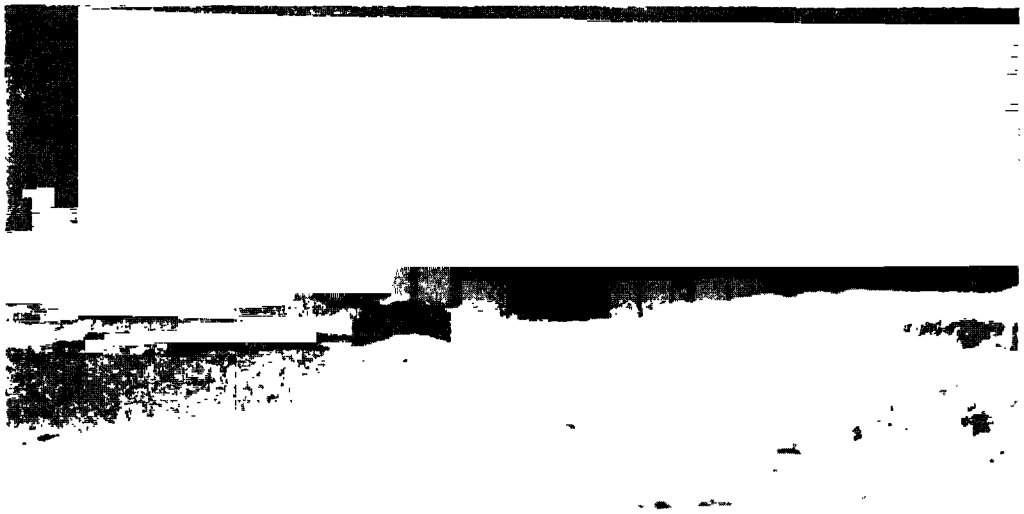


Figure 5-45

Wadi Channel to the South-west of the Project Site

Figure 5-46

Sandy Island within the Nile to the West of the Project Site

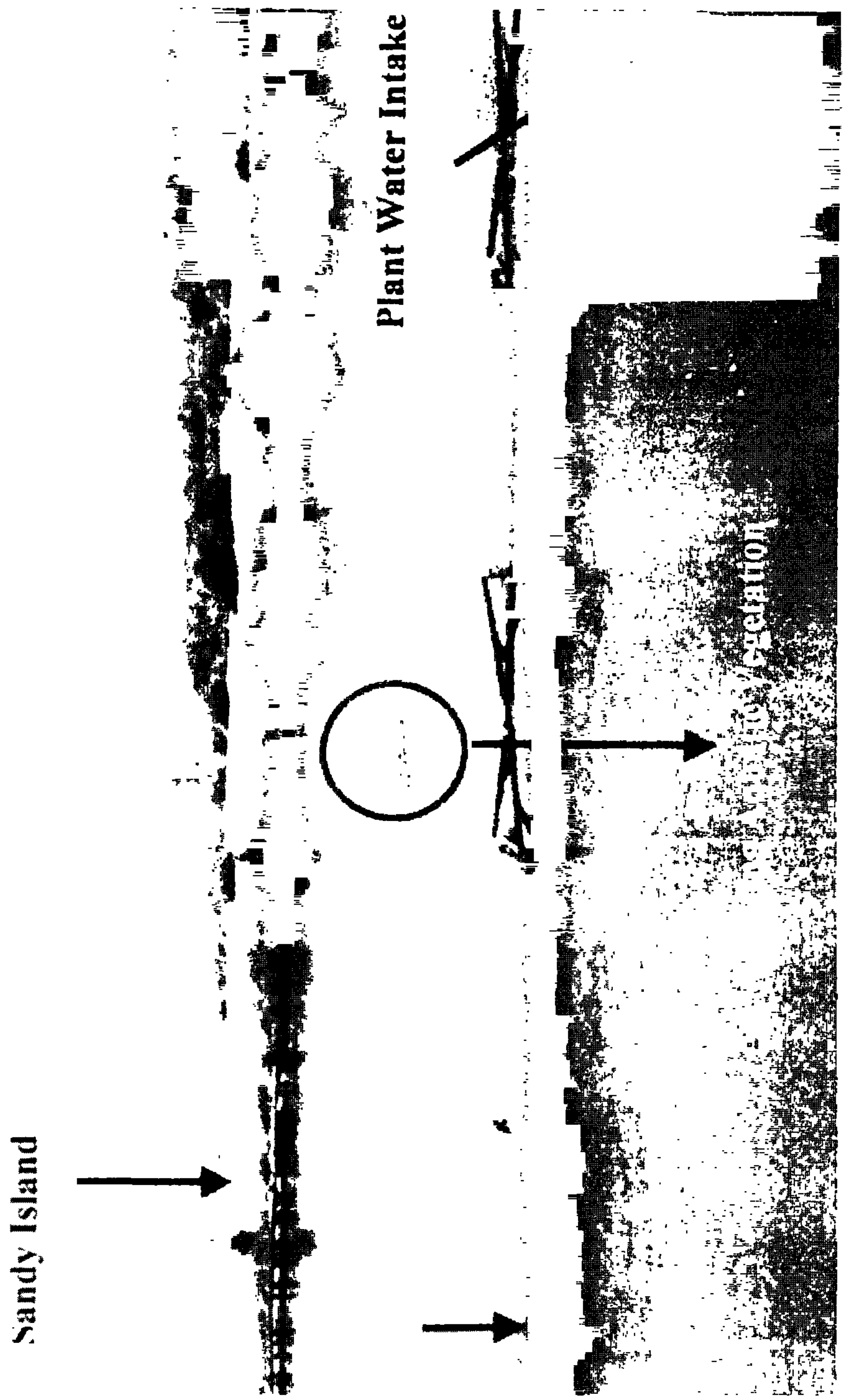


Figure 5-47

Wadi with Thin Vegetation Cover to the North West of the Project Site

Figure 5-48

Example of Landscape Plantation on Site as Depicted in the Present Kuraymat Thermal Power Plant

5.8 AMBIENT NOISE

5.8.1 Noise Sensitive Receivers

The major land use surrounding the site is agricultural (to the south) and residential (to the west), supplemented by the noise that may be generated from traffic on the Es-Saff/Beni-sueif road to the very west.

Residential properties have been identified by the existing power plant community against the western side of the proposed site boundaries and there are no other population centers within one km of the proposed site.

Due to the existing operational power plant and scattered quarries in the wider area around the site, and irrespective of the rural/desert nature of the proposed site itself, the area is categorized as "Industrial areas" with respect to Egyptian ambient noise standards (see *Table 2-5* in Section 2.6.4).

5.8.2 Ambient Noise Levels

In view of the presence of residential community in the western part against west boundary of the proposed site and the presence of adjacent rural setting a noise survey was carried out on the site of the proposed plant by MB Consultant in June 2004. The main existing noise sources on, and surrounding the site, were found to comprise the following:

- Existing operational Kuraymat two 2x600 MWe capacity power plant units;
- vehicular traffic on the Es-Saff/Beni-sueif road; and
- prevailing wind.

Baseline measurements were taken using a calibrated Brüel and Kjaer Type 2260 precision sound analyser, in a "free-field" location (see *Figure 5-49*) away from any reflective surfaces and 1.2m above the ground. The average ambient level recorded at the power plant site in the absence of moving vehicles on the Es-Saff/Beni-sueif road was L_{Aeq} 43.9 dB. *Table 5-29* and *Figure 5-50* present the results giving the sound levels for each third-octave band.

Figure 5-49

Location of Baseline Noise Measurements

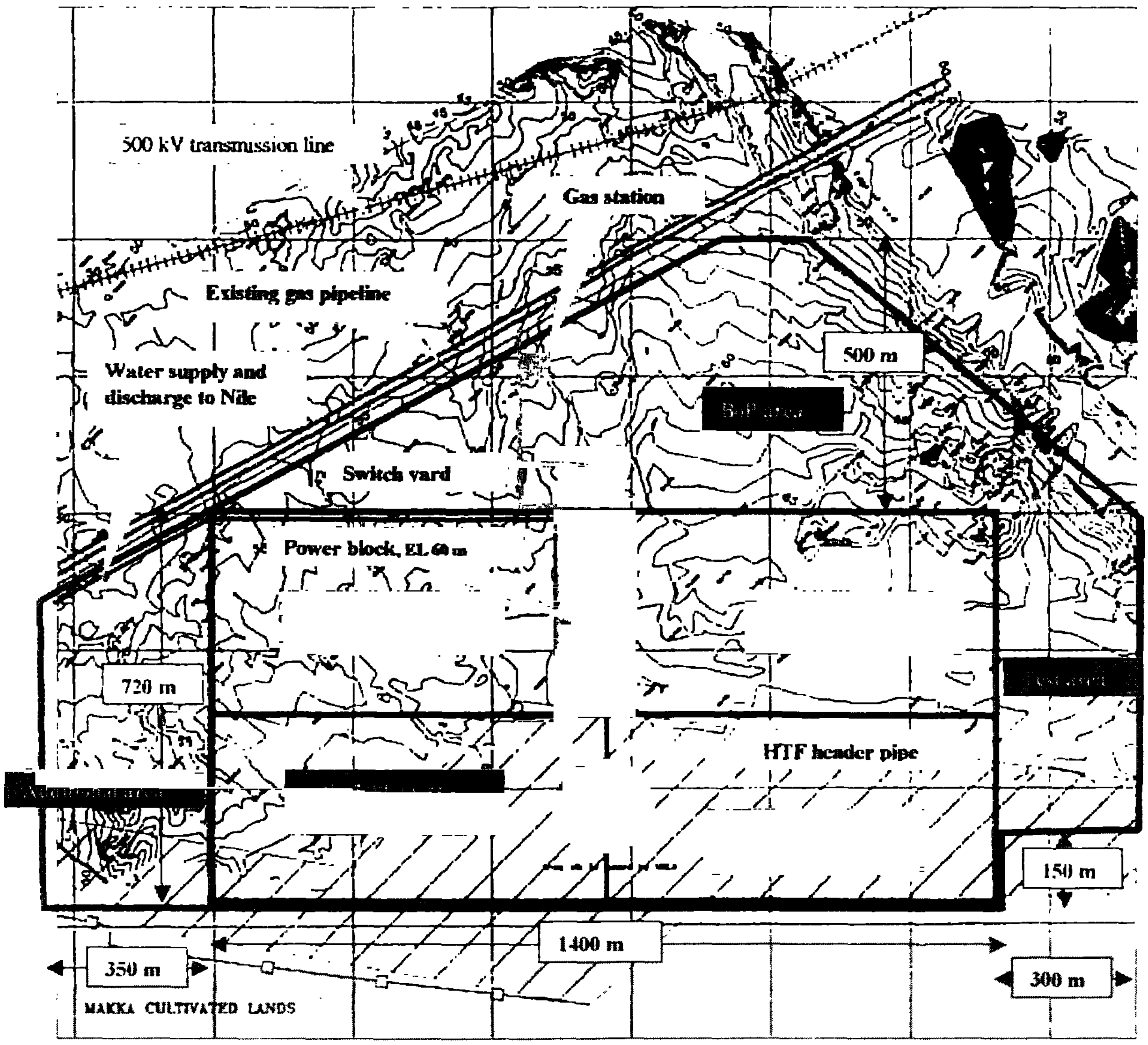


Table 5-29

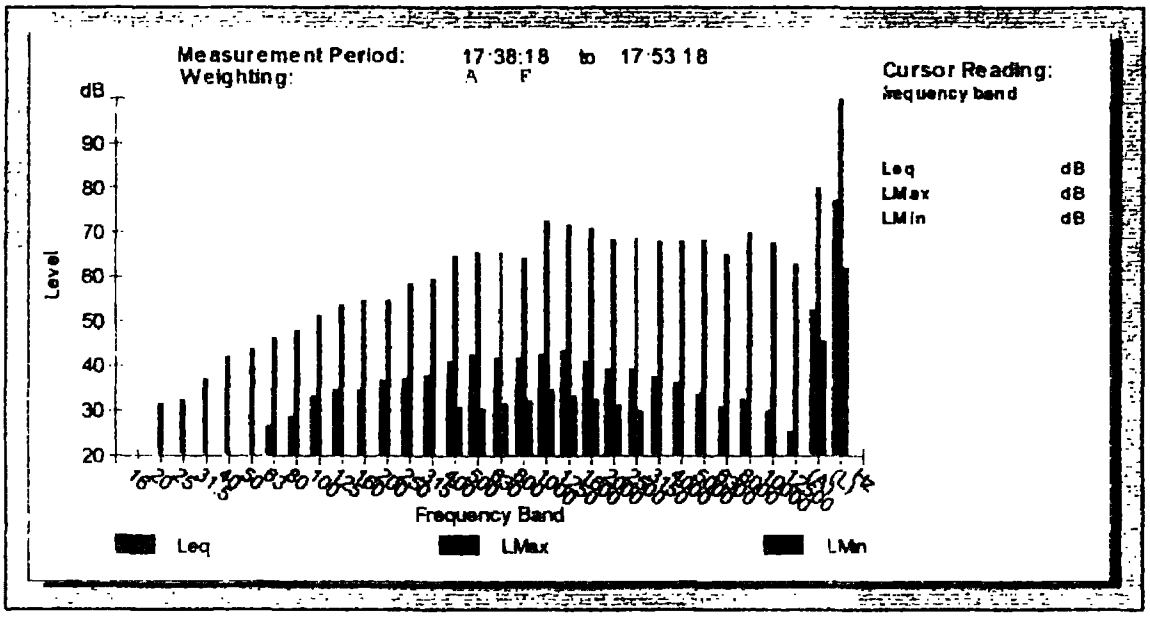
Values of Sound Levels at the Site

Band	Leq	LMax	LMin	Band	Leq	LMax	LMin
16 Hz		-	-	500 Hz	42.2	65.1	30.4
20 Hz		31.7	-	630 Hz	41.4	65.3	31.6
25 Hz		32.4	-	800 Hz	41.4	64.0	31.9
31.5 Hz		36.9	-	1000 Hz	42.2	72.2	34.3
40 Hz		41.8	-	1250 Hz	43.1	71.7	33.1
50 Hz	17.4	43.7	-	1600 Hz	40.6	70.5	32.2
63 Hz	26.5	46.3	-	2000 Hz	39.1	68.0	31.2
80 Hz	28.4	47.6	-	2500 Hz	38.9	68.8	29.9
100 Hz	33.3	50.9	-	3150 Hz	37.5	67.8	-
125 Hz	34.5	53.4	-	4000 Hz	36.1	67.9	-
160 Hz	34.6	54.6	-	5000 Hz	33.4	68.0	-
200 Hz	36.4	54.2	-	6300 Hz	30.7	64.8	-
250 Hz	36.7	58.2	-	8000 Hz	32.2	69.3	-
315 Hz	37.9	59.6	-	10000 Hz	29.7	67.2	-
400 Hz	40.6	64.4	30.6	12500 Hz	25.2	62.9	-

Figure 5-50

Spectrum Graph of Values of Sound Levels for Each Third-Octave Band

(Measurements Undertaken at the Site on 15 June 2004)



5.9 LAND USE AND LANDSCAPE CHARACTER

5.9.1 The Proposed Site

Field surveys. conducted by NREA during July, September & December 2003 and verified by E&E in January and March 2004, were undertaken to examine the site location and its surrounding area.

The survey showed that there are no significant terrestrial ecosystems on or near the proposed site. The ecosystems present are typical of those throughout the rural and desert lands of Egypt. Moreover, the site currently houses an uncultivated bare area, mostly sand dominated with spatially heterogeneous vegetation cover. This site is situatated in a irregular-shaped fenced piece of land (Annex D provides with the land acquisition documents).

Figure 5-43 shows satellite image, with a high spatial resolution 28x28m, of the project hinterland illustrating the surrounding rural and desert landscape. It delineates the boundaries of the project site, its relation to adjacent landscape and some details of the field survey.

5.9.2 Overview of the Surrounding Land Use

The site is situated in a generally rustic, low-density rural/desert setting within the Kuraymat wide-area (Please refer to *Figures 5-4 through 5-11 and Figures 5-13 , 5-45 & 5-47* for the photos of the site). Land uses in the immediate vicinity of the site is limited to agriculture in the south and in the wider area agriculture is limited to the floodplain between the marsh area and the plateau, and in wadi confluences. There is a cemetery and a small village to the south-west, and another small village to the north-west.

The cultivated areas around the power plant are utilized by farming families. None of the families live on the land, but commute or walk to their small plots from nearby villages.

Typical agriculture crops grown in this area of the valley include wheat, corn, oranges, grapes, tomatoes, and other fruits and vegetables preferred by the individual farming families. Normally, two crops per year produced on a rotational basis. Irrigation water is provided by canals from central pumping station at Kuraymat village downstream. Water is taken out of the canal with hand pumps, sluices, or small portable gas-operated pumps. Water is also pumped directly from the Nile. No potable water supply is located in the immediate area.

Markets for crops are located in Es-Saff, Beni-sueif, Cairo, and local villages. Crops are transported to the markets by truck or bus.

Because of the sparseness of forage, livestock grazing in the plateau area above the Nile is extremely limited. Grazing in this area usually occurs only during or following a wet period.

The village south-west about 5.5 kilometer and nearest, from this side, to the power plant site, Dayr al-Maymun, has a population of about 3,000. About 3.0 km north of Dayr al-Maymun is

Ezbet EL-Hagg Ghanem, with its population less than 200. The principal occupation is construction labor subsidized with farming. Agricultural lands owned by al-Maymun villagers are far south-west of the site. The cemetery next to the village actually is for the city of El-Wasta on the west bank of the Nile. Several thousand graves were estimated to occur within the cemetery boundaries. The north boundary of the cemetery is approximately 2.5 kilometers from the site boundary. The plant facilities nearest the southern boundary of the site are located about 0.75 kilometers to the north-east, providing additional distance to the cemetery.

In the Nile upstream of the power plant site is Kuraymat Island, which has a population of about 2,500 people. Their chief occupation is farming. Access to the island is by boat only. Kuraymat village is 3 km north-west of the site and serves as the closest commercial and government center for the proposed project area. Kuraymat village has almost 7,000 residents (see Table 5-40) and a visit to the village was conducted during March 2004 site visits.

Figures 5-2(A) shows a detailed map for land uses of the proposed site surrounding area.

5.9.3 Landscape Character

The landscape character of the site and its surrounding area is determined and characterized by:

- the near to bankal location and the influence of the Nile river;
- the flat terrain and rural character of the Kuraymat zone;
- the partially vegetated, partially desert surroundings; and
- existance of residential urban-style plant community and residential rural-style spots and road linkages.

The hybrid character of the green cultivation and desert land of the region is the main influence on the area. However, despite the scale of the rustic development, this would ensure that the landscape is visually able to accommodate those intrusive features without significant impact. Given the solar field with its reflector-mirrors, the landscape may gain a quite nice shape.

5.10 TRAFFIC AND TRANSPORT

5.10.1 Introduction

Road transport provides the main mode of transport in the Kuraymat zone. The proposed power plant site will be accessed via the Es-Saff Beni-sueif road from the north and GizaBeni-sueif which crosses the Nile to the east bank and then follow Beni-sueif desert road to the north. These two roads connect the proposed power plant site to the major road network as shown in *Figure 5-51*.

Information on traffic conditions and flows have been obtained from primary assessment work conducted by the "Egypt National Institute of Transport" (ENIT), Ministry of Transport, during September 2003, and from observations made during site visit in early January 2004.

5.10.2 Main Access Roads

Road Network

The road network surrounding the power plant is confined to two access roads.

The shortest path to access ISCC Kuraymat power plant from Cairo is by traveling along AlCorniche Corridor till Et-Tebbin, then joining Es-Saff desert road till the intersection of EsSaff/Beni-sueif road and El-Zafarana road. The main entrance of the power plant is about 2km away from the Beni-sueif road.

There is another path which is around 60 km longer than the previous one. This path starts from Giza to El-Badrashein, then to El-Ayyat, El-Wasta and finally Beni-sueif via Upper Egypt agriculture road along the west bank of the Nile River. From Beni-sueif, it crosses the Nile to the east bank and then follows Beni-sueif desert road 30 km to the north till the main entrance of the power plant. This path could be used as an alternative path only when Benisueif road is blocked for traffic, as it sometimes happens when there is an accident. However, this bath could be shortened by 60km if a new bridge over the Nile river were constructed at the Kuraymat.

Recently additional stander access desert roads are available from Cairo, Helwan, and Tebbin direction to Beni-sueif crossing Zafarana- Kuraymat road.

The access paths to the power plant site are illustrated in *Figure 5-51.*

The ISCC Kuraymat power plant has its unique location concerning the road network since it lies nearby Giza Beni-sueif regional road, and there is no other regional or local roads passing nearby. Therefore, it was necessary to examine the geometric characteristics as well as the available traffic data for this road as part of the traffic assessment analysis. Moreover, a classified traffic count survey was conducted at a section of this road and the results are presented in the next section.

The roadway section of Giza/Beni-sueif regional road is a 2-lane 2-way single carriageway with a total width of 11 m (including 2 m unpaved shoulder on each side). Its pavement is generally in a good condition. The road serves both regional passenger and freight traffic to/from Upper Egypt. Furthermore, sections of this road passing through the nearby villages are heavily used by local traffic. The pavement conditions along these sections are terribly deteriorated and road humps are recurrent and very close to each other. They are intentionally constructed by local authorities as a measure to reduce speed along the sections passing through the nearby villages. The lane capacity for this regional road is in the range of 1000-1200 vehicle/hour.

As for traffic data on this road (for the section near El-Ayyat, around 40km from the ISCC Kuraymat power plant), a time series on Average Annual Daily Traffic (AADT) records for the period 1992 - 2002, was obtained from the General Authority for Roads, Bridges and Land Transport (GARBLT). Also, monthly traffic variations for the year 2002 as well as hourly traffic variations during the seven weekdays of September 2002 were obtained from the same source.

AADT data is presented graphically in *Figure 5-52,* while the source data is given in *Table 5-30* below.

Table 5-30

Average Annual Daily Traffic on Giza/Beni-sueif Desert Road During the Period 1992-2002

Year	AADT (Vehicles/day)	Year	AADT (Vehicles/day)
1992	8421	1998	10318
1993	8030	1999	10326
1994	8761	2000	10349
1995	9309	2001	12192
1996	10366	2002	13042
1997	9146	2003	13629[(1)]

Notes:
(1) An estimated value based on an average annual growth rate of 4.5%.

Source: General Authority for Roads, Bridges and Land Transport (GARBLT)

Traffic growth on Giza/Beni-sueif regional road during the period 1992 - 2002 was in the range of 0-18% per annum, with an overall average annual value of 4.5%. As depicted in *Figure 5-52,* the AADT also had a sudden drop in 1997. On the contrary, the AADT during the period 1998-2000 was almost the same, then it increased by 18% and 7% during the two successive years respectively.

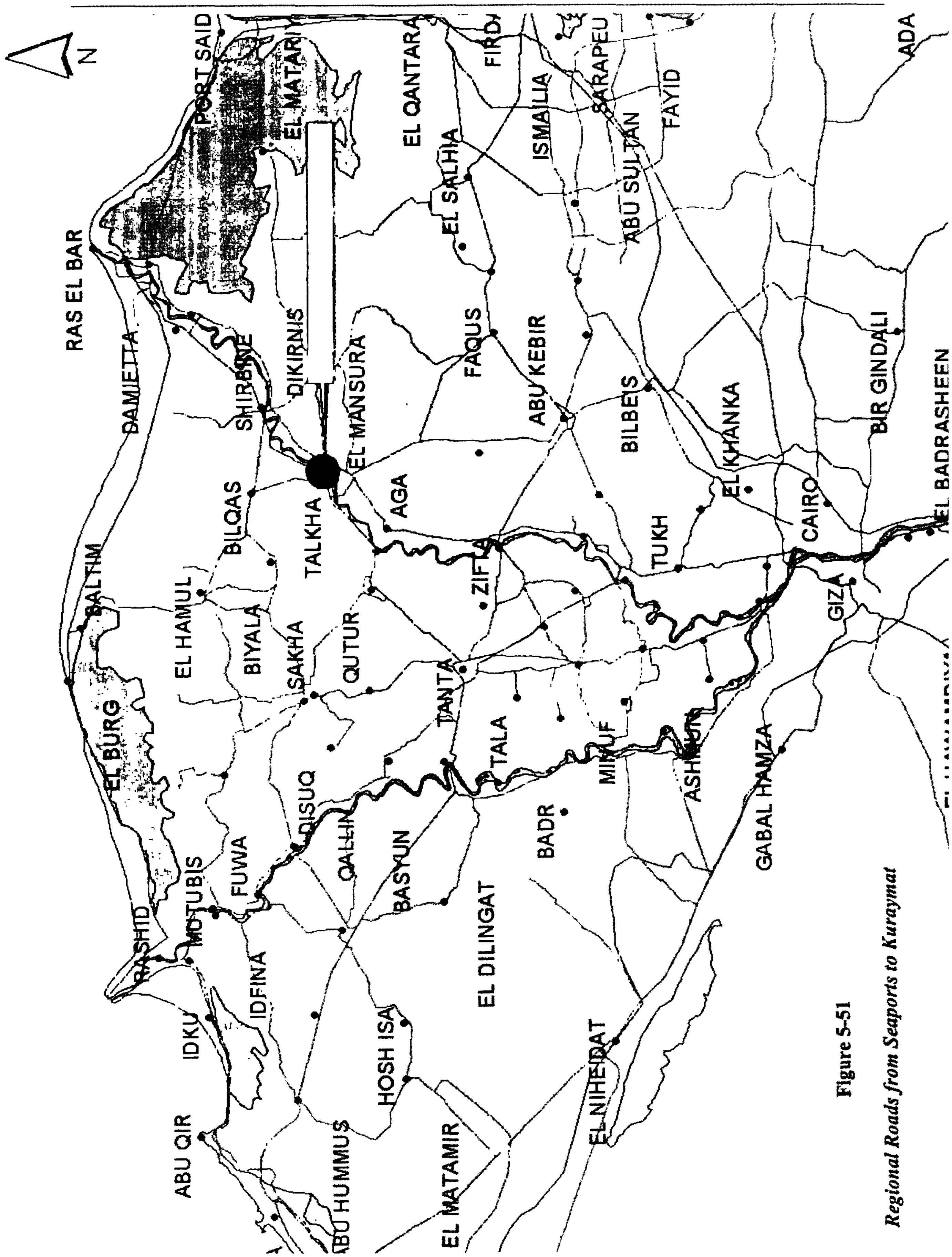


Figure 5-51

Regional Roads from Seaports to Kuraymat

Figure 5-52

Average Annual Daily Traffic on Giza/Beni-sueif Desert Road

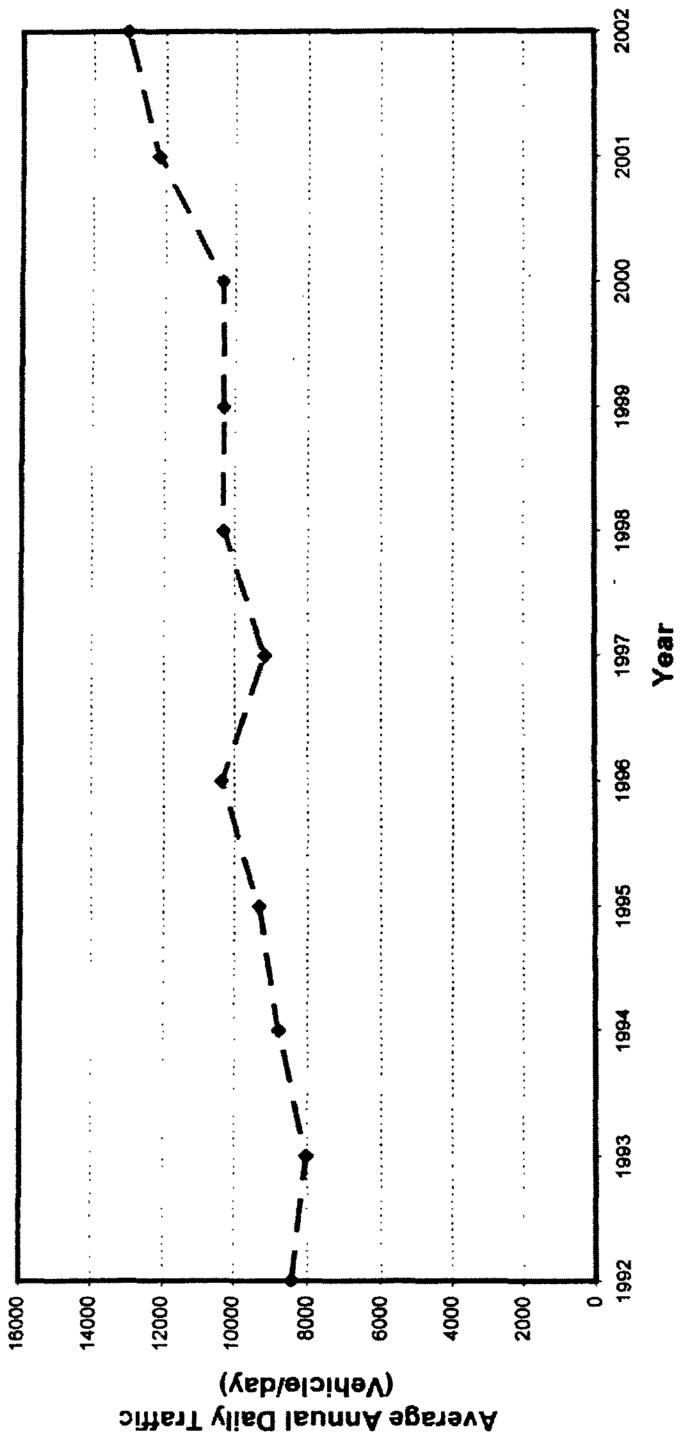


Figure 5-53 represents the average daily traffic for each month of the year 2002 on Giza/Beni-sueif road during 2002. The Figure shows that except for January and April, the average daily traffic volume for the rest months of the year is 13,000 vehicles/day or more. The month of September records the highest average daily traffic volume over the whole year i.e. 13,756 vehicles/day). This is followed by July and August with an average daily traffic volume of 13,688 and 13,566 vehicles/day respectively. This result indicates that the average daily traffic volume on Giza/Beni-sueif road increases slightly during summer months. Moreover, the average daily traffic volume during February, March and May approximately represents the Average Annual Daily Traffic (AADT) for the year 2002.

Hourly traffic variations during the weekdays of September 2002 (which represents the highest month during 2002) are presented graphically in *Figure5-54*.

Figure 5-54 shows that the hourly traffic volumes during the seven days of the week on Giza/ Beni-sueif road almost follow the same pattern with two obvious peaks: morning peak and evening peak. On the one hand, the morning peak traffic volume is the highest on Saturday and the lowest on Friday compared with other weekdays. On the other hand, the evening peak traffic volume on Thursday is the highest among the weekdays. Also the evening hourly traffic volumes (after 7:00pm) on Friday are slightly higher than similar traffic volumes during the same period for other weekdays except for Thursday.

The main conclusion that emerges from the daily traffic pattern along Giza/Beni-sueif road is that traffic volume obviously increases on Thursday evening because people from different places along this road return home to spend the week end with their families and relatives. and on Friday evening and Saturday morning for returning back to their work.

Figure 5-53

Average Daily Traffic for Each Month of the Year 2002 on Giza/Beni-sueif Desert Road

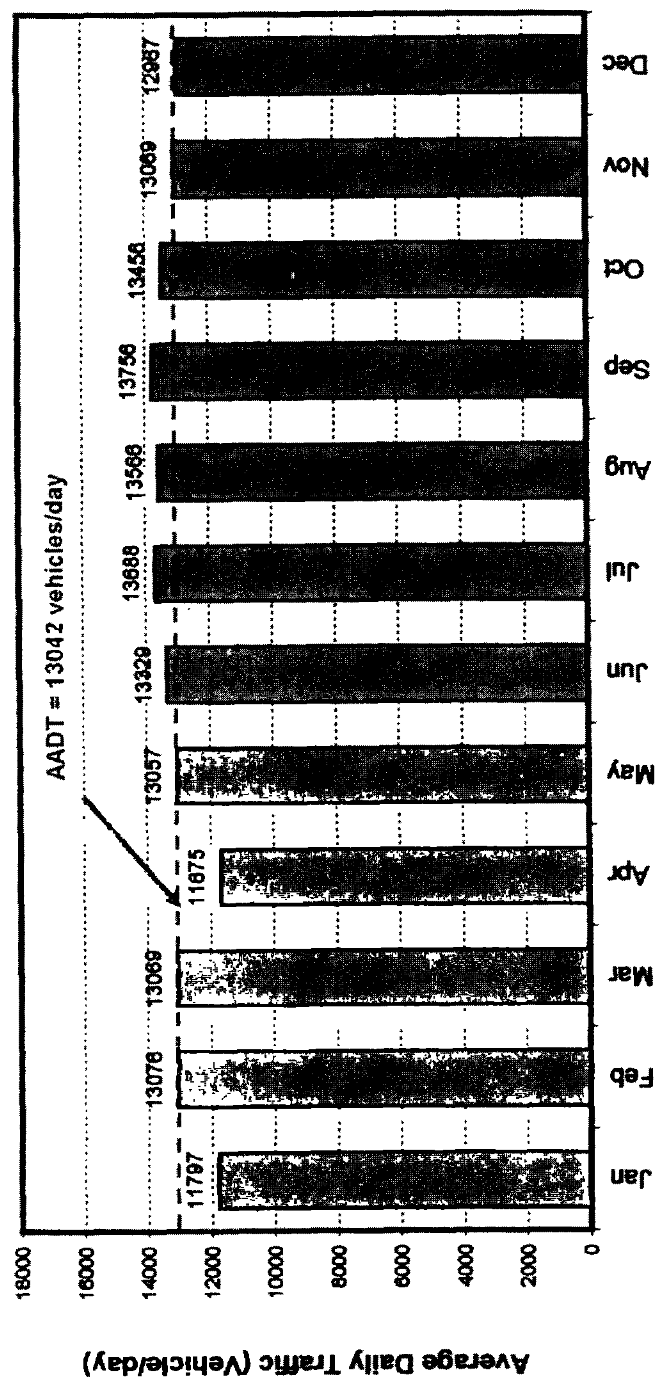
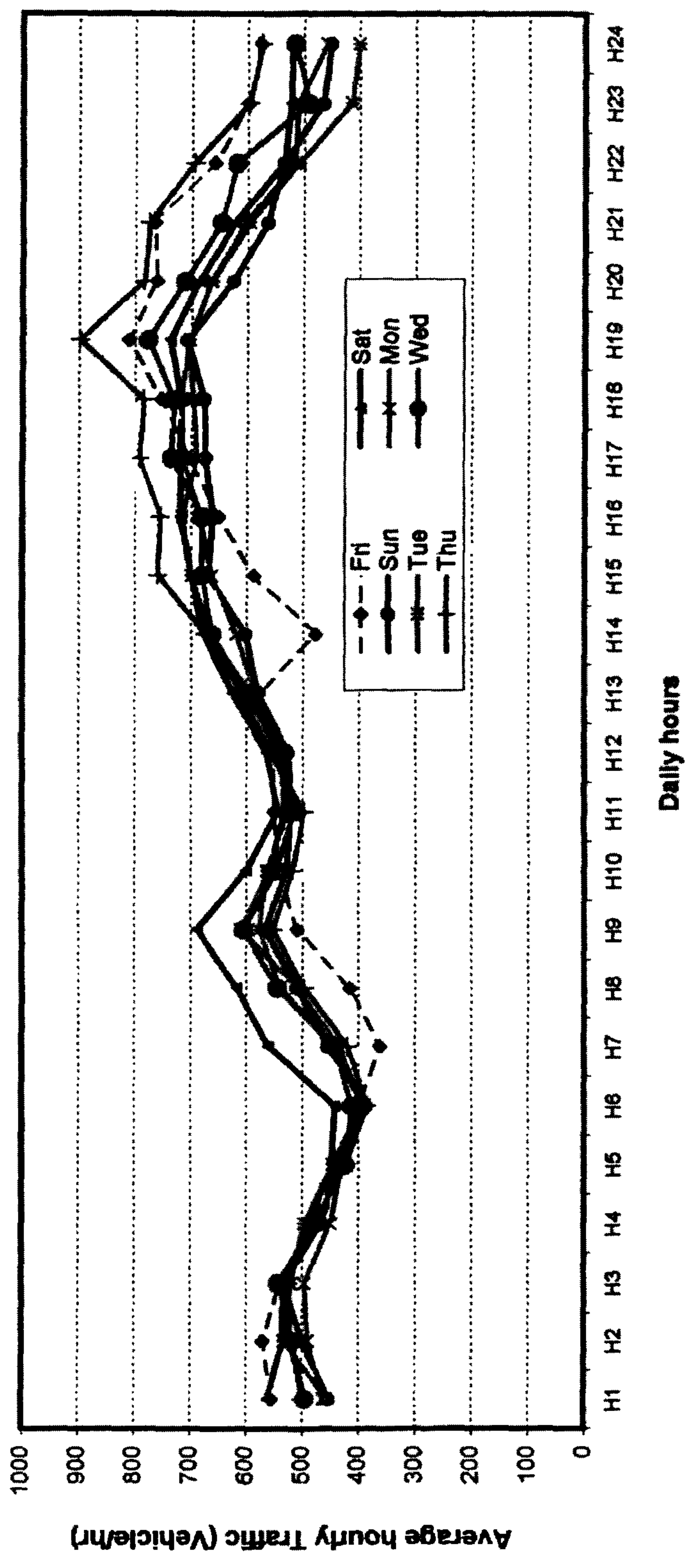


Figure 5-54

Average Hourly Traffic During the Weekdays on Giza/Beni-sueif Desert Road, September 2002



Public Transport Service

The only public transport mode serving people living and working in this area and the nearby farms and villages is pick up vehicles, which provides a poor and inconvenient service with a high occupancy rate. The occupancy rate is almost double the vehicle capacity since some passengers hang on the back of the vehicle, while some others ride on the top of the vehicle with half price).

5.10.3 Regional Roads

The ISCC Kuraymat power plant will be supplied by a number of heavy equipment imported from a number of seaport during construction (e.g. Alexandria and Ain-Sukhna Ports). Therefore, it was necessary to examine the power plant as part of the traffic assessment analysis. This analysis is composed of two elements: description of the physical roads geometric, and traffic data analysis.

The only regional road providing access to the new power plant from the different parts of the country is Giza/Beni-sueif Desert Highway. Therefore, access from ports to the power plant will make use of other regional roads linked to Greater Cairo Region then to Giza/Beni-sueif Highway. These roads include Cairo/Alexandria Agriculture Highway, Cairo/Alexandria Desert Highway, and Cairo/Suez Desert Highway. The location of these roads is shown in *Figures 5-51* and 5-57, and their geometric characteristics are described in *Table 5-31*.

As for traffic data on these roads, a time series on average annual daily traffic (AADT) records on Cairo/Alexandria Highways (during the period 1990 - 2003) were obtained from the General Authority for Roads, Bridges and Land Transport (GARBLT). These data are given in *Table 5-32.* The table clearly illustrates that Cairo/Alexandria Agriculture Highway carries much higher traffic volumes than Cairo/Alexandria Desert Highway (around fourfolds on average during this period). *Ta*ble *5-33* illustrates, also, the average annual daily traffic records on Cairo/Suez, Cairo/Ismailia and Giza/Beni-sueif Desert Highways during the period 1997 - 2002).

Traffic growth on Giza / Beni-sueif Desert Highway during the period 1992 - 2002 is in the range of 0-18% per annum, with an overall average annual value of 4.5%. As depicted in the table, AADT also had a sudden drop in 1997. On the contrary, AADT during the period 1998-2000 was almost the same, then it increased by 18% and 7% during the two successive years respectively.

Table 5-31

Geometric Characteristics of Main Regional Roads

Road Name	Geometric Description
Cairo/Alexandria Agricultur Highway	Dual 3-lane carriageway highway (in most of its length) with a paved shoulder linking Cairo to Alexandria Seaport. The road is heavily used by passenger and freight transport. It serves local and regional traffic as it passes through cities in the Delta area. The average lane capacity is in the range of 1200-1400 vehicle/hour.
Cairo/Alexandria Desert Highway	Dual 3-lane carriageway highway with a paved shoulder linking Cairo to Alexandria Seaport. Widening of the Highway to 4 lanes in each direction is undergoing to cater for the increase in traffic flow. The road is a toll road and becoming heavily used by passenger and freight transport given the urban expansion along its route. The road is generally in a very good condition. The average lane capacity is given as 1500 vehicle/hour.
Cairo / Ismailia Desert Highway	Toll road and is a dual 2-lane carriageway highway with a paved shoulder linking Cairo to Port Said and Damietta Seaports. The section from Cairo to 10th of Ramadan City has been widened recently to 3 lanes in each direction to cater for the increase in traffic flow to/from the City. The road is generally in a very good condition. The average lane capacity is given as 1800 vehicle/hour.
Cairo / Suez Desert Highway	Dual 2-lane carriageway highway with a paved shoulder linking Cairo to Suez and Ain Sukhna Seaports. The road is generally in a very good condition. The average lane capacity is given as 1800 vehicle/hour.
Cairo / Beni-sueif Desert Highway	Single two-lane two-way Highway with a paved shoulder. It is located on the eastern side of the Nile river. The pavement condition along stretches of the Highway requires heavy maintenance work due to the presence of high percentage of trucks. The average lane capacity ranges from 1000 to 1200 vehicle/hour.

Table 5-32

Average Annual Daily Traffic on Cairo/Alexandria Highway During the Period 1990-1996, Vehicles/day

Year	Cairo/Alex Desert Highway	Cairo/Alex Agriculture Highway	Year	Cairo/Alex Desert Highway	Cairo/Alex Agriculture Highway
1990	9332	39661	**1996**	11647	51658
1991	8821	38919	**1997**	13581	51812
1992	8735	37388	**1998**	16119	51831
1993	9092	37738	**1999**	17886	55163
1994	8296	37988	**2000**	23736	80358
1995	9670	42026	**2001**	24588	88688
1996	10171	48912	**2003**	25237	92010

Source: Information Center, Roads, Bridges and Land Transport Authority.

Table 5-33

Average Annual Daily Traffic on Cairo/Suez, Cairo/Ismailia and Giza/Beni-sueif Desert Highways During the Period 1997-2002, Vehicles/day

Year	Cairo/Suez Desert Highway	Cairo/Ismailia Desert Highway	Giza / Beni-sueif Desert Highway
1997	7567	21916	9146
1998	8718	26872	10318
1999	10043	28791	10326
2000	10962	30290	10349
2001	12170	35027	12192
2002	13216	38135	13042

Source: Information Center, Roads, Bridges and Land Transport Authority.

5.10.4 Traffic Conditions

A photolog of the conditions on roads surrounding the proposed power plant site is give in *Figure 5-57.* Taffic counts and assessment of level of service were undertaken as part of the evaluation of existing conditions.

Traffic Surveys

As part of the evaluation of existing conditions, a 16 hour classified traffic count was conducted on a typical working day (i.e. Tuesday, September 16, 2003) at Giza / Beni-sueif desert road across the road segment west to the power plant, i.e. Kuraymat / Beni–sueif segment.

The counts were manually carried out in order to depict the variation of the daily flow, peak flow and timing, and existing traffic composition. Traffic was split into the normal vehicle categories: private car, taxi, microbus and minibus, van and pick up, private / public bus, light and heavy trucks, and others.

Figure 5-55 illustrates the fluctuation of traffic flow during the 16 hours of the survey on both directions of travel for Kuraymat / Beni-sueif section.

The total 16 hour traffic flow was recorded as 1280 vehicles in the direction from Kuraymat to Beni-sueif, and 1307 vehicles in the opposite direction. The traffic volume on this road section is considered very low compared with the section near El-Ayyat along the same road, where traffic volume at El-Ayyat section is almost fourfolds that at Kuraymat section. *Figure 5-55* depicts that the two directions of travel are almost balanced, yet they don't follow the same pattern. On the one hand, the direction to Beni-sueif has two obvious peaks, i.e. the morning peak between 7:00 and 8:00 am and the evening peak between 6:00 pm and 7:00 pm. On the other hand, the direction from Beni-sueif to Kuraymat has a morning peak between 8:00 am and 9:00 am, and then traffic fluctuates until 7:00 pm before it steadily goes down. The hourly traffic volume during the fluctuation period could increase the morning peak hour traffic volume for this direction. The maximum traffic flow during the three peaks is given in *Table 5-34*. It can be seen that the highest flow in both directions of travel occurs during the morning peak.

Table 5-34

Maximum Peak Hour Traffic Volume on the Kuraymat / Beni-sueif Road

Direction	Peak Hour Traffic Volume (Vehicles / hour)		
	Morning	Afternoon	Evening
Kuraymat to Beni-sueif	116	72	115
Beni-sueif to Kuraymat	100	105	77
Total	**216**	**177**	**192**

Figure 5-56 illustrates traffic composition observed over the 16-hour survey period for both directions of travel for Kuraymat/Beni-sueif Road. It shows that van/pick-ups and heavy trucks have a significant share of traffic composition along this road (38% and 23% of the total traffic volume respectively). This is followed by ligh trucks, passenger cars and Micro/Minibuses with 14%, 11% and 10% respectively. Taxis, buses and others only represent 4% of the total traffic along this road.

Figure 5-55

Fluctuation of Traffic Flow on the Kuraymat / Beni-sueif Road

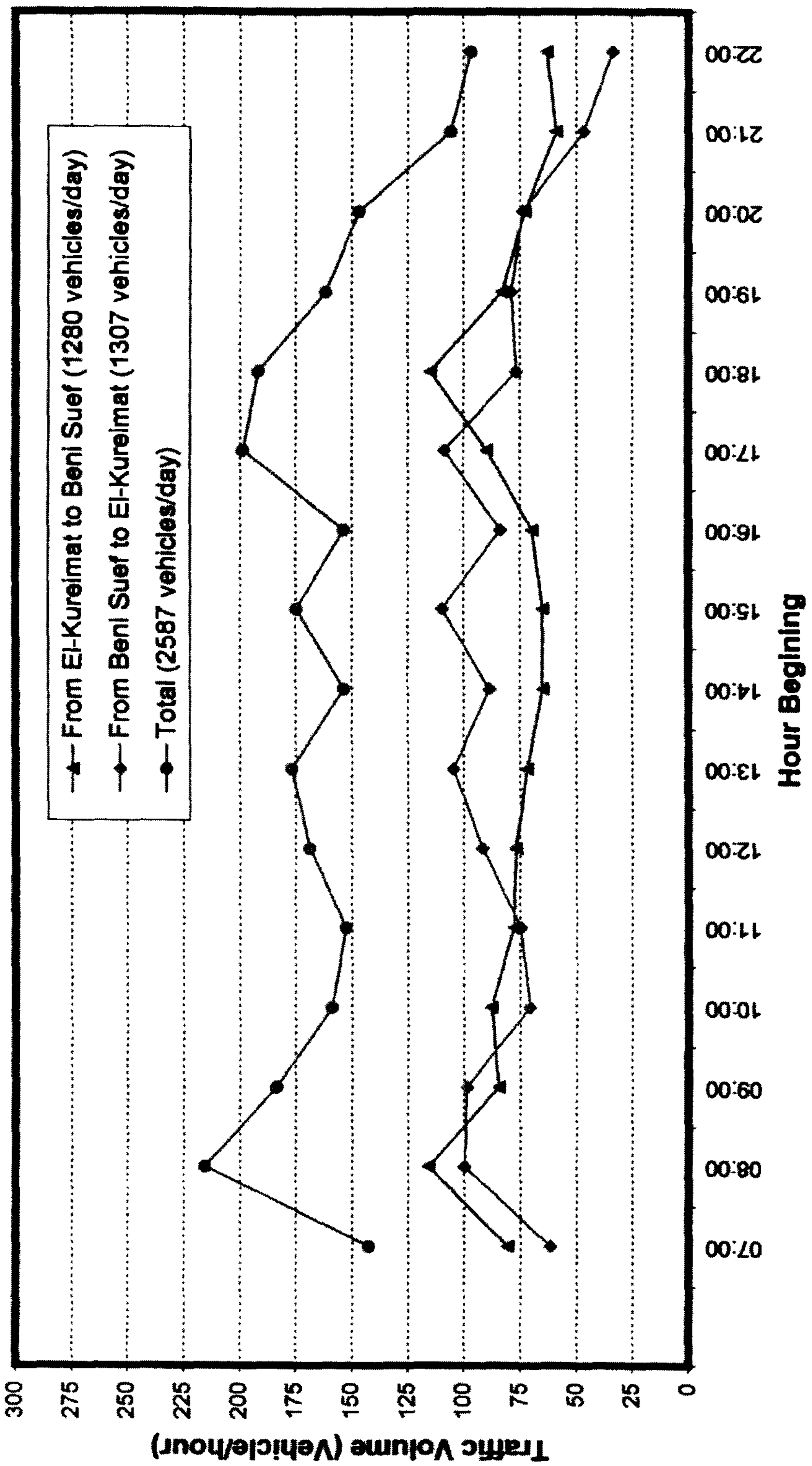
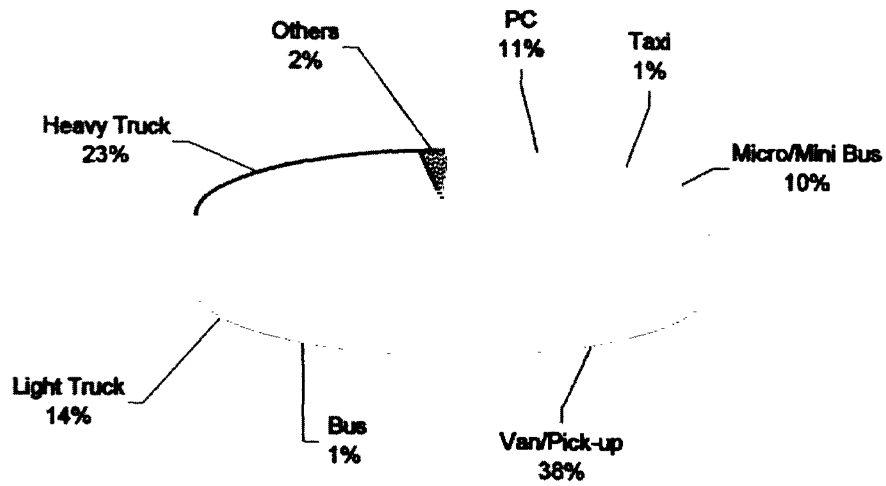


Figure 5-56

Traffic Composition on the Kuraymat / Beni-sueif Road



Road Inventory Using Video Mapping System (VMS)

In addition to the classified traffic survey explained above, road inventory surveys were carried out for local roads around the power station in order to assess their existing conditions. Road inventory surveys were carried out by visual inspection and by video mapping system (VMS) (*Figure 5-57*). In the VMS, the study area map was digitized to a computer and a process of checking was carried out. Thereafter, the local surrounding roads were video taped (using digital cameras) and then transferred to the computer. The next step was preparation of ARCVIEW file data by importing the taped data and carrying out a number of adjustments. The produced maps were then supported with a database for geometric characteristics of the road network as well as the current traffic volumes at different survey sites. The result of this effort is summarized in *Table 5-35* below.

Table 5-35

Results of Road Inventory and Traffic Count Survey

Road Section	Direction	No. of Lanes	Road Width	Shoulder Width	Pavement Condition	16he Traffic Count(1)
Kuraymat/ Beni-sueif	To Beni-sueif	1	3.5 m	2m (unpav.)	Good	1,280
	To Kuraymat	1	3.5 m	2m (unpav.)	Good	1,307

Notes:
(1) These figures represent the results of the 16 hour traffic count survey conducted on Tuesday, 16 Sept. 2003.

It is worthmentioning that although the pavement condition along this section of the Kuraymat/Beni-sueif road is good, there is a great variation in its gradients particularly few hundred meters before the power plant reach, which would completely obstruct the line of sight and might cause serious accidents.

Travel Time Survey

Travel speed and travel time are considered the most important operational characteristics of road links. These two parameters are quite useful in defining the operational efficiency of road links and the different causes of traffic delay at critical spots, such as road intersections, pedestrian crossing and railway crossing. This would help analyzing and solving traffic problems at such critical spots and hence mitigating traffic delay.

In order to measure the average travel time and speed on the access road leading to the power plant, an observation vehicle moving among the traffic flow with the normal traffic speed was used. Both travel time and travel distances are recorded using stopwatch and the vehicle kilometer respectively. Delays at mid-block (if any) were also recorded as well as causes of

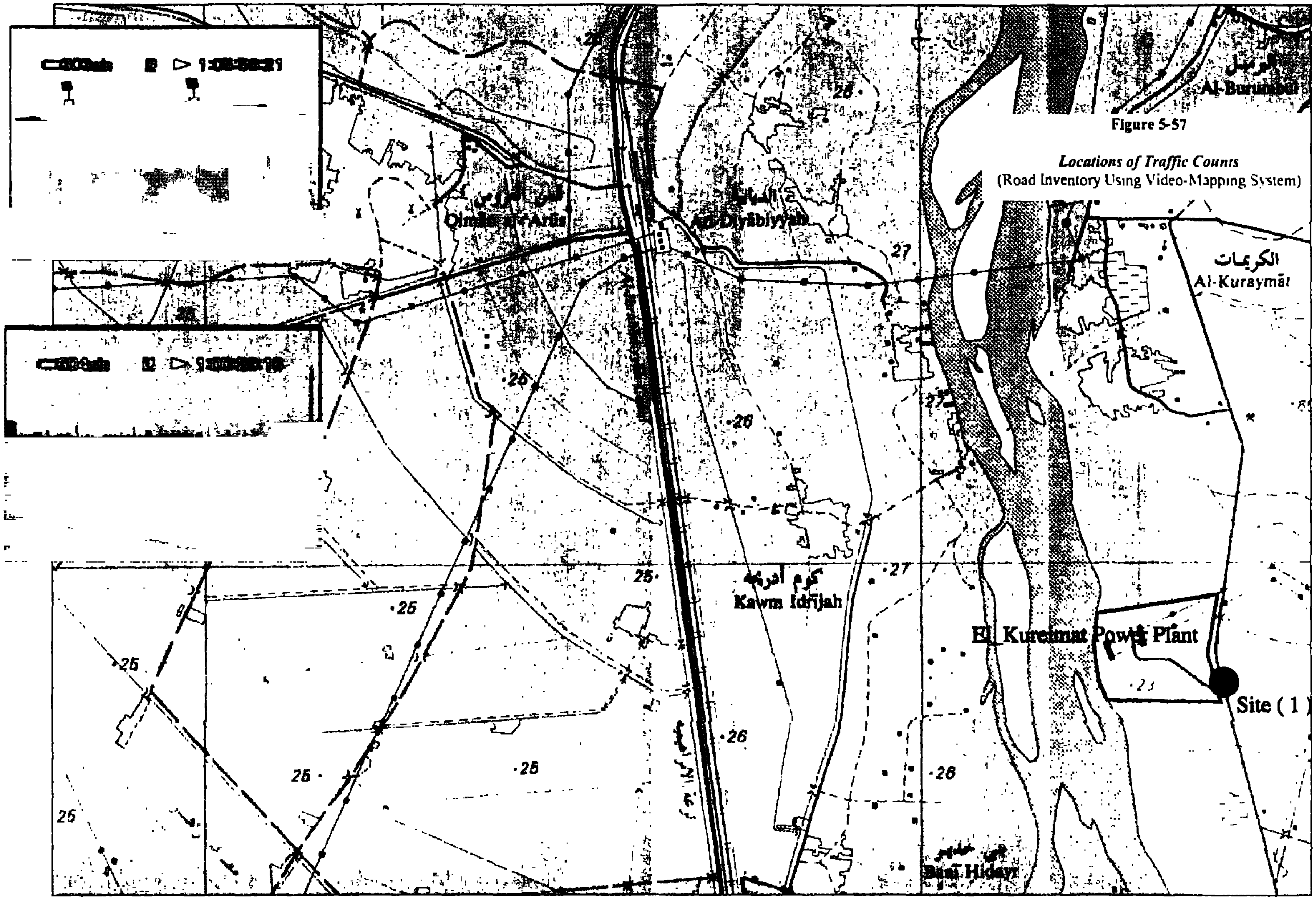


Figure 5-57

Locations of Traffic Counts
(Road Inventory Using Video-Mapping System)

delay. These procedures were carried out five times in each direction of flow during morning peak on a typical working day (i.e. Tuesday, September. 16, 2003) along the section of Giza-Beni-sueif road between the power plant and its intersection with El-Zafarana road.

Table 5-36 summaries the results of travel time survey for this section. These results indicate that the average travel speed for both directions of travel during morning peak is 70 km/hr. This is considered a good speed and would be referred to the lower traffic volume along this section. Since no mid-block exists along this road section, no travel delay has been experienced during the survey period.

Table 5-36

Average Travel Time and Speed for the Selected Section

Average Travel Time (Minutes)	Distance (km)	Average Travel Speed (km/hr)
3.0	3.50	70

5.11 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

There is no available information which identifies any archaeological, historic or cultural remains of significance on the site. This is supported by the present situation which designates the wider area of the site as the one that has been thoroughly investigated and surveyed before since early nineties of the last century as containing one of the candidate sites that have been exposed to selection process.

Historically, the lower Upper Egypt Region has been occupied by a number of civilizations, in particular by pharaonic populations, the Greeks, Romans, Copts and Moslems. In the northern part of lower Upper Egypt at Giza city, which is about 65 km far from the site, there is a highly rich archaeological and historic center created by the existence of pyramids and sphinx. Other significant archaeological sites are sprinkled around in surrounding areas such as sackkara pyramid.

The archaeological sites and areas reflect the importance that the Egyptian Government attaches to preserving the wealth of historical monuments and sites of Egypt's cultural heritage.

However, a "preliminary archaeological assessment for the Kuraymat, Egypt feasibility study" was undertaken in February 1991 by "Office of Public Archaeology, Boston University". The goals of the assessment were: 1) to identify recorded archeological sites within the project area and its vicinity; and 2) to assess the potential archaeological sensitivity of the project area. The study outcomes could be summarized as follows (see Annex II):

"Because of major geographical differences, the Fayum and the west bank of the Nile in the region of El-Kuraymat have much more extensive archaeological evidence than the east bank, where El-Kuraymat is located. Lake Moeris provided water for extensive irrigation projects in the Fayum, and to the east of this a very wide strip of land is cultivable between the Bar Yusef canal and the Nile. In contrast, the east bank has a very narrow floodplain with the limestone formation of the low desert beginning less than 1 km east of the Nile in some places".

"While the west bank has a rich and well-documented archaeological history, with sites spanning all periods of Egyptian prehistory and history (and even paleontological specimens dating back millions of years), the east bank is poorly represented in the archaeological record. Sites from the Neolithic and Greco-Roman periods have been found on the east side in the vicinity of the project area, although pharaonic sites seem to be only rarely reported there. An important track leading to the Red Sea also begins a few kilometers south of the project area; this track is at least 1500 years old. No sites have been reported within the El-Kuraymat project area".

5.12 SOCIO-ECONOMIC ENVIRONMENT

5.12.1 Population and Demography

The project site is located at the very south zone of Giza Governorate, adjacent to the northern territory of the Beni-sueif Governorate, on east side of the River Nile, about 2km distant from its bank, and close to the road running approximately parallel to the eastern bank of the Nile river. The total area of the Giza Governorate is 85,153 km^2, out of which 1,156 km^2 is inhabited by population of 5,427,000 (according to CAPMAS estimates of population by governorates in 1/112003). The population at the Kuraymat village is approximately 7,000.

The total population of Giza Governorate, including all zones (North, East, Middle, West, South) was estimated as 5,207,047 in 2002, which indicates, when compared to estimates of 1/1/2003, an increase of around 4.22% over 2001 figures.

Under the proposals set out in the Governorate's Development Plan, the population of the Kuraymat zone is likely to increase with the development of new industrial, commercial and residential businesses and is expected to reach about 8,200 by 2008. *Tables 5-37 through 5-39* show population data for Giza Governorate, and *Table 5-40* gives special emphasis on Kuraymat zone, collected in 2002.

Table 5-37

Population of Giza Governorate, 1/1/2006 (1)

Sex Area	Male (1000)	Female (1000)	Total (1000)	Percentage (%)
Giza Governorate	2,972	2,784	5,756	8.1
Total Egypt	36,508	34,839	71,347	100

Notes:
(1) Exclude Egyptians abroad.

Source: Central Agency for Public Mobilization and Statistics (CAPMAS).

Table 5-38

Number and Percentage of Population by Urban/Rural Residence, Giza Governorate, 1996

Area	Urban		Rural		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
Giza Governorate	2,589,807	10.2	2,194,292	6.4	4,784,099	8.1
Total Egypt (1)	25,286,335	100	34,026,579	100	59,312,914	100

Notes:
(1) Exclude Egyptians abroad.

Source: Central Agency for Public Mobilization and Statistics (CAPMAS).

Table 5-39

Population of Giza Governorate By Age Category, 2002

Age Category	< 1 year	1-5	5-10	10-15	15-20
Number of Population	64,004	520,351	662,180	698,578	602,241

Age Category	20-25	25-30	30-35	35-40	40-45
Number of Population	445,964	396,958	373,285	362,716	296,329

Age Category	45-50	50-55	55-60	60-65	65-70
Number of Population	237,208	176,881	120,041	112,252	64,948

Age Category	70-75	75	Un-classified	Total
Number of Population	42,248	29,657	4	**5,207,047**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-40

Population of Kuriemat Village
By Age Category, 2002

Age Category	< 1 year	1-5	5-10	10-15	15-20
Number of Population	32	1,001	1,044	1,132	635

Age Category	20-25	25-30	30-35	35-40	40-45
Number of Population	538	460	386	393	299

Age Category	45-50	50-55	55-60	60-65	65-70
Number of Population	240	236	139	146	54

Age Category	70-75	75	Un-classified	Total
Number of Population	76	35	-	**6,846**

Source: Information Center, Giza Governorate, 9/10/2002

5.12.2 Employment and the Labor Market

The labor force of Giza Governorate is around 1,449,922 with unemployment, including recently un-employed university and high school graduates, at around 4.49% in 2002. *Table 5-41* gives labor force data for Giza Governorate.

In Giza Governorate, around 26.59% of the Goverorate total population forms the active work force, while in the Kuraymat zone this ratio reaches about 50.71%. This labor pool is comprised of employees of agricultural activities small industrial activities (extraction of plant oils, cotton ginning and combacting, primitive chemicals, food, textiles, provender, ... etc.) and employees of small business operators. Around 19% of the total labor pool can be categorized as skilled, having been trained as manufacture technicians. *Table 5-42 and Table 5-43* present some details on the manufacturing establishments as well as the industrial labor force of Giza Governorate in the year 2002.

Portion of the Kuraymat's economy centers on small businesses which comprise a part of the private activities sector. *Table 5-44* indicates these small businesses. Also, *Table 5-45* gives an overiew about new projections for investment in Giza Governorate.

Planned investment businesses in the year 2002 for the Giza Governorate provide 1,637 investment projects with a total cost of 7.629 milliards. These investments provide more than 121,000 job opportunities over the next five years. Also, *Table 5-45* presents some useful details on the new projections for investments which will offer additional thousands of job opportunities.

The proposals outlined in the Giza Governorate future economic and social development plan, which correspond to the Government of Egypt's development program for the country, are likely to offer employment opportunities through the construction and operation of the proposed businesses as well as industrial and commercial developments in the Kuraymat area.

Table 5-41

Estimates of Giza Population by Work Status, 15 Years and Above, 2002

Markaz/ District	Business Men	Profess-ionals	Workers	Workers Without Salary	Un - employed	Recently Unemployed	Total Work Force	Only Students
1. Markaz Ousim	2,379	14,659	31,957	989	605	2,170	52,759	13,833
2. Markaz Al-Warrak	7,487	23,731	84,536	301	714	3,459	120,228	30,347
3. Markaz Imbaba	9,938	44,973	113,978	3,934	1,734	5,730	180,287	41,108
4. Al-Wahat Al-Baharyyah	677	862	5,516	282	2	1,133	8,472	2,045
5. Markaz Al-Hawamdyyah	922	4,916	23,696	112	407	2,567	32,620	10,320
6. Markaz Atfieh	8,924	7,284	31,293	3,019	109	2,468	53,097	11,690
7. Markaz Es-Saff	1,645	12,543	42,191	1,619	707	3,116	61,822	14,838
8. Markaz El-Giza	3,018	15,304	30,387	850	288	1,593	51,440	10,730
9. Markaz El- Badrashin	2,091	20,170	50,556	2,190	515	3,000	78,522	16,799

Markaz/ District	House-Women	Desist from Work	Retired	Old with no Job	Disable	Total non-Work Force	Un-Classified	Total Population 15 Years & Above
1. Markaz Ousim	50,218	1,532	1,999	1,669	487	69,738	83	122,580
2. Markaz Al-Warrak	99,187	2,151	5,018	2,551	1,003	140,257	78	260,563
3. Markaz Imbaba	166,826	2,902	5,808	6,831	4,185	227,660	179	408,126
4. Al-Wahat Al-Baharyyah	6,748	90	360	410	62	9,715	13	18,200
5. Markaz Al-Hawamdyyah	28,802	1,227	3,512	891	295	45,047	28	77,695
6. Markaz Atfieh	53,035	817	882	3,290	714	70,428	34	123,559
7. Markaz Es-Saff	59,936	1,305	2,769	3,214	677	82,739	24	144,585
8. Markaz El-Giza	49,955	1,095	1,506	2,391	435	63,112	36	114,588
9. Markaz El- Badrashin	77,154	2,416	3,473	3,146	679	103,667	67	182,256

Table 5-41 (Contd.)

Estimates of Giza Population by Work Status, 15 Years and Above, 2002

Markaz/ District	Business Men	Profess-ionals	Workers	Workers Without Salary	Un - employed	Recently Unemployed	Total Work Force	Only Students
10. Markaz El-Ayyat	13,743	11,321	45,005	3,972	191	3,623	77,855	17,535
11. North District	6,844	21,839	126,922	19	1,869	10,112	167,607	51,711
12. Agouza District	4,719	5,116	47,153	10	720	3,406	61,124	26,003
13. Dokki District	3,233	2,996	26,747	1	134	1,310	34,421	19,574
14. South District	3,752	10,231	58,782	30	1,039	4,185	78,019	23,328
15. Boulak District	8,278	20,690	115,421	19	1,361	8,311	154,080	48,610
16. Haram District	3,058	8,676	47,006	121	947	2,254	62,062	17,057
17. Omranyah District	10,209	17,188	17,188	52	1,282	6,667	175,507	59,707
Total	90,917	242,499	898,334	17,520	12,624	65,104	1,449,922	415,235

Markaz/ District	House-Women	Desist from Work	Retired	Old with no Job	Disable	Total non-Work Force	Un-Classified	Total Population 15 Years & Above
10. Markaz El-Ayyat	71,339	1,099	1,686	3,526	712	95,897	87	173,839
11. North District	131,685	4,376	12,872	5,896	1,895	208,435	158	376,200
12. Agouza District	38,934	1,564	7,787	2,744	647	77,679	227	139,030
13. Dokki District	19,999	634	3,953	3,686	232	48,078	104	82,603
14. South District	58,010	2,686	7,165	3,198	945	95,332	100	173,451
15. Boulak District	111,086	3,440	9,665	2,952	1,389	177,142	104	331,326
16. Haram District	50,941	1,497	4,141	1,756	508	75,900	1,418	139,380
17. Omranyah District	114,220	2,594	11,649	4,702	1,344	194,216	87	369,810
Total	1,165,075	31,425	84,245	52,853	16,209	1,785,042	2,827	3,237,791

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-42

Population of Giza Governorate by Economic Activity, 2002

Activity	Population (Number)	Percentage (%)
Agriculture & Hunting	198,321	6.1
Mining	5,474	0.2
Manufacturing	265,190	8.1
Electricity / Gas / Steam	13,613	0.4
Construction & Building	175,922	5.4
Retail & Wholesale Trade	195,020	5.98
Hotels & Restaurants	33,361	1.02
Transport & Storage	103,690	3.2
Financial Prokery / Business Services	91,067	2.8
Public Administration & Defence	118,535	3.6
Education	100,699	3.1
Health & Social Care	35,173	1.1
Society Services / International & Regional Organizations	51,954	1.6
Other Activities	13,751	0.42
Un-enrolled	1,859,999	57.0
Total	**3,261,769**	**100.0**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-43

Vocational Workshops and Their Total Employment in Giza Governorate Including Kuraymat Zone, 2002

Markaz / Town / District	No. of Workshops	No. of Workers
Markaz Al-Badrashin	314	890
Markaz Al-Warrak	889	2,783
Markaz Al-Wahat Al-Baharyyah	59	100
Markaz Es-Saff	30	134
Markaz El-Ayyat	114	1,077
Markaz Atfieh	189	367
Markaz El-Giza & Abu En-Numros	20	275
Hawamdyyah town	103	283
Agouza District	390	780
North District	230	470
Omranyyah District	508	1,175
Total	**2,846**	**8,334**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-44

Manufacturing and Commercial Activities at Kuraymat, 2002

Type of Activity	Workshops		Type of Activity	Commercial Shops	
	No. of Facilities	No. of Workers		No. of Facilities	No. of Workers
Bakery	1	6	Grocery	11	11
Welding	3	6	Wheat and Maize	9	8
			Cafeteria	4	14
			Coffee Shop	1	2
			Gas Storage	2	4
			Furniture	1	1
			Farmacy	1	3
			Gazolin Fueling Station	1	6
Total	**4**	**12**	**Total**	**30**	**49**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-45

New Projections for Investment in Giza Governorate, 2002

No.	Planned Region	Area (Feddans)
1	Industrial Zone at Tahma	1,400/1,700
2	Industrial Zone at Kuraymat	8,740
3	Extension of Industrial Zone at Abu-Rawash	124
4	Brick Factories Zone at Arab Abu-Musaid	1,780
5	Brick Factories Zone at Askar	1,500
6	Investment Zone, Cairo/Alexandria Road	19,000
7	Investment Zone, Misr/Wahat Road	5,950
8	Investment Zone, Wahat Baharyyah	81,500
9	Technicians City, Misr/Fayyoum Road	122.6

Source: Information Center, Giza Governorate, 9/10/2002.

5.12.3 Income Distribution and Socio-economic Profile

There is no published information concerning the income distribution and socio-economic profile of the population within the Giza Governorate area. However, fieldwork carried out, suggests that the local population of the Giza Governorate is composed of a mix of agricultural and manual workers.

In discussions with Governorate representatives in February 2004, it was suggested that manual construction work is generally undertaken by migrant labor as there is little indigenous labor available (or willing) to carry out this work. Migrants, often from Upper Egypt, travel to any other area within Egypt attracted by the employment possibilities in this area. They are not actively recruited from outside the area by development companies. The migrants remain in the area until employment prospects draw them elsewhere. This migrant labor process is common in Egypt. All Governorate officials consulted expressed that facilities (housing, public and social services etc.) in the Kuraymat area will be adequate to absorb these migrants and they with bever create any social problems in the area.

5.12.4 Government and Public Services

Basic services in Giza Governorate include social affairs, civil defense, Nile-deliverance force, terrestrial deliverance force, cultural main facilities, youth & sports and food security. *Table 5-46* presents number of facilities in each of these basic services.

Potable Water Supply

The Nile river is the principal source for potable water for almost the entire Giza Governorate in the year 2002. Other sources include fast filteration and artesian wells.

Treatment/purification stations as well as fast filtration and artesian wells provide Giza Governorate with actual production of 1,790,000 m^3/day. There are 102 artesian wells, 15 fast filtration facilities and 4 treatment / purification stations*.

This water is distributed via a water pipleline network and consumed in a daily rate of about 1,626,900 m^3/day.

The per capita potable water consumption in Giza Governorate reaches an average of about 195 m^3/day.

Irrigation demands for agriculture in the Kuraymat zone are satisfied by the Nile water supplies from the Nile river. Irrigation includes overflowing, lifting stations or sprinkling irrigation. No irrigation by underground water exists. Geotechnical borings at the Kuraymat area showed groundwater in the floodplain same depth as the Nile river. Botable water in the Kuraymat zone is provided with Atfieh water facility of actual capacity of 41,400 m^3/day. *Table 5-47* gives some details on the Giza water resources in the year 2002.

* Information and Decision Taking Support Center: "Giza 2003".

Table 5-46

Basic Administrative, Social and Cultural Services in Giza Governorate, 2002

Type of Service	Number of Facilities
Social Affairs:	
• Social Care Centers	107
• Non-governmental Organizations	1,335
• Women Clubs	46
• Training Centers for "Productive Family"	152
• Nurseries	1,108
• Child-Clubs	19
• Cultural Clubs	20
• Family Consultation Offices	9
• Child-Shelter Houses	19
Civil Defence:	
• Hydraulic Ladders	4
• Fire-Fighting Units	42
• Fire-Fighting Vehicles	95
Nile-Deliverance Force:	
• Deliverance Cruisers	4
• Diving Clothes	22
• Diving Equipment	26
Terrestrial Deliverance Force:	
• Modern Vehicles	2
Culture main facilities:	
• Culture Palaces	3
• Public Liberaries	12
• Culture Houses	13
• Child Liberaries	83
Youth and Sports:	
• Sport Clubs	73
• Youth Centers	203
• Assigned Areas for Sports	17
• Sports Committees	29
Food Security:	
• Governmental Bakeries	9
• Public Sector's Bakeries	41
• Rural-type Bakeries	849
• Urban-type Bakeries	560
• Allocated Wheat Quantity (for monthly consumption)	40,200 ton / month
• Grinding Mills	30
• Storage Yard Places	1605

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-47

Distribution of Potable Water in Giza Governorate, 2002

Markaz / Town	Population	Total Actual Production of Water (m^3/day)	Total Actual Consumption of Water (m^3/day)	Water Losses (m^3/day)	Per Capita Water Production (m^3/day)	Per Capita Water Consumption (m^3/day)
1. Markaz El-Giza	199,016	24,400	20,770	2,440	123	104
2. Al-Hawamduyyah Town	129,417	19,000	14,650	1,900	147	113
3. Maraz El-Badeashin	319,976	77,100	6,990	7,710	240	218
4. Markaz Ousim	598,316	36,600	31,500	3,660	62	52
5. Markaz Al-Warrak	431,296	1,000	790	100	231	183
6. Markaz Imbaba	322,940	70,700	59,310	7,070	218	183
7. Markaz El-Ayyat	315,629	56,900	43,950	5,690	180	139
8. Markaz Es-Saff	257,936	49,900	42,250	4,990	193	163
9. Markaz Atfieh	229,060	41,400	35,620	4,140	181	156
10 Al-Wahar Town	30,351	21,60	19,500	2,160	712	642
Total	2,833,937	398,600	275,330	39.860	Average 229	Average 195

Source: Information Center, Giza Governorate, 9/10/2002.

Sewage System

Table 5-48 lists the sanitary drainage facilities in Giza Governorate in the year 2002. The total drainage capacity of Giza area is 6,131,700 m^3/day. The average per capita sanitary drainage capacity for Giza Governorate in the year 2002, including those of Kuraymat Zone is about 1.125 m^3/day.

Electricity

Figure 5-58 shows the existing electrical facilities for the entire Giza Governorate whereas *Figure 5-59* presents the anticipated electrical power system for the year 2012. *Figure 5-59* shows how the proposed power plant will be connected to exiting electrical facilities running around the site and supplying all industrial, commercial and residential demands located in the Giza area. *Tables 5-49 through 5-51* give some details on the power supply facilities in service today in the Giza Governorate.

Annual electricity production in the Giza Governorate in the year 2002 was about 1,291 million kWeh. Electricity annual consumption reached about 3,186 kWh in the same year with per capita share of about 79.1 kWh/year.

Natural Gas

Table 5-52 presents some details on the natural gas facilities and subscribers in Giza Governorate.

Table 5-48

Giza Sanitary Drainage in the Year 2002, 1000m^3/day

Area Served	Station Location	Station Type	% age Operation	Capacity (1000m^3/day)
El-Haram District	Khopho	spiral	8%	240
	El-Haram	spiral	29%	624
	Kafr Chatata	minor up-lift	42%	12
	Mansheyyet El-Bakry	minor up-lift	5%	120
Boulak ed-Dakrour District	Zennin	secondary treatment	100%	330
	Nahia	minor up-lift	stand-by	4
	Station-10	minor up-lift	94%	17
	Al-Ittihad	minor up-lift	92%	13
	Abu-Katada	minor up-lift	68%	28
Giza North District	Imbaba Airport	minor up-lift	92%	13
	Imbaba Spiral	spiral	28%	360
	Imbaba Tunnel	occasional	occasional	2.1
	El-Mounira Tunnel	occasional	occasional	2.1
Dokki District	Giza Main Station	Main	42%	600
	Hunting Club	minor up-lift	stand-by	9
	Sheraton Tunnel	occasional	occasional	2.5
Giza South District	University Bridge	substation	stand-by	80
	El-Mansterly	substation	71%	28
	Abu-Hurairah	substation	74%	27
	Ed-Dahab Island	substation	67%	27
	Abbass Tunnel	occasional	occasional	5
Al-Omranyyah District	Ard EL-Lewa	substation	74%	27
	Japanees Friendship	substation	74%	27
	New Omranyyah	substation	63%	35
	Old Omranyyah	substation	57%	7
	Studio Station	substation	71%	28
	El-Haram Tunnel	occasional	occasional	5
	Talbyyah Station	Main	89%	180
	Terssa-6	substation	42%	120
Abu-Rawash Village	Al-Ittisal	substation	75%	832
	Abu-Rawash Spiral	substation	78%	832
	Abu-Rawash Treatment	primary treatment	100%	650
Nahya	South Prephery	substation	48%	832
Kerdasa	Minor up-lift	substation	48%	13

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-49

Giza Power Plants, 2002/2003

Location (Site)	Power Plant	Commercial Operation Date	Installed Capacity (MWe)	Total Energy Generated (GWeh)
Kuraymat	Kuraymat Thermal Power Plant (Gas/Oil-fired)	1998-1999	2x627 (1245)	6335

Source: Annual Report 2002/2003, Egyptian Electricity Holding Company.

Table 5-50

Electrical Substations in Giza Governorate, 2002

No.	Substation Name	Substation Location	Rated Power (MWe)	Actual Power (Maximum Load) (MWe)
1	El-Warrak	Markaz El-Warrak	90	61.5
2	El-Alamin	El-Agouza	100	72
3	Imbaba	Giza North	90	68.5
4	Al-Mashtal	Boulak Ed-Dakrour	40	33.5
5	Zennin	Boulak Ed-Dakrour	75	66.5
6	Giza	Giza South	100	80
7	Al-Haram	El-Haram	102.5	82
8	Al-Hadaba	El-Haram	75	25
9	Hadayk Al-Ahram	El-Haram	100	68
10	Al-Kemawayyat	Markaz Imbaba	60	47
11	Gazeyret Ed-Dahab	Giza South	100	72
12	Abu-Rawash	Markaz Imbaba	50	26
13	Al-Hawamdyyah	Al-Hawamdyyah	80	63.5
14	Al-Gezerah	Markaz El-Giza	100	65.5
15	Dokki	Dokki	100	71
16	Ar-Remayah	El-Haram	50	26
17	Al-Lebini	Es-Saff	20	15
18	Es-Saff North	Es-Saff	40	22
19	El-Ayyat	El-Ayyat	25	18
20	Es-Saff South	Es-Saff	40	8
21	North Kuraymat	Es-Saff	20	14
22	Al-Bawiti	El-Wahat	20	10
23	Al-Moatamadyyah	Boulak	100	72
24	Faisal S/S	El-Haram	100	75
25	Badrashin S/S	El-Badrashin	50	40
26	October I	6 October	150	125
27	October II	6 October	50	20
28	Ash-Shekh Zayed	6 October	10	7

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-51

Electrical Energy Consumption in Giza Governorate, 2002

No.	Markaz/Town/ District	Population	Subscribers				Total Energy Production (KWh)	Total Energy Consumption (kVA)	Per Capita Consumption (kWh)
			Gov.	Pub.	Rriv.	Total			
1	Markaz Imbaba	322,940	-	-	61,076	61,076	80,000	72.525	22.458
2	Markaz El-Warrak	431,296	-	-	286,333	286,333	175,000	413	95.758
3	Markaz Ousim	598,316	-	-	69,144	69,144	100,000	103	148.964
4	Markaz El-Giza	199,016	-	-	57,430	57,430	42,000	79.469	4.020
5	Markaz Al-Hawamdyyah	129,417	-	-	50,783	50,783	62,500	66.654	52
6	Markaz El-Badrashin	319,976	-	-	67,311	67,311	40,000	87.432	27.190
7	Markaz El-Ayyat	315,629	-	-	63,810	63,810	25,000	69.807	22.178
8	Markaz Es-Saff	257,936	-	-	52,085	52,085	60,000	64.226	24.812
9	Markaz Atfien	229,060	-	-	42,176	42,176	40,000	41.731	18.336
10	Markaz Al-Waghat	30,351	-	-	6,724	6,724	12,000	7.777	26
11	District North	580,077	-	-	76,856	76,856	80,000	129.549	22
12	District South	259,075	-	-	60,612	60,612	100,000	101.123	39
13	Dokki District	105,297	-	-	76,399	76,399	75,000	379.142	359
14	El-Agouza District	184,568	-	-	59,417	59,417	100,000	242.006	131
15	Omranyyah District	571,603	-	-	127,883	127,883	75,000	215.947	36
16	Haram District	223,844	-	-	186,356	186,356	75,000	398	179
17	Boulak Ed-Dakrour District	518,016	-	-	444,982	444,982	75,000	711	137
Total							**1,291,500**	**3,186**	**Average 79.1**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-52

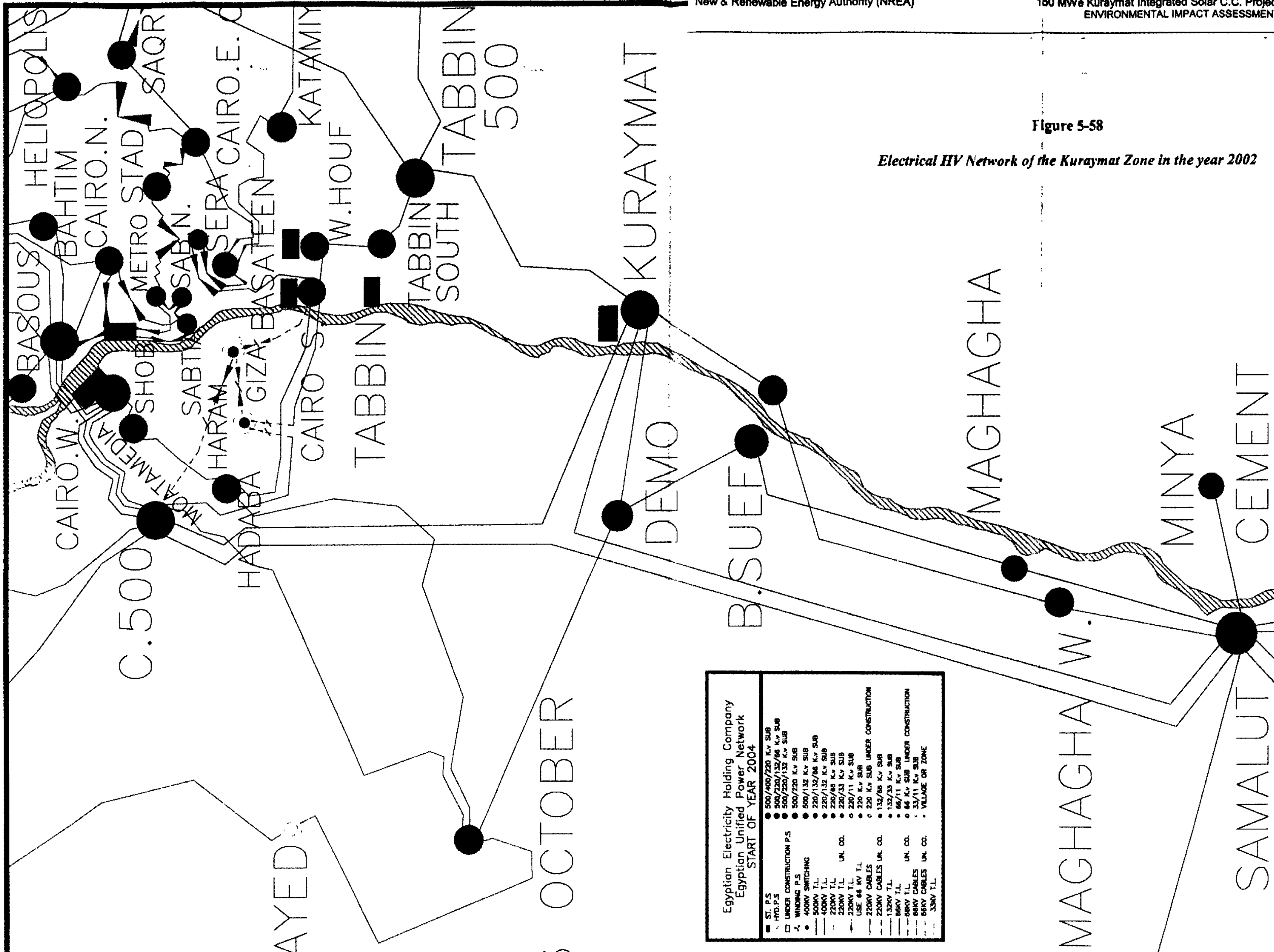
Natural Gas Facilities and Subscribers in Giza Governorate, 2002

Facilities & Subscribers	Number
Steel Pipelines & their attachments	49 km
Main and Sub-networks lines	814 km
Domestic Subscribers	287,507
Commercial Subscribers	2,616
Industrial Subscribers	7
Bakeries Subscribers	284
CarGas Fueling Stations	7

Source: Information Center, Giza Governorate, 9/10/2002.

Figure 5-58

Electrical HV Network of the Kuraymat Zone in the year 2002



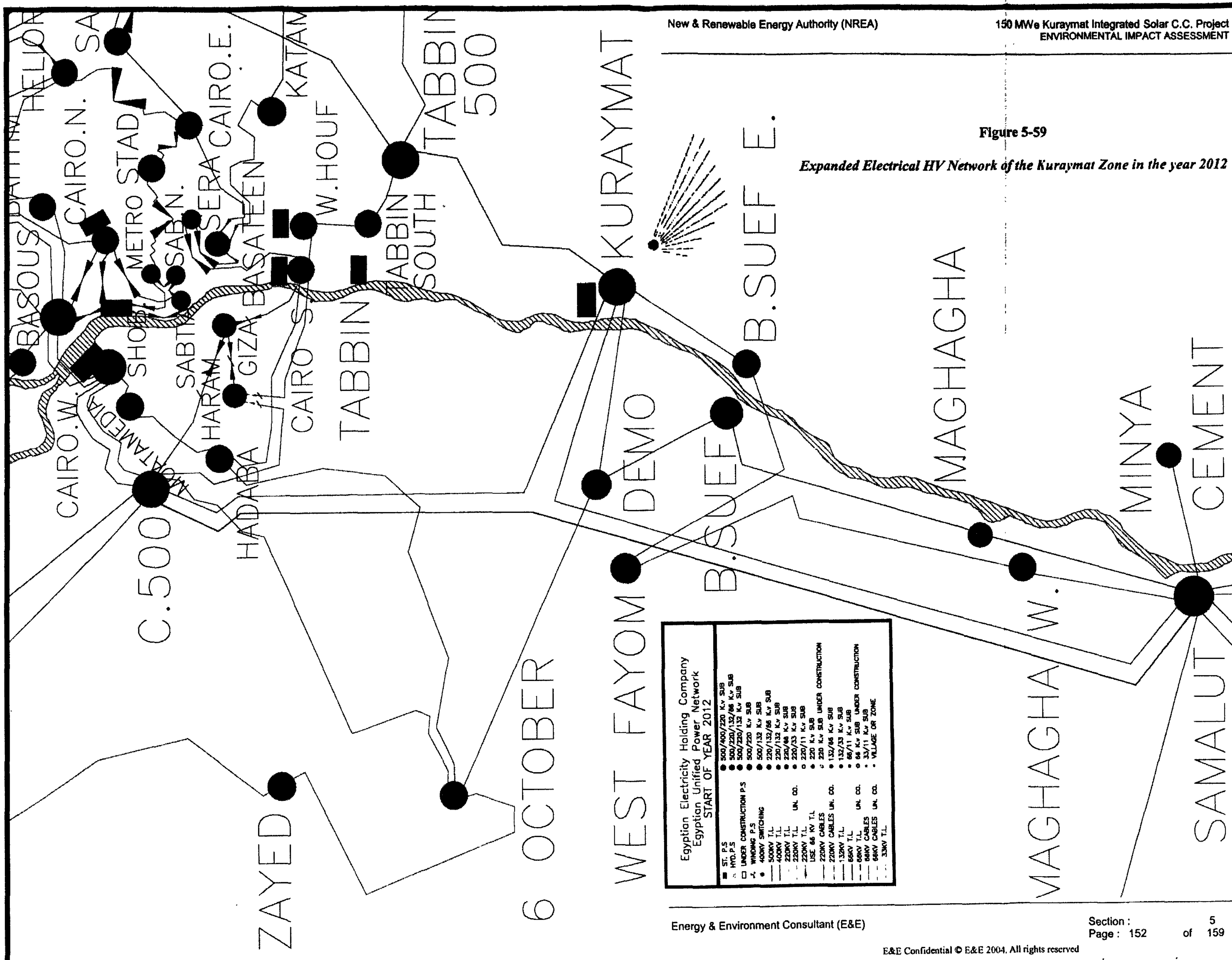


Figure 5-59

Expanded Electrical HV Network of the Kuraymat Zone in the year 2012

Health and Education

Main medical facilities in Giza Governorate consists of 52 hospitals (13 general/central hospitals, 8 specialized ones, 16 integrated health care hospitals and 15 urban health care centers) in addition to 111 rural clinical units and 11 health care group-units as shown in *Table 5-53*. The hospitals collectively support approximately 5,225 beds, they are well equipped for most types of surgery and convalescence and are staffed by more than 1,850 physicians and 6,750 nurses covering all medical specializations.

Many other motherhood and childhood care centers, family guidance centers, health care offices, shest nursing clinics, emergency health care units, emergency care vehicles in addition to many private clinics and pharmacies are distributed all over the Giza area. *Table 5-54* provides with data on the number of most of these facilities.

The educational status of the Giza Givernorate population is given by *Table 5-55* .

The educational facilities available within the Giza Governorate include 2256 public schools (comprising Nursery and Elementary (ages under 6) and Primary schools (ages 6-12) for both boys and girls and Secondary (ages 12-15) general schools, in addition to Secondary technical schools. The total number of pupils in public schools reached 1,300,549 in the year 2002.

In parallel, AL-Azhar education includes 294 institutions distributed over Primary schools, Preparator schools and general Secondary schools which collectively serves more than 70,000 pupils.

Table 5-55 provides also with data on the number of high education institutions in Giza Governorate. In the year 2002/2003 the total number of enrolled students reached 153,362.

Table 5-53

Main Hospitals in Giza Governorate, Including Kuraymat Zone, 2002

Hospitals	Number
General / Central Hospitals	13
Specialized Hospitals	8
Integrated Health Care Hospitals	16
Urban Health Centers	15
Rural Clinical Units	111
Health Care Group-units	11
Total	**174**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-54

Health Care Facilities (other than Hospitals) In Giza Governorate, 2002

Facility	Number
Motherhood & Childhood Care Centers	12
Family Guidance Centers	277
Health Care Offices	23
Shest Nursing Clinics	5
Emergency Health Care Units	54
Emergency Care Vehicles	97

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-55

Education Institutions in Giza Governorate, 2002

Facilities, Pupils & Staff	Number
Public Schools	2256
Pupils	1,300,549
Classes	28,675
Class Capacity	45 pupils
Azhar Institutions	294
Classes	1,884
Pupils	70,354
Class Capacity	37 pupils
Colleges	20
Students	153,362
Staff	6,041

Source: Information Center, Giza Governorate, 9/10/2002.

Communications and Transportation

Table 5-56 lists the available basic communication services in Giza Governorate while *Tables 5-57 & 5-58* presents the distribution of telephone services, including Kuraymat Zone for the year 2002. Kuraymat zone, including Es-Saff and Atfieh, comprises 13 telephone centrals and 39,136 telephone lines while the entire Giza Governorate includes 60 telephone centrals (57 Automatic, 3 Half-automatic) and 1,227,155 telephone lines.

The roads and highways network available within the Giza Governorate includes 1200 km highways, 1,425 km local and interzonal paved roads and 172 dusty (unpaved) roads.

Transportation throughout the Atfieh and El-Burumbul is limited to private microbuses and donkeys. Large private buses run regular routes between Cairo, Es-Saff and Beni-sueif. Vehicle traffic is limited to the high ways and paved village and town streets. Private boats also provide transportation on the Nile. Main regional roads include Cairo/Alexandria (double, 205 km), Giza/Ayyat (double, 47 km), Haram/Wahat (single, 355 km), Helwan/Es-Saff/Kuraymat (single, 56 km) and Giza/Fayyoum (single, 89 km).

Table 5-59 gives the available post office service centers today in Giza Governorate including some details on the Kuraymat zone.

Security and Tribunals

The Kuraymat zone comprises 4 (four) police points (Es-Saff, Atfieh, El-Burumbul & Kuraymat). 2 (two) Fire Fighting points are also available at Es-Saff and Atfien. The Kuraymat zone has one tribunal located at Es-Saff.

Government offices locate at Es-Saff include administration, work, land and building, survey, supply, roads, social affairs, Al-Azhar, agriculture, irrigation, health, emergency health service, emergency road service, police center, Court, and railway offices.

Table 5-56

Basic Communication Services in Giza Governorate, 2002

Facilities & Subscribers	Number
Total Communications:	
• Telephone Centrals	68
• Subscribers	959,239
• Available Telephone Lines	1,227,155
• Wait-listed Subscribers	12,175
Public Telephones:	
• Egyptian Company for Communications	282
• Menatell (Co.)	2,997
• Telephone Offices	76
• Telex Offices	161
• Nile for Communications (Co.)	1,587
Post Offices	185

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-57

Distribution of Communication Services in Giza Governorate Including Kuraymat Zone, 2002

No.	Markaz/Town/ District	Telephone Central				Communication Service	
		Automatic		Half-Automatic		Telex	Card
		Number	Capacity	Number	Capacity	Numbers	Numbers
1	Markaz Imbaba	9	43,000	-		-	9
2	Ousiem	6	96,108	-		-	154
3	El-Warrak	2	96,000	-		-	64
4	Giza	3	13,590	-		-	44
5	Al-Hawamdyyah	1	8,500	-		-	65
6	El-Badrashin	7	35,016	-		-	39
7	El-Ayyat	8	23,876	-		-	24
8	Es-Saff	6	21,536	-		-	57
9	Al-Wahat	-	-	3	500	-	-
10	El-Agouzah	1	80,000	-		34	622
11	Dokki	1	82,250	-		94	834
12	North	1	95,200	-		1	409
13	South	1	81,562	-		20	820
14	Al-Haram	1	127,409	-		6	381
15	Omranyyah	1	172,144	-		1	532
16	Boulak Ed-Dakour	2	108,864	-		-	293
17	Atfeif	7	17,600	-		-	-
Total		**57**	**1,102,655**	**3**	**500**	**156**	**4,387**

Source: Information Center, Giza Governorate, 9/10/2002.

Table 5-58

Distribution of Telephone Services in Giza Governorate Including Kuraymat Zone, 2002

No.	Markaz/Town/ District	Total Population	Available Telephone Lines	Number of Subscribers	Waite-listed Subscribers	
					Paid Fees	Waiting for Payment
1	Giza North District	580,077	95,200	91,854	7,438	Open
2	El-Agouzh	188,536	80,000	68,270	-	Open
3	Dokki	105,297	82,250	79,781	-	Open
4	Boulak	518,016	108,864	103,550	1,010	Open
5	South	259,075	81,562	73,670	-	Open
6	Omranyyah	571,603	172,144	146,972	4,578	Open
7	El-Haram	223,844	127,409	105,763	1,958	Open
8	6 of October	38,615	119,500	41,468	1,329	Open
9	Markaz El-Warrak	431,296	96,000	75,343	7,772	Open
10	Imbaba	322,943	43,000	17,513	4,480	Open
11	Ousim	598,316	96,108	73,831	1,922	Open
12	Giza	199,816	13,590	11,848	375	4,203
13	A-Hawamdyyah	129,417	8,500	8,1480	-	7,972
14	Markaz El-Bdrashin	319,976	35,016	22,582	2,899	Open
15	El-Ayyat	315,929	23,876	12,590	426	Open
16	Es-Saff	257,936	21,536	12,985	1,428	Open
17	Atfien	229,060	17,600	9,703	828	Open
18	Al-Wahat Al-Baharyyah	30,351	5,000	3,336	128	Open
Total			**1,227,155**	**959,239**	**36,571**	**12,175**

Source: Information Center, Giza Governorate, 9/10/2002

Table 5-59

Post and Telegraph Offices in Giza Governorate Including Kuraymat Zone, 2002

No.	Markaz/Town/ District	Post Offices				Number of Telegraph Offices
		Governmental	Public	Rail-way	Walki-lines	
1	Markaz Imbaba	14	2	10	4	15
2	Ousiem	17	2	3	5	2
3	El-Warrak	7	-	2	-	2
4	Giza	8	-	2	2	4
5	Al-Hawamdyyah	2	-	3	1	3
6	El-Badrashin	19	3	4	5	4
7	El-Ayyat	21	9	9	9	4
8	Es-Saff	11	2	-	-	2
9	Atfien	11	4	-	-	3
10	Al-Wahat	6	-	-	-	4
11	North	9	-	1	-	7
12	South	13	-	2	-	4
13	El-Agouzah	7	-	-	-	3
14	Dokki	5	-	-	-	3
15	Al-Omranyyah	6	-	-	-	3
16	El-Haram	14	-	-	-	3
17	Boulak	7	-	1	-	3
Total		**177**	**22**	**37**	**26**	**69**

Source: Information Center, Giza Governorate, 9/10/2002.

6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 ENVIRONMENTAL IMPACT PROCESS

6.1.1 Introduction

This section identifies and evaluates the primary environmental impacts of the proposed construction and operation of the ISCC Kuraymat power plant.

For each subject area (i.e. air quality, noise, .. etc.), the nature of the impact is discussed along with its potential significance, given the existing characteristics of the site and the Egyptian and World Bank Guidelines for New Thermal Power Plants[(1)]. Where potentially significant adverse impacts are identified, possible mitigation measures are suggested wherever possible, to ameliorate the impact to an acceptable level. Where identified, beneficial or positive impacts/effects of the project are also highlighted.

6.1.2 Assessment Methodology

Identification and assessment of impacts has been undertaken through a process comprising consultation, on site observations, literature review and experience of other similar projects. In addition, several impact models were carried out as follows:

- atmospheric dispersion modeling of the stack emissions (carried out by Energy and Environment Consultant "E&E");
- comparative study of cooling system alternatives for Integrated Solar Combined Cycle Power Plant (carried out by the Power Generation Engineering and Services Company "PGESCo");
- noise levels modeling of the power plant during operation (carried out by Dr. M. El-Bardisi, Prof. of noise and vibration engineering, Ain Shams University; on behalf of E&E);
- transport impact modeling (conducted by the Egypt National Institute of Transport, Ministry of Transport);
- ecological assessment of impacts that may occur due to the power plant operation (carried out by Dr. A. N. Hassan, Ain Shams University); and
- seismic modeling of impacts which may affect the power plant during its overall life time and the physical environmental setting of the wider area of the proposed

(1) World Bank Group, Pollution Prevention and Abatement Handbook-Thermal Power Guidelines for New Plants, July 1998.

site (carried out by the Arab International Environmental Services Corporation "Enviro-Pro").

These modeling results have been reviewed, and commented on by E&E and NREA as part of the preparation of this EIA report. The results of this process are documented in this EIA along with further work and investigations that have taken place.

The potential impacts associated with the construction and operation of the ISCC Kuraymat power plant are listed in *Table 6-1*.

Table 6-1

Environmental, Health and Safety Issues Relating to Construction and Operation of ISCC Kuraymat power plant

Subject Area	Potential Impacts During Construction	Potential Impacts During Operation
Air Quality	Dust from construction activities. Traffic-related air quality impacts.	Impacts of emissions from stacks on ambient air quality. Traffic-related air quality impacts. Global warming potential.
Aquatic Environment	Control and management of site drainage. Wastewater discharge. Sewage disposal and foul drainage.	Water requirements for power plant operation. Discharge of process and wastewater. Operation of drainage systems on site. Discharge of storm water, sewage and drainage.
Noise and Vibration	Noise from construction activities.	Noise from power plant operations on surrounding land uses.
Land Use, Landscape and Visual Issues	Land use on site. Land use in the surrounding area. Effects of construction activities on landscape character. Visual impact of construction activities.	Land use on site. Land use in the surrounding area. Effects on landscape character. Visual impact of the power plant and operation activities.
Soils, Geology and Hydrogeology	Effects on soils and geological features. Soil contamination. Effects on groundwater.	Soil contamination. Effect on groundwater.

Table 6-1 (Contd.)

Environmental, Health and Safety Issues Relating to Construction and Operation of ISCC Kuraymat power plant

Subject Area	Potential Impacts During Construction	Potential Impacts During Operation
Flora and Fauna	Loss of habitat or species due to landtake. Disturbance or damage to adjacent habitat of species.	Disturbance or damage to adjacent habitat. Effects of structures on bird migration routes.
Traffic	Traffic conditions/disruption to road users. Traffic-related air quality. Traffic-related noise.	Traffic conditions/disruption to road users. Traffic-related air quality impacts. Traffic-related noise impacts.
Major Accident Hazards	Risk to third-party hazardous industry.	Risk to third-party hazardous industry. Risk to power plant of third-party hazardous industry.
Natural Disaster Risk	Seismic risk. Flood risk.	Seismic risk. Flood risk.
Solid Waste Management	Contamination of soils and water. Hazards to workers health. Accident risks.	Contamination of soils and water. Hazards to workers health. Accident risks.
Occupational Health and Safety	Accidents. Effects on health of workforce. Safety at work.	Accidents. Effects on health of workforce. Safety at work.

6.1.3 Assessment Content

The following items are examined in the corresponding sub-sections of this Section:

- Air Quality;
- Aquatic Environment;
- Noise and Vibration;
- Flora and Fauna;
- Land use, Landscape and Visual Impacts;
- Soils, Geology and Hydrology;
- Traffic;
- Socio-economics and Socio-cultural Effects;
- Archaeology, Historical and Cultural Heritage;
- Natural Disaster Risks;
- Major Accident Hazards;

- Solid Waste Management;
- Public Health Effects;
- Occupational Health and Safety; and
- Associated Infrastructure.

For each of these items, a concise description and evaluation of the significance of potential impacts of the project is presented. Where modeling has been undertaken, a description of the model as well as corresponding maps summarizing the results of the assessment are provided.

If mitigation measures are considered to be necessary, these measures are presented and taken into account in order to estimate the predicted environmental impacts of the power plant.

6.2 AIR QUALITY

6.2.1 Introduction

One of the more significant impacts of the power plant on environment is the impact on the air quality. During construction activities and power plant operation, several pollutants will be released to the atmosphere including:

- intermittent fugitive emissions of dust during the construction period;
- emissions from the exhausts of vehicles used for the transport of the workers, the transport of construction materials and of basic equipment as well as transport during the power plant operation (fuel trucks); and
- stack emissions during the power plant operation (particularly of nitrogen oxides (NOx)).

The power plant will burn natural gas as the main fuel. As a result, emissions of particulate matter and sulfur dioxide during ɔrmal operation of the power plant will be very low.

Atmospheric dispersion modeling of stack emissions has been carried out in order to assess the impact of the power plant operation on ground level concentrations of nitrogen oxides NOx, sulfur dioxide SO_2 and carbon monoxide CO and to determine the scale of any impact on air quality, relative to accepted criteria.

Whilst the plume from the power station may travel ultimately over many hundreds of kilometers, the impacts in terms of increments to ground level concentrations of nitrogen dioxide will be confined to an area within a 20 km radius of the power station site. This then may be regarded as the "airshed", to use the terminology from the World Bank guidelines on thermal power plants.

6.2.2 Atmospheric Emissions During Construction Activities

Dust Emissions

Dust generated during construction can be significant locally. The following activities have the potential to result in the generation of dust during construction:

- "earthmoving" operations on site (excavation and removal of superficial sands);
- earthworks engineering.
- site stripping.
- wind blow; and

- circulation of vehicles and trucks for the import of the construction materials, for the export of excavated soil, for the transport of the workers and the transport of the equipment. This is a particularly significant source of dust emissions on unmade roads.

In the climate type experienced in this region as well as the relatively high suspended matter concentrations of background air, existing concentrations of airborne dust are somehow high. Relative to these existing levels, the contribution of additional dust from construction will be low and temporal.

Other Emissions

The movements of vehicles will also result in the emission of airborne pollutants, from the exhausts of the vehicles. The amount of such emissions will depend on the number of the vehicles concerned, vehicle type and the volume of traffic.

Mitigation Measures

In order to limit the impact of the construction activities on air quality, the following mitigation measures will be implemented

- land transfers and stock piles of material will be carefully managed to minimize the risk of wind blown material and dust;
- the construction phase will begin with the construction of the access roads (in order to minimize dust from vehicle movements;
- roads during construction will be compacted and graveled if necessary;
- roads will be maintained in good condition;
- access to the site will be regulated;
- vehicle speed will be limited on site; and
- vehicles will correspond with Egyptian pollutant emission standards.

6.23 Atmospheric Emissions during Power Plant Operation .*Pollutants Emitted*

The ISCC Kuraymat power-plant will have one mode of operation with regard to fuel type by firing with natural gas, which will be purchased from GASCO, Affiliate Company to the Egyptian Natural Gas Holding Company (EGAS) under a Fuel Supply Agreement.

The principal pollutant when burning natural gas will be oxides of nitrogen (NOx). Use of fuel solar oil will also result in emissions of particulate matter (PM) and sulfur dioxide (SO2), along with trace amounts of some other pollutants.

The emission characteristics for the ISCC Kuraymat power plant are described below according to the fuel supply (natural gas).

Operation with Natural Gas

The concentrations of SO2 will depend directly on the sulfur content in the fuel. The natural gas used as primary fuel is practically free from sulfur, and emissions of SO2 will be negligible when firing natural gas fuel during normal operation.

Egyptian regulations and requirements of the World Bank (1998) for stack emissions will be complied with when firing with the main fuel. *Table 6-2* summarizes this.

Table 6-2

Stack Emission Concentrations for Firing with Natural Gas (per unit)

Pollutant	Estimate Value	Egyptian Requirement(1)	World Bank Guideline
NOx	< 25 mg/Nm^3	300 mg/m3 (2)	125 mg/Nm^3
SO_2	< 1 mg/Nm^3	2500 mg/m^3	2000 mg/Nm^3 2.0 t/d/MWe for the fast 500 MWe Plus 0.1 t/d/MWe additional over 500 MWe
Particulate Matter (all size)	< 5 mg/Nm^3	200 mg/m^3	50 mg/Nm^3

Notes:

(1) values taken at 3% of 0_2 in dry fumes parameters of natural gas.

(2) There are no Egyptian Standards for NO_2. Emission limit of 300 mg/m^3 is for NO_x.

In addition, E&E has undertaken modeling of the dominating fuel and the results of the analysis are given in the following sections.

Mitigation Measures

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions). However, low NO_x combustors will be used on the gas turbines for reducing NO_x emissions.

Conclusion

The pollutant emissions of the power plant will comply with all requirements when firing natural gas.

The exceedence of air quality standards would be due to any other background levels and could not be attributed to the plant. The costs of reducing these emissions would not be economically viable given the minor benefits to air quality that measures would bring. The World **Bank** Guidelines for New Thermal Power Plants states that all of the maximum emissions levels should be achieved for at least 95% of the time the plant is available operating. The remaining 5% is assumed to be for start-up, shut down or emergency fuel use. This is the stance also taken by the Egyptian practice (i.e. EEHC).

6.2.4 Atmospheric Dispersion Modeling

The proposed units will be installed in the proposed ISCC Kuraymat plant site, which is located on the eastern land of the Nile River approximately 2 km far from the Nile bank and 95 km south of Cairo in a ruralidesert setting. The proposed plant will contain two gas turbine generator units of industrial heavy-duty type with gross output of around 2x43 MWe at ISO conditions.

The height of the stack will comply with Egyptian requirements and World Bank guidance on Good Engineering Practice (GEP). The stack of 35 m was defined according to the atmospheric dispersion modeling undertaken for the ISCC Kuraymat power plant EIA in June 2004.

Purpose

Atmospheric dispersion modeling has been carried out by E&E in order to determine power plant impacts on local air quality, when firing natural gas.

This modeling is able to quantify the impact of stack emissions on local air quality, define the areas where the maximum impact will occur and enable the evaluation of the concentrations of nitrogen oxides, sulfur dioxides and carbon monoxide in the air against the ambient air quality standards.

As light fuel oil will be used only as emergency fuel, less than 2% of the operating time, the modeling has been restricted to the case of firing on natural gas.

Description of the Model ISC-Prime

The ISC-Prime air dispersion model was used to estimate the onsite and off site air quality impacts. Onsite impacts were assessed to protect the workers' safety and off site impacts were investigated to determine compliance of the Egyptian Ambient Air Quality Limits (EAAQLs).

ISC-Prime is a computer program designed to simulate atmospheric dispersion processes over long periods, in order to estimate ambient concentration levels of air pollutants resulting from any set of gas emission sources or suspended particulate matter emission sources. It concerns mainly stack emissions, but can be applied to other stationary emission sources.

It is appropriate for application to a wide variety of problems (in particular regulatory applications) related to industrial source complexes, with transport distances up to 50 km in flat or rolling terrain.

The model is mainly based on the Gaussian plume dispersion equations as described by Pasquill, Gifford and Turner, as well as the Brigg's plume rise equations. It includes several sets of dispersion coefficients, alternative plume rise equations, and various options concerning plume downwash, such as buoyancy-induced dispersion and terrain adjustment.

Computations are made with an hourly time step and allow if necessary hourly variations in the pollutant emission rates. For every day over the period for which meteorological data are used as input to the model, concentrations are calculated over three different averaging times including one hour, 24 hours and annual. At the end of the simulation the program output provides the maximum value of pollutants considered for each of the three averaging times for each receptor considered over the study zone.

In addition, detailed information about the highest concentrations is computed over the period.

From such results, various levels of pollution can be established and comparisons can be made with current air quality standards.

Input Data

- Plant Data

The complete design of the ISCC Kuraymat power plant has not been developed yet. Thus no data on gas turbine generator units is available. Most of the stack parameters and gas turbine emission characteristics are provided from almost similar gas turbine units in actual operation within the last five years of capacities range from 40-45 MWe each. Plant input data were selected, on that basis, for a gas turbine generator unit of capacity 41 MWe, which is very close to the ISCC Kuraymat power plant unit. Dimensions of the turbine enclosure building and stack locations were assumed. Site General Arrangement (*see Figure 6-1*) was obtained from Fichtner Solar GmbH.

The HRSG and the bypass stacks have the same emission rates. Stack parameters and emission rates are presented below.

Emission Rate (g/s)	Gas	Distillate Oil
NO_2	14.3	30.4
CO	19.8	2.49
SO_2	0.4	35.4
Particulate matter (PM)	2.5	0.32
Stack Parameters		
ByPass Stack Height, m	25.0	25.0
HRSG Stack Height, m	35.0	35.0
Exit Temperature, °C	400	410
Exit Diameter, m	4.8	4.8
Exit velocity, m/s	15.0	15.0
Building Dimensions		
HRSG platform height		12m
Combustion Turbine Bldg. (L x W x H)		33m x 25m x 13.5m
Steam Turbine Bldg. (L x W x H)		33m x 13m x 14 m

It should be noted that the above building dimensions are based on the configuration of the current proposed module. In the stack height determination and the subsequent air dispersion modeling analysis, two units were considered.

- Meteorological Data

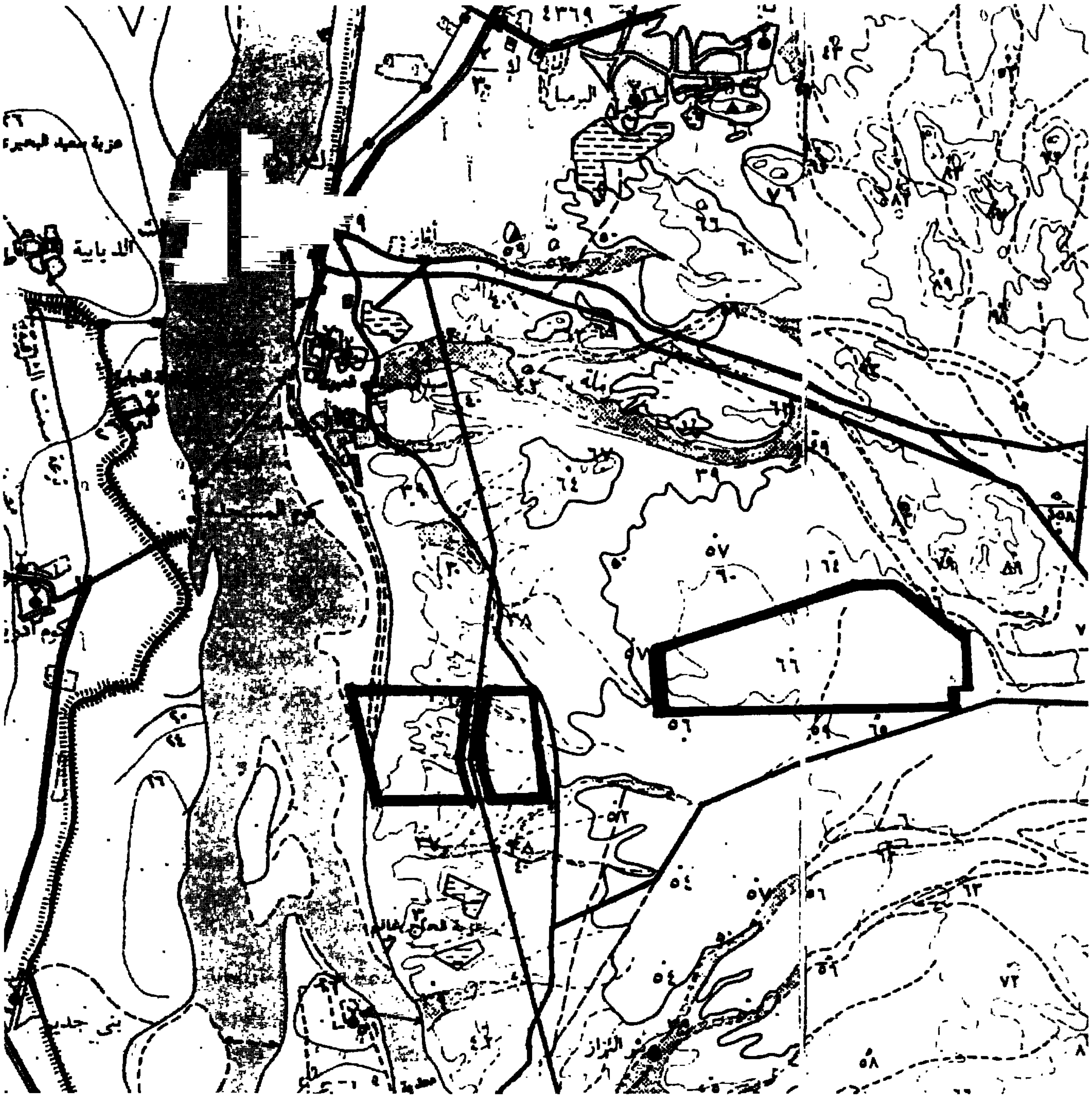
Five years (1993-97) of the Cairo consecutive hourly meteorological data used for the air dispersion analysis. This data was processed from records measured at the Cairo International Airport.

- Background Air Quality Data

The model-predicted maximum concentrations were added to the representative ambient background concentrations in order to compare with the Egyptian Ambient Air Quality Limits (EAAQLs). The total maximum combined impact levels should be lower than the corresponding EAAQLs. The EAAQLs are defined in Law #4 of 1994 (Law for the Environment) established by the Egyptian Environmental Affairs Agency (see Section 2.6.2).

Figure 6-1

Project Zone (Area)Location



The representative onsite background air quality concentrations for the ISCC Kuraymat Project were measured by the National Research Center, air pollution preclusion unit in March 2004 (see Section 5.4.1). These background levels were collected continuously at five monitoring locations at the Kuraymat site. The averages of the maximum monitored levels, as presented in *Table 6-4 (B)* were treated as the air quality levels representing the background status at the Kuraymat site.

The 24-hour average reported in *Tables 5-7 & 5-8* can be converted to the annual average by multiplying conversion factors obtained by extracting from a log-log curve based on the conversion factors suggested by the U.S. Environment Protection Agency EPA, 1995).

Methodology

- Dispersion Model

An air dispersion model was used to estimate the off-site air quality impacts which were investigated to determine compliance of the EAAQLs.

Generally, because of the influence of the major nearby structures, power plant stack effluents might be caught in the wake region downwind of the stack causing adverse air quality impacts. A stack with Good Engineering Practice (GEP) height has a minimum stack height at which significant adverse aerodynamic effects are avoided (EPA, 1981). The U.S. Federal Government issued the Stack Height Regulation in 1985 (40 CFR 51) to define the GEP stack height. To be cost effective, sub-GEP stack heights are often built in the United States if the predicted air quality impacts do not exceed the regulated air quality standards or limits under plume downwash conditions. However, the Egyptian Law No. 4 (1994), Article 42, Item B stipulates that "stacks from which a total gaseous wastes reaches more than 15,000kg/hr, the height of the stack shall be more than at least two and half times the height of the surrounding building, including the building served by the stack." Consequently, the main HRSG stacks were designed to satisfy the requirement of Egyptian Law No. 4. The bypass stacks will not be operated on a routine basis; therefore, a sub-GEP stack height was designed for it.

The major onsite structure, which will dictate both the bypass and HRSG stack heights, is the 14 m high STG building. Based on the dimensions of this building and the proposed stack locations, the U.S. Environmental Protection Agency (EPA)-approved BPIPPRM model (EPA, 1997) was used to obtain the building downwash parameters for the bypass stack. The BPIPPRM is the revised Building Profile Input Program (BPIP, 1995) to be used in conjunction with the EPA-approved Industrial Source Complex/Plume Rise Model Enhancements (ISC-Prime) air dispersion model (EPA, 1997). Building downwash parameters generated by the BPIPPRM model were used as part of the input data for the ISC-Prime model. The ISC-Prime model was selected for this study because it has incorporated enhanced plume dispersion coefficients due to the building wake, and reduced plume rise caused by a combination of the descending streamlines in the lee of the building, as well as the increased entrainment in the wake.

- Grid Networks and Flagpole Receptors

In order to assess the onsite impact from the downwash plume, two flagpole receptors were placed at each of the 12-m height HRSG platform where workers perform the routine maintenance services. Three flagpole receptors at different elevations (22 m, 30 m, and 34 m) were also placed along each HRSG main stack to determine the plume impact at the potential stack platforms. Fifty eight discrete receptors with an increment of about 100 m were placed along the site boundary (see *Figure 6-2*). Additionally, 179 near-field off-site Cartesian receptors with 100 m increment were also placed between the site boundary and the 1100-m circle. For convenience, the origin of the Cartesian network is supposed to be placed at the middle of a line connecting the centers of the two main stacks. As depicted in *Figure 6-2*, the 1100-m radius encompassed the entire site boundary.

Beyond 1100 m from the origin, a polar grid receptor network was further used to assess the far-field off-site air quality impacts. Using the same origin as the Cartesian network, the polar network consists of 36-direction radials incrementing by 10 degrees with radial distances of 1.1 km, 1.25 km and beyond. Above 1.25 km, an increment of 250 m was used up to 4 km downwind. Beyond that, the grid system extends to 7 km (4.5 km, 5.0 km, 5.5 km, 6.0 km and 7.0 km). The radial distance was extended to 7 km in order to identify the maximum impact locations for different averaging periods.

- Number and Location of Monitors

Station Pre-Construction Phase

Based on the U.S. Environmental Protection Agency guidance (EPA, 1987), air dispersion modeling should first be performed to determine the general location(s) of maximum air pollutant concentrations from the proposed source. Secondly, the general location(s) of maximum air pollutant concentration from the existing sources should be determined. Thirdly, combined impacts from the proposed source and the existing sources should be analyzed. This approach would provide sufficient information to determine the number of monitors required to encompass (a) the location(s) of the maximum air pollutant concentration increase expected from the proposed source, (b) the location(s) of the maximum air pollutant concentration from existing sources, and (c) the location(s) of the maximum combined impact area.

Because of logistic limitations, i.e., security, available power supply, and existing structure, monitoring should be conducted in or as close to these areas as possible Generally, one to four sites would cover most situations in multiple settings. For areas in which the permit granting agency has determined that there are no significant existing sources, a minimum number of monitors would be needed, i.e., one or possibly two at the most.

Station Post-Construction Phase

Air quality monitors should be placed at (a) the expected area of the maximum concentration from the new source, and (b) the maximum combined impact area(s). Locations for these monitors may be different from those sites for the pre-construction phase due to other new sources in the area since the pre-construction monitoring.

In general, two to three sites would be sufficient for most situations in multi-source areas. In areas where there are no significant existing sources, one or two sites would be sufficient.

Modeling Results

- BPIPPRM

The BPIPPRM-generated GEP stack height estimates and building profile parameters is used by the ISC-Prime. GEP stack height for the HRSG stacks is 35 m above grade. The STG Building height of 14 m dictates this GEP stack height. Basically, the GEP stack height is calculated as:

$$Hg = h_B + 1.5L$$

where Hg is the GEP stack height, h_B is the nearby major building height, and L is the dimension of the major building height or width whichever is less. Since the existing STG Building height (14 m) is less than the STG building width, the GEP stack height was calculated as $Hg = 2.5\ h_B = 2.5 \times 14 = 35$ m.

ByPass1 and ByPass2 are referring to the bypass stacks, and VENT1 and VENT2 are referring to the HRSG stacks, while VENT3 and VENT4 are referring to the existing 2 x 600 MWe 152-m stacks and VENT 5 and VENT 6 are referring to the proposed by pass I and by pass II 80 m stacks of the proposed 750 MWe combined cycle module in the location of the existing Kuraymat thermal power plant (extension) (see *Figure 6-1)*.

The bypass stack height was designed as 25 m. Usually the bypass stack height is designed to be about 1.5 times building height. For example, the nearby STG building height is 14 m; thus, the bypass stack height could be 21 m high. At this height. the bypass stack would be at the cavity height created by the STG building. The exhaust plume could be caught within the cavity zone, which is formed by enclosed circulations. Once the plume is caught in the cavity zone, relatively high ground level pollutant concentration would be expected. To avoid this type of adverse effect, sub-GEP stack heights are usually designed not too low from the cavity height. The thermal and momentum plume rise would assist the plume to escape from the cavity zone even if the stack elevation is slightly lower than the cavity height. The cavity height induced by the closest CTG building, which is 13 m in height, would be about 20.5 m. A bypass stack height of 25 m was determined after several iterative runs.

- ISC-Prime Modeling Results

As described in the former section, using different stack heights, iterative runs were made to identify the optimum stack height that will satisfy the EAAQLs for the operation of the bypass stacks. Comparing to the HRSG stacks, the bypass stacks have a higher exit temperature and exit velocity. Consequently the bypass stacks are expected to produce a higher plume rise. As discussed before, the bypass stacks will not be operated on a routine basis. Therefore, the physical stack height of the bypass stacks can be somewhat lower than that of the HRSG stacks without creating adverse effects when the plant is under normal operation. However, a downwash analysis was performed to determine a sub-GEP stack height for the bypass stacks in order to safeguard the performance of the bypass stack.

Mainly two scenarios were considered in this modeling analysis.

1) Normal Operational Mode - two HRSG stacks.
2) Normal Operational Combined Mode - two HRSG stacks + existing 2 x 600 MWe stacks + proposed 2 x 250 MWe stacks (proposed extention of the existing Kuraymat)

Scenario 2 was studied to determine the combined impact from the operation of the proposed units under the normal operation and the existing units in addition to their proposed extension. (see *Figure 6-1).*

On-Site Impacts

Ambient air quality standards or limits apply to off-site receptors. To safeguard workers' health, onsite air quality impacts were estimated by placing discrete receptors on the 12-m high platform surrounding each of the HRSGs. This platform is crucial because it is where workers are most likely to perform routine maintenance works. Also, three potential platforms around the HRSG stack were assumed to locate at 22, 30 and 34-m levels. Health-related onsite air quality impacts at these platforms were assessed because workers might need to perform stack sampling or maintain the stack emission monitoring system occasionally at these platforms while the plant is under normal operation.

The model-predicted onsite maximum air quality impacts were compared to the time-weighted average (TWA) concentration for a normal 8-hour workday (40-hour work week) health-related air quality limit implemented by the U.S. Occupational Safety and Health Administration (OSHA, 1990).

The worst-case 8-hour NO_2 concentration that occurred on the HRSG platform is 8.32 μg/m3, while the worst-case 8-hour NO_2 concentration on the HRSG stack platform is 62.1 μg/m3 occurred at the 34-m level.

The OSHA limit for NO_2 is 6 mg/m^3. The OSHA limits are for a 40-hour workweek, while the model-predicted 8-hour maximum is unlikely to occur continuously for 5 working days. Unlike the 12-m level HRSG platform where workers might need to perform routine maintenance, the use of the higher-level platforms along the HRSG stack is an infrequent event. Since the model-predicted 8-hour NO_2 concentrations are relatively small compared to the 40-hour OSHA limit, no significant onsite air quality impact is expected. Above all, the normal operation would involve the combined cycle mode, which uses the HRSG stacks; instead of the simple cycle mode, which uses the bypass stacks. In conclusion, the health-related onsite air quality poses no significant impact to the onsite workers during the working hours due to the operation of the proposed units.

Off-Site Impacts

The ISC-Prime modeling results are presented in *Table 6-5* and *Table 6-6* for cases involving the normal operation of the HRSG stacks only, and the normal operation of them plus the existing units (2x600 MW) in addition to the proposed extension (2x250 MW). As noted, the Egyptian Law #4 of 1994 requires that the main stacks shall be more than at least two and half times the height of the surrounding building, including the building served by the stack. Section 6.2.4 indicates that the GEP stack height is 35 m. Therefore, the 35-m HRSG stacks were designed for the project. This decision satisfies the Law #4 requirement.

Scenario 1

Under the normal operational mode, the NO_2 hourly maximum impact (211.4 $\mu g/m^3$) from the operation of the HRSG stack is about 52.85% of the corresponding EAAQL (400 $\mu g/m^3$).

It is worthmentioning that during maintenance, the plant would operate only one HRSG stack and one bypass stack.

Scenario 2

Under the normal operational combined mode, the NO_2 hourly maximum combined impact (295.0 μg/m3) from the operation of the HRSG stacks and the existing 2 x 600 MWe units in addition to the proposed 2 x 250 MWe units is about 74% of the corresponding EAAQL (400 μg/m3).

It is worthmentioning that during maintenance, the plant would operate only one HRSG stack and one bypass stack. The air quality impact during maintenance period is somewhat higher than under normal operation, but the increases do not exceed very small fractions of the normal operation case. This is expected because the bypass stack has a sub-GEP height, which could induce higher ground level pollutant concentrations due to plume downwash within the wake zone.

In summary, with the consideration of the representative background air quality level, the operation of the 35-m HRSG stacks and the 25-m bypass stacks under normal operation will meet the corresponding NO_2 EAAQLs.

Final Results

Air Monitoring Siting

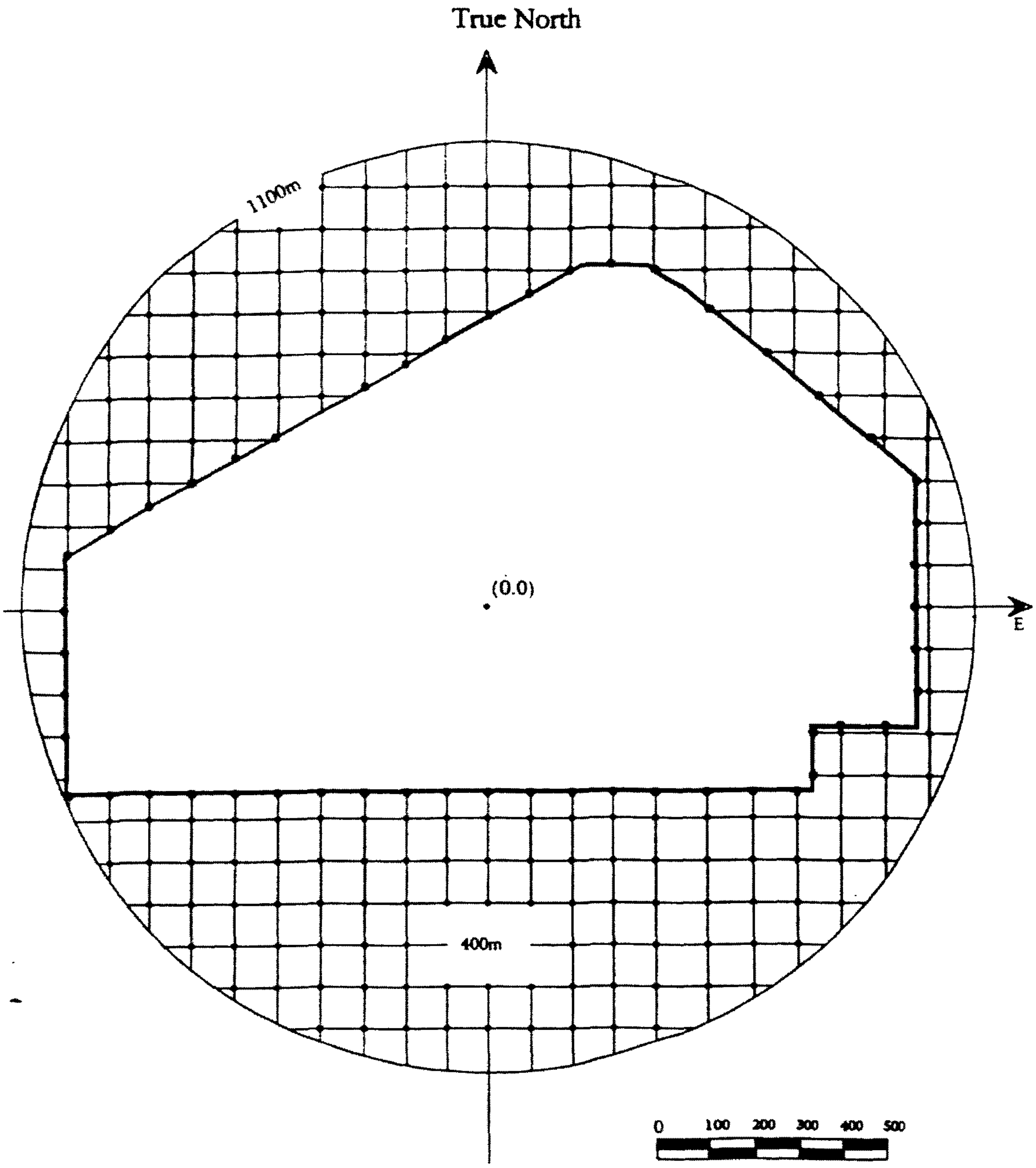
For monitoring siting purposes, a modeling analysis was performed to evaluate the combined effect of the proposed sources and the existing sources. As shown in *Tables 6-5 & 6-6*, using 5-years (1993-1997) of meteorological data, the maximum 1-hour impact area contributed by the proposed ISCC sources alone occurred mostly around (250 m, -350 m), while the maximum 1-hour impact area contributed by the proposed and the existing sources occurred all around (-2190 m, -1375 m). The maximum impact locations of the proposed ISCC sources never exceed 400 m from the proposed stacks. This relatively short distance from the proposed ISCC sources would result in easier management of the monitoring stations.

These maximum impact areas are presented in *Figure 6-3*. The origin of the Cartesian coordinate system is placed at the mid-point of the proposed ISCC stacks. In general, at the maximum combined impact areas, the contribution from the proposed new sources is negligible. Therefore, at these maximum impact areas, the contribution from the existing and proposed Kuraymat sources is dominating

As a result, monitoring stations are proposed to be installed at the maximum combined impact areas. There is no need, actually, to monitoring stations at the maximum impact areas contributed by the proposed ISCC sources alone. The NO_2 monitoring stations are to be installed at shaded areas as suggested in *Figure 6-3* which will be the responsibility of UEEPC.

Figure 6-2

ISCC Kuraymat Power Plant Modeling Receptor Grid System
(Within 1100-m Radius, Grid Spacing = 100 m)



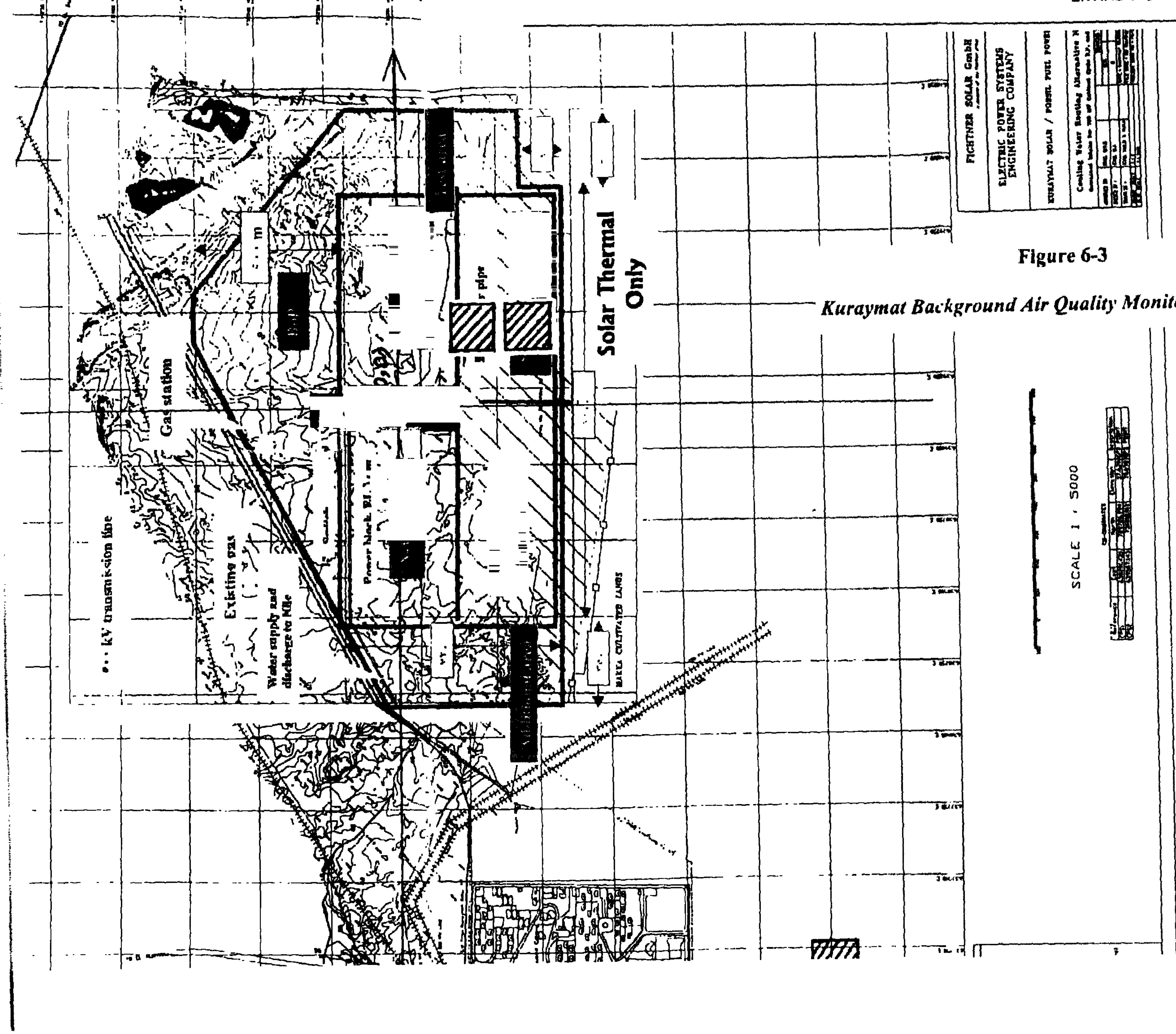


Figure 6-3

Kuraymat Background Air Quality Monitoring Locations

Table 6-4 (A)

Egyptian Ambient Air Quality Limits, Law #4 ($\mu g/m^3$)

Averaging Time	SO_2	CO	NO_2	TSP
1-hour	350	30,000	400	N/A
8-hour	N/A[1]	10,000	N/A	N/A
24-hour	150	N/A	150	230
Annual	60	N/A	N/A	N/A

Notes:

(1) N/A = Not Available

Table 6-4 (B)

Kuraymat Background Air Quality Levels [1] ($\mu g/m^3$)

Averaging Time	SO_2	CO (mg/m^3)	NO_2	TSP
1-hour	170.7	N/A	177.75	N/A
8-hour	N/A[2]	1.6	N/A	N/A
24-hour	68.28	N/A	71.1	744.2
Annual	13.66	N/A	14.22	N/A

Notes:

(1) Reference: Air Pollution Preclusion Unit, National Research Center, Cairo, March 2004.
(2) N/A = Not Available

Table 6-5

ISCC Kuraymat ISC-Prime NO_2 Modeling Results
(Normal Operation-HRSGs Only)

Period	Annual Average	1-Hour Average	24-Hour Average
	HRSGs Only	HRSG Only	HRSGs Only
1993	2.2 (100m , - 450 m)	33.4 (250m, - 350m)	13.8 (250m , - 450 m)
1994	2.2 (100m , - 450 m)	33.4 (250 m, -350 m)	13.5 (250m , - 400 m)
1995	2.4 (150m , - 450 m)	33.1 (150 m, -350 m)	14.1 (250m , - 450 m)
1996	2.7 (100m , - 450 m)	33.1 (250 m, -350 m)	13.2 (300m , - 450 m)
1997	2.1 (200m , - 450 m)	33.7 (250 m, -350 m)	13.0 (250m , - 400 m)
Maximum	2.7	33.7	14.1
Background	14.2	177.7	71.1
Total	16.9	211.4	85.2
Egyptian Limit	N/A(1)	400	150(2)

Notes:
(1) N/A = Not Available
(2) Egyptian Standard is for NOx.

Table 6-

Kuraymat ISC-Prime NO_2 Modeling Results
(Normal Operation –Combined Effect)

Period	Annual Average	1-Hour Average	24-Hour Average
1993	9.6 (-1840m, -1690m)	115.2 (-2190m, -1375m)	38.2 (-1940m,- 1690m)
1994	11.8 (-1840m, -1690m)	117.3 (-2190m, -1375m)	40.5 (-1940m,- 1490m)
1995	8.4 (-1840m, -1690m)	110.9 (-2190m, -1375m)	37.7 (-1940m,- 1690m)
1996	11.2 (-1940m, -1690m)	113.5 (-2190m, -1375m)	39.1 (-1740m,- 1690m)
1997	8.7 (-1940m, -1690m)	110.3 (-2190m, -1375m)	36.5 (-1940m,- 1490m)
Maximum	11.8	117.3	40.5
Background	14.2	177.7	71.1
Total	26.0	295.0	111.6
Egyptian Limit	N/A(1)	400	150(2)

Notes:
(1) N/A = Not Available
(2) Egyptian Standard is for NOx.

As can be seen from the Tables, whichever standard is selected, the additional concentrations are a relatively lower fraction of the value required to equal that which would cause an exceedence, even allowing for the existing concentrations. Accordingly, no waiver offset regarding the airshed will be required.

Mitigation Measures

On the basis of the dispersion modeling results, no further mitigation measures are required to reduce stack emissions (i.e. beyond the use of natural gas and low-NOx combustors). The stack height (35 meters) has been designed to reduce pollutant air concentrations and optimize atmospheric dilution of the stack plume and is adequate for this purpose.

Conclusion

Although these concentrations of pollutants have been established for the worst case operating conditions of the plant (continuous operation of the two gas turbines at 75% load during continuous operation of the existing two 600 MWe thermal steam turbine units at full load in addition to continuous operation of the proposed extention of the 750 MWe module having two 250 MWe gas turbines at 75% load) using the primary fuel, they still remain below the Egyptian requirements and the World Bank guidelines corresponding to the air quality standards. Their addition to the existing background concentrations will not cause these standards and guidelines to be exceeded. The plant will have no significant impact on the ambient air quality.

6.2.6 Fugitive Emissions from Fuel Storage Tanks

There will be two principal fixed-roof fuel storage tanks on the power plant site for storage of light fuel oil. Fugitive emissions from fixed-roof tanks may occur as a result of evaporation of the liquid fuel into the space between the roof and the liquid surface. This vapor may be emitted to the atmosphere through vents during the tank filling process. However, since the fuel oil consists of low volatility liquid and the tanks will only be filled infrequently (as this fuel will only be used if natural gas is unavailable), the potential for significant releases through venting of the tanks is limited and therefore the potential to cause odor nuisance is not considered to be significant. Additionally, the nearest receptors are far away.

6.3 AQUATIC ENVIRONMENT

6.3.1 Introduction

This section considers the significance of potential impacts to the aquatic environment from the construction and operation of the ISCC Kuraymat power plant. The section is based on conceptual design work undertaken by Fichtner Solar GmbH, and survey and comparison work and economic analysis for cooling system alternatives undertaken by Power Generation Engineering and Services Company (PGESCo) in April 2004, delivered to E&E in June 2004.

6.3.2 Potential Construction Impacts

The potential impacts on the aquatic environment during construction are likely to occur as a result of:

- laying of pipes across the Nile bank;
- dredging process for the intake structures;
- construction of the inlet structures;
- construction of the discharge system structures;
- natural surface drainage of contaminants and sediments; and
- discharge of solid wastes and industrial liquid effluents into the water body.

The potential impacts that can be anticipated as a result of these activities are summarized in *Table 6-7* below.

Table 6-7

Summary of Potential Construction Impacts on the Aquatic Environment

Activity	Potential Impacts
Dredging	• Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Loss of aquatic habitat. • Disturbance to benthic animals. • Disturbance to mobile animals including fish and birds. • Disturbance due to disposal of dredged materials. • Disturbance to fishing. • Navigational constraints.

Table 6-7 (Contd.)

Summary of Potential Construction Impacts on the Aquatic Environment

Activity	Potential Impacts
Construction of intake structures	• Discharge of effluents to the Kuraymat Nile segment. • Permanent loss of aquatic habitat. • Navigational constraints. • Disturbance to fishing. • Elevated suspended sediment levels. • Alteration of sediment transport regime. • Disturbance to birds.
Construction of discharge system structures	• Temporary spillage of chemicals and disposal of wastes.
Surface water runoff	• Elevated suspended sediment levels. • Oily water effluent discharge. • Elevated concentrations of pollutants released from sediments into water column.
Construction of pipeline across bank	• Temporary disturbance to bank habitat. • Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Disturbance to birds.

Physical Aquagraphy

The construction methodology for the intake structures remains to be defined. Dredging will however, be required for the intake structures. This is likely to result in very local alteration of the prevailing currents immediately adjacent to the dredging works. This in turn will result in some local and limited changes to scouring and deposition rates adjacent to the dredging works.

The impacts identified are considered acceptable and no mitigation measures are proposed. The construction method for the intake structures will include an acceptable operational procedure which will minimize the impacts from dredging and construction on sedimentation. This should be included in any contract which NREA commission.

During construction, arisings from the dredging process will be disposed of on the existing site of the power plant or via a licensed contractor. No special permit is required and no significant impacts are anticipated.

Impacts on Water Quality

Any dredging will mobilize sediments into the water column and result in an increased suspended sediment load.

Heavy metal concentrations in sediments measured at the site, can be compared with standards applied in Holland and which are commonly used on a global basis[(1)]. The heavy metal concentrations measured at the five sample locations before the site of the power plant, are compared with these reference values in *Table 6-8* below.

Table 6-8

Reconciliation of Measured Sediment Concentration (mg/kg) with Dutch Standards

Parameter	Measurements Taken at the Proposed Site					Dutch Guidelines		
	Site 1	Site 2	Site 3	Site 4	Site 5	Reference Value	Testing Value	Signaling Value
Cd	0.1	0.2	0.5	0.3	0.1	0.8	7.5	30
Cr	0.42	0.40	0.63	0.61	0.56	100	480	1000
Pb	0.28	0.25	0.86	0.70	0.54	85	530	1000
Ni	0.44	0.50	0.71	0.68	0.52	35	45	200
Zn	2.0	2.05	0.95	2.38	3.86	140	1000	2500

Explanatory Notes:
Sediments containing metals in concentrations below the "reference value" are considered uncontaminated, and are suitable for general disposal if present in dredged material at these concentrations.

Contaminant concentrations between the "reference value" and the "testing value" are considered moderately contaminated, and can be disposed of in open water under suitable conditions.

Sediments containing chemical concentrations between the "testing value" and the "signaling value" are heavily contaminated, and can only be disposed of under controlled conditions

If the "signaling value" is exceeded, then the material is considered toxic waste, and is not suitable for Nile disposal.

The pollutant concentrations are far below the reference value shown in the Dutch Standards for all parameters considered in the table. These concentrations are below the "reference

(1) Andries Krijgsman, Classification systems for sediment quality and dredged material handling, disposal and beneficial use in the Netherlands, November 1996.

value" and are therefore considered un contaminated. The Dutch guidelines recommend that un contaminated sediments are suitable for general disposal if present in dredged material at these concentrations.

It is anticipated that disposal of dredged arisings will take place on the power plant site or via a licensed contractor (no permit will be required).

Groundwater and Effluents

Construction activities could potentially also result in the release of solid wastes and effluents to the ground water. This should be limited to a minimum by using the best construction techniques. A stormwater collection system, which is discussed in more detail in Section 6.7.3, will be provided that will include oil interceptors. Sanitary effluents will be disposed of via power plant sewage disposal system. Solid wastes will be disposed of by a licensed contractor.

The impact of construction on groundwater resources will be minimal as no boreholes will be located in the area and groundwater abstraction is not required during the construction phase. The only potential impacts will arise from spillage of chemicals and disposal of wastes and this has been addressed above.

Reduced infiltration may occur, but this will be low and, as there are no wells in the immediate area, the impact will be insignificant.

Aquatic Ecology

There are a number of impacts associated with the construction of the intake structures:

- temporary loss of bank habitat;
- permanent loss of aquatic habitat;
- new bank surface habitat will be generated due to the material used in the construction of the intake structures and will be colonized by algae and organisms and may encourage fish species; and
- disturbance of benthic and mobile fauna and flora as a result of settlement of suspended sediments through interference with feeding mechanisms, gills and reduction of photosynthetic activity.

With regard to the loss and disturbance to benthic fauna and flora the following should be noted:

- the area where losses may occur is relatively small in the context of the Nile river, the construction of the intake water structures will disturb a very limited area. The sensitivity of the benthos in this area is low, since much of the riverbed being degraded with poor biodiversity;

- much of the losses are temporary in nature and it can be expected that dredged sediments will be re-colonized within a relatively small period; and
- field survey information did not identify any fauna, flora or habitats of conservation importance.

The impacts of the power plant on birds is discussed in Section 6.5.

Fish and Fisheries

The impacts on fish and commercial fisheries, in case of abstracting water from the Nile river, are expected to include the short term and local effects due to elevated concentrations of suspended sediments and pollutants in the water column. The natural dilution and dispersion in the area of construction will ensure that the suspended sediment load and elevated pollutant levels are rapidly reduced to background levels. The survey of the project indicated that the area was limited in fish populations.

In addition to suspended sediment and pollutant loads there may be physical disruption to fishing activity due to dredging. However, given that the area adjacent to the power plant is currently limited as used for commercial or artisanal fishing, the overall impact is not considered significant.

The impacts identified relating to water quality are considered not significant and no mitigation measures are proposed.

With regard to Nile bank birds, construction activities, if undertaken, will cross landflats from the Nile river to the steam turbine condenser during laying of water intake pipes. The Nile bank and landflats affected will however be restored between the site perimeter and the Nile, using material which has been excavated. Significant impacts to birds in this area are therefore considered unlikely (see Section 6.5).

Access to Nile Bank

The area of Nile bank potentially to be affected by the construction of the cross bank pipelines and intake structures is not currently used for leisure or recreation. The construction activities are not therefore expected to affect Nile bank access.

6.3.3 Potential Impacts During Power Plant Operation

The potential impact of the power plant on the aquatic environment could be the result of:

- the presence of new structures;
- the physical characteristics of effluents discharged into the surrounding environment; and
- the chemical composition of effluents discharged.

The potential impacts related to the operation of the power plant are summarized in *Table 6-9* and are discussed in further detail below.

Table 6-9

Operation Related Environmental Impacts

Issue	Impacts
Presence of new structures (Nile water abstraction)	• Sediment scour. • Disruption to sediment transport along Nile bank. • Navigational constraints. • Fisheries constraints.
Discharge	• Impact of changes in physical characteristics (e.g. temperature, humidity, evaporation, etc.) on aquatic ecology and surrounding environment. • Discharge of chemicals.
Intake	• Entrainment of fish and mobile organisms (if Nile waters are abstracted).

Cooling System Alternatives

Based on the comparison study carried out by PGESCo (Annex C), different alternatives for supplying cooling water to the proposed power plant have been investigated. The study aimed at analyzing two main options for providing cooling water, namely once through and closed circuit cooling systems.

Cooling requirements and main configuration for each case were assumed as follow:

- Once Through Cooling System-Option I:
  - The condenser heat duty — 128.96×10^6 J/s
  - Circulating water flow rate — 6.2 m^3/s
  - Temperature rise across the condenser — 5 °C
  - GRP Pipeline

- Once Through Cooling System-Option II:
  - The condenser heat duty — 128.96×10^6 J/s
  - Circulating water flow rate — 6.2 m^3/s
  - Temperature rise across the condenser — 5 °C
  - Pre-stressed Pipeline

- Once Through Cooling System-Option III:
  - The condenser heat duty — 128.96×10^6 J/s
  - Circulating water flow rate — 3.9 m^3/s
  - Temperature rise across the condenser — 8 °C
  - GRP Pipeline

- Once Through Cooling System-Option IV:
  - The condenser heat duty — 128.96×10^6 J/s
  - Circulating water flow rate — 3.9 m^3/s
  - Temperature rise across the condenser — 8 °C
  - Pre-Stressed Pipeline

- Closed Circuit Cooling System-Option V:
  - Cooling tower heat duty — 129.3×10^6 J/s
  - Circulating water flow rate — 3.1 m^3/s
  - Temperature rise across the condenser — 10 °C
  - Make up flow rate — 0.048 m^3/s
  - Blow down flow rate — 0.01 m^3/s
  - Make up and blow down from the ground water reservoir

- Closed Circuit Cooling System-Option VI:
  - Cooling tower heat duty — 129.3×10^6 J/s
  - Circulating water flow rate — 3.1 m^3/s
  - Temperature rise across the condenser — 10 °C
  - Make up flow rate — 0.048 m^3/s
  - Blow down flow rate — 0.01 m^3/s
  - Make up and blow down from and to the Nile river

The following section presents the conclusion of this comparison.

Once Through Cooling System

- Option I

The length of the cooling water delivery pipeline is about 3500m, depending on routing of the pipeline and exact location of the condenser. The warm water will flow out of the condenser through around 3300 m length, 1.4 m inner diameter GRP discharge pipeline to the discharge structure. The discharge structure will be located downstream the existing Kuraymat discharge structure.

Figure 6-4 depicts the layout of the proposed once through cooling system.

Calculated power required for pumping pressure for this option is approximately 4.9MWe.

- Option II

The only difference between this option and the previous one (Option I) lies on the material of the pipeline used to convey cooling water which is selected of Pre-Stressed pipes instead of GRP.

- Option III

In option III, the discharge is limited to 3.9 m^3/s and the water will flow through 1.4 m I.D, GRP pressurized pipes from the pumping station location towards the potential location of the condenser. The warm water will flow out of the condenser to the discharge structure through a discharge pipeline of 1.1 m I.D, GRP pressurized pipes.

Calculations proved that the power consumed during pumping process is then 2.3 MWe.

- Option IV

The only difference between this option and the previous one (Option III) lies on the material of the pipeline used to convey the cooling water which is selected of Pre-Stressed pipes instead of the GRP.

Closed Circuit Cooling Tower System

Wet-cooling towers dissipate heat rejected by the plant to the environment by these mechanisms: (1) addition of sensible heat to the air and (2) evaporation of a portion of the recirculation water itself. When operated in the open mode, there is a third mechanism: (3) addition of sensible heat to the natural body of water as a result of the terminal temperature difference (TTD).

Wet cooling towers have a hot-water distribution system that showers or sprays the water evenly over a latticework of closely set horizontal slats or bars called *fill, or packing*. The fill thoroughly mixes the falling water with air moving through the fill as the water splashes down from one fill level to the next by gravity. Outside air enters the tower via louvers in the form of horizontal slats on the side of the tower. The slats usually slope downward to keep the water in. The intimate mix between water and air enhances heat and mass transfer (evaporation), which cools the water. Cold water is then collected in a concrete basin at the bottom of the tower where it is pumped back to the condenser (closed or helper mode) or returned to the natural body of water (open mode). The now hot, moist air leaves the tower at the top.

In closed circuit cooling tower system, after the excess temperature of the cooling water is transferred to the ambient air, the water is dripped again to the basin of the cooling tower. The cooling tower is filled with water once, and then a make up pump provides continuous flow to compensate for the water volume lost during ventilation process.

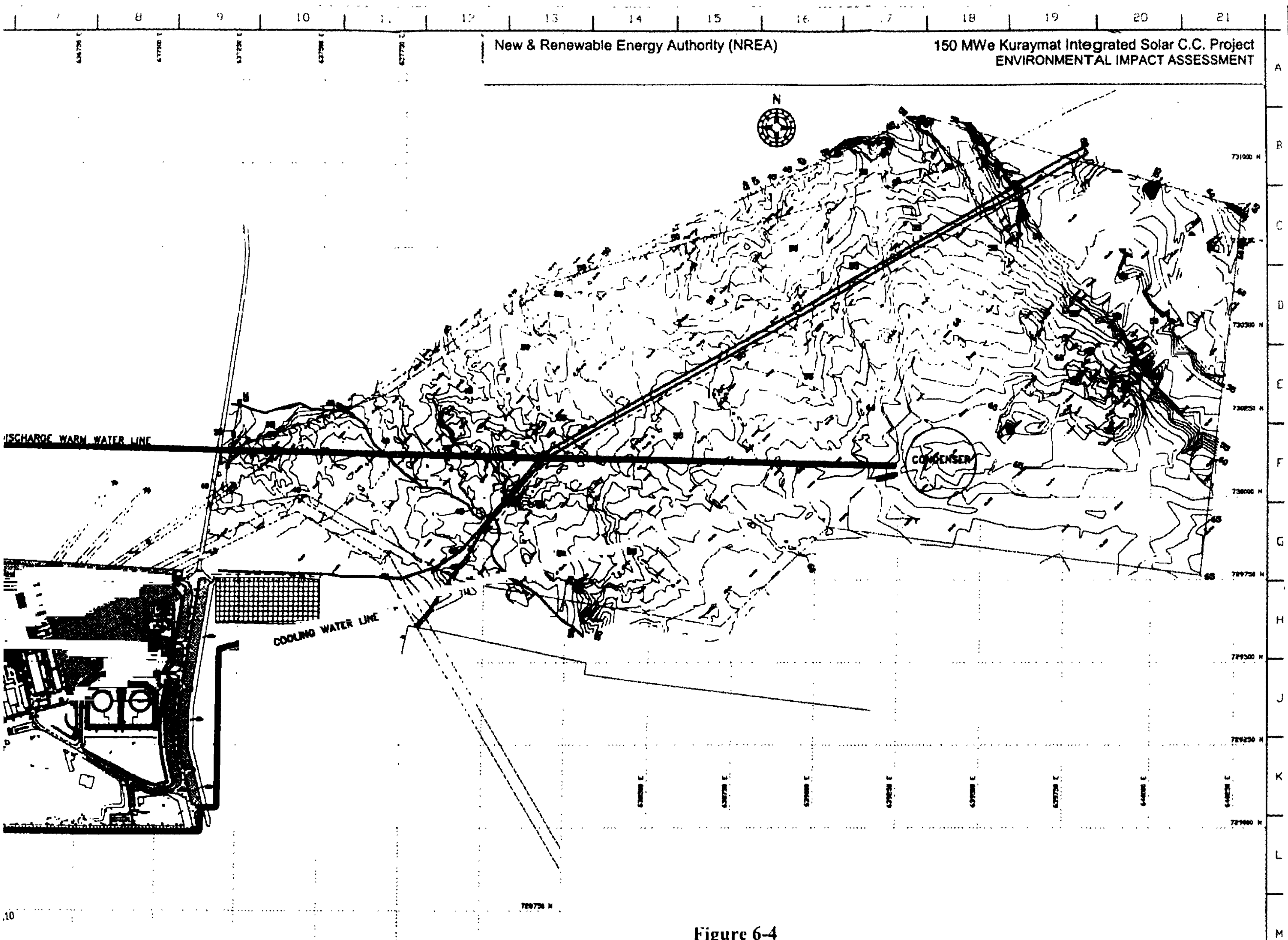


Figure 6-4

New & Renewable Energy Authority (NREA)
150 MWe Kuraymat Integrated Solar C.C. Project
ENVIRONMENTAL IMPACT ASSESSMENT

Make up water may to abstracted either from a deep well if the ground water reservoir assures sustainability of providing the required make up water flow or the Nile river. Blow down water is to be discharged back to the ground water reservoir or to a nearby drain.

- Option V

Make up water will be pumped from a ground water reservoir and the blow down water will be discharged to a well.

Design considerations of the cooling tower include the following:

- Circulating water flow	3.1	m^3/s
- Make up water flow	0.04	m^3/s
- Blow down flow	0.001	m^3/s
- Ambient air temperature	20	°C
- Cooling tower range	10	°C
- Wet bulb temperature	13	°C
- Warm water temperature to the cooling tower	27	°C
- Cold water temperature out of the cooling tower	17	°C
- Blow down water temperature	17	°C
- Total fan motor power	0.77	MWe
- Cycle of concentration	5	(-)
- Number of cells	4	(-)
- Cells arrangement	Train	
- Tower overall dimensions (L x W x H)	to be provided	
- Basin inside dimensions (L x W x H)	to be provided	
- Fan diameter	to be provided	
- Fan stack height	to be provided	
- Structure material	concrete with internals of fiberglass	

Calculations proved that the overall power consumption in cooling tower operation will be the sum of 0.85 + 0.1 + 0.77 MWe or 1.72 MWe.

- Option VI

Last option depends on pumping the make up water from the intake structure of the proposed Kuraymat 750 MWe extension combined cycle project through a GRP pipeline to the cooling tower. Blow down water will be discharged to a nearby drain located about 5km away from the cooling tower. Blow down water will flow through a 100mm GRP pipeline to the drain. Consumed power for make up water abstracted from the Nile river is about 0.034 MWe and consumed power for blow down water to a drainage basin/wadi or ground well is about 0.00015 MWe. The overall consumed power on option II is then 1.65 MWe.

Cost Analysis

Tables 6-10 and 6-11 present installation (capital) costs as well as operational (running) costs for the once through cooling system and closed circuit cooling system based on the available database.

Table 6-10

Capital Cost Estimates for Both the Once Through and the Closed Circuit Options

Type	Option	Description	Total Cost Estimate (L.E.)
Once Through System	$Q = 6.2\ m^3/s$ $\Delta t = 5\ ^\circ C$	• 1.8 m I.D. GRC intake pipes • 1.4 m I.D. GRC discharge pipes • intake & discharge structures • pumping station: civil works and mechanical equipment	47,890,000
	$Q = 6.2\ m^3/s$ $\Delta t = 5\ ^\circ C$	• 1.8 m I.D. pre-stressed intake pipes • 1.4 m I.D. pre-stressed discharge pipes • intake & discharge structures • pumping station: civil works and mechanical equipment	77,400,000
	$Q = 3.9 m^3/s$ $\Delta t = 8\ ^\circ C$	• 1.4 m I.D. GRP intake pipes • 1.1 m I.D. GRP discharge pipes • intake & discharge structures • pumping station: civil works and mechanical equipment	35,540,000
	$Q = 3.9\ m^3/s$ $\Delta t = 8\ ^\circ C$	• 1.4 m I.D. pre-stressed intake pipes • 1.4 m I.D. pre-stressed discharge pipes • intake & discharge structures • pumping station: civil works and mechanical equipment	59,550,000
Cooling Tower System	• 4-cells • Pumping station • Circulating pump capacity = 1.55 m3/s (Head 20 m)	• make up pump capacity = $0.05\ m^3/s$ – Head 150 m • deep well : 150 m depth – 150 mm diameter • blow down pump capacity = $0.01\ m^3/s$ Head 15 m	15,770,000
		• make up pump capacity = $0.05\ m^3/s$ – Head 60 m • 0.2 m I.D. GRP pipes • blow down pump capacity = $0.01\ m^3/s$ – Head 15 m • 0.1 m I.D. GRP pipes	18,320,000

Table 6-11

Running Cost Estimates for Both the Once Through and the Cooling Tower Systems

<table>
<tr><th rowspan="2">Option</th><th colspan="2">Consumption</th><th colspan="2">Unit Price
L.E.</th><th colspan="3">Total Cost
L.E.</th></tr>
<tr><th>Water (m3/year)</th><th>Electricity (kWeh/year)</th><th>Water (m^3)</th><th>Electricity (kWeh)</th><th colspan="2">Water/year</th><th>Electrical Energy/year (kWeh/year)</th></tr>
<tr><td rowspan="2">Once Through System-Option I and II</td><td rowspan="2">-</td><td rowspan="2">43 x 10^6</td><td rowspan="2">-</td><td rowspan="2">0.15</td><td colspan="2">-</td><td>6.44 x 10^6</td></tr>
<tr><td colspan="3">6.44 x 10^6</td></tr>
<tr><td rowspan="2">Once Through System-Option III and IV</td><td rowspan="2">-</td><td rowspan="2">26.8 x 10^6</td><td rowspan="2">-</td><td rowspan="2">0.15</td><td colspan="2">-</td><td>4 x 10^6</td></tr>
<tr><td colspan="3">2.45 x 10^6</td></tr>
<tr><td rowspan="2">Cooling Tower - Option V</td><td rowspan="2">1.26 x 10^6</td><td rowspan="2">15.07 x 10^6</td><td rowspan="2">0.15</td><td rowspan="2">0.15</td><td colspan="2">0.19 x 10^6</td><td>2.25 x 10^6</td></tr>
<tr><td colspan="3">2.45 x 10^6</td></tr>
<tr><td rowspan="2">Cooling Tower - Option VI</td><td>Fresh Water from Nile 1.26 x 10^6</td><td rowspan="2">14.45 x 10^6</td><td rowspan="2">0.15</td><td rowspan="2">0.15</td><td>0.19 x 10^6</td><td>0.005x10^6</td><td>2.2 x 10^6</td></tr>
<tr><td>Blow down water to drain 0.03 x 10^6</td><td colspan="3">2.4 x 10^6</td></tr>
</table>

Conclusion

The comparative study of the may options for cooling water system demonstrated that at any cases, the cooling tower option is much cheaper than once through system, hence, assessment of environmental impacts of the cooling tower system is addressed below.

The least cost option (V) of the cooling tower system is based on the assumption that the groundwater is available along the lifetime of the power plant at a level of (-150m) under the ground of the proposed condenser location. This should be studied by appropriate experts and hydrogeologists. A comprehensive geophysical, geological, hydogeological, and hydrochemical studies should be carried out to delineate the available water-bearing formations and their average depths.

Impact of Plant Operation on Water Quantity and Quality

Service Water Abstractions

The proposed development will have two major impacts on surface waters during the operational phase: the requirement for potable and service water, including water for make-up for the closed-circuit steam generation water system; for general use and fire-fighting purposes; and the requirement for cooling water.

The make up water for the closed circuit steam generation system will be obtained either from a well to be drilled on site or from the Nile river. Potable water for the facility will be supplied from either two sources, also. Once the facility is fully commissioned the total number of employees will be around 300 persons and this should not place a strain on the existing resources. Assuming a demand of 30 litres per person per day, a rate of 15 m^3/day will be required from this source. The impact of this additional demand on existing water resources is considered to be a small part of the available resource and impacts will be minimal.

Cooling Water Abstraction

As detailed before, underground water or Nile water will be used as the main source of service, potable and make-up water for both the closed-circuit steam generation system and the cooling tower system, thus will provide cold water for the condenser cooling and heat exchangers.

In both options, abstraction of water will occur at a rate of 270 m^3/h (0.075 m^3/s). For the purpose of illustrating the impact of water abstraction on the Nile, abstraction rates are compared with the flow rates of the Nile river at the Kuraymat segment.

The abstraction rate represents a negligible fraction of this flow (see Section 5.5.3) in all months over the year.

For the purpose of analyzing the impact of water abstraction on the groundwater, available information illustrates that, as previously noted (Sections 5.1 and 5.2), the groundwater basin, which lies both beneath and closely adjacent to the Nile valley from Cairo to Aswan, includes an area of about 2 million feddans. Water storage in this linear basin has estimated at approximately 27 billion m^3. However, because the hydrologic balance of the Nile valley alluvial aquifer is directly connected with Nile surface flows, production from the aquifer is nominally the same as withdrawing water from the river. In essence, the valley aquifer is a transmission medium for river surface resource.

The Research Institute for Groundwater drilled two observation wells in the Kuraymat area (east and west banks) in 1979. Water quality data from a well close to the power plant site are shown in *Table 6-12*. The well near the east bank at Kuraymat village found groundwater at 3 meters below the surface; the second well, located directly across from the old power plant site near Nile's west bank, found groundwater 1.5 meters below the surface. Well delivery data were not recorded. These wells were located in lower elevations than the elevation of the proposed ISCC power plant. Geotechnical borings at the Kuraymat area showed groundwater in the floodplain at the same depth as the river and on the plateau groundwater was not found at depths of 40m from the surface.

Table 6-12

Water Quality of Groundwater Near the ISCC Kuraymat Power Plant Site

Constituent	mg/l(1)	EPA National Secondary Drinking Water Levels mg/l(2)
pH (value)	7.8	6.5-8.5
HCO_3	94	-
Ca	92	-
mg	42	-
CI	127	250
Na	80	-
SO_4	6.24	250
K	8.97	-
TDS	852	500
Na (%)	29.5	-

Notes:
(1) Research Institute for Groundwater, 1979.
(2) Environment Reporter part 143, section 143.3, Secondary Maximum Contaminant Levels.

The quality of both surface water and groundwater in the Kureyamt reach of the Nile is generally good. Only in localized sectors where there are concentrated sources of contaminants, such as irrigation drainage return waters, would water quality degradation be expected to occur.

Water Discharges

There are 3 main sources of water discharges for discharge to the discharge system:

- blowdown of cooling towers from the cooling water system.
- backwash water from the water treatment filters.
- regeneration of demineralization plant.

This section also includes impacts associated with other wastewaters and wastes. The baseline characteristics of the Nile waters have been provided in section 5.5 (Aquatic Environment).

Cooling Water Discharge

The cooling water required for the plant will be cooled in a multi-cell cooling tower. The cooling towers will be provided with a blowdown pipe which will discharge water to the discharge system, where the treated water will ultimately be disposed of to a natural flood drain (drainage basin or drainage wadi) or to a ground well, at discontinuous intervals.

The circulating tower blowdown water is warm and fully aerated, contains suspended solids, is relatively high in conductivity, and is a good biological nutrient.

It is almost always corrosive, requiring a corrosion inhibitor such as chromates. To prevent scale and deposits that foul heat-transfer surfaces, it often needs scale inhibitors. Silt washed off the air by the cooling tower usually is in the form of small colloidal mater and is difficult to remove, but can be treated by a family of chemicals called polyelectrolytes. These keep the particles suspended in flowing water but allow them to precipitate in basins where they can be removed as mud. Microbiological growth (algae, slime, bacteria), besides fouling, contributes to corrosion by shielding metal surfaces and thus producing oxygen-concentration cells. In addition, the decomposition of the organisms produces H_2S, CO_2, and other products, themselves corrosive. Chlorination, alternated with biocides, is used (organisms can build up tolerance to chlorine, if used along).

Because of the above additives, cooling-tower bleed or blowdown can be an unacceptable source of pollution to the natural body of water. (Boiler blowdown is another source of pollution. It is mainly thermal but also contains small quantities of phosphates and organics). Bleed may contain chemicals and various minerals contained in or added to the circulating water, including chromate inhibitors, various phosphates, organic and inorganic compounds, combined with some heavy metals.

Bleed, therefore, has to be handled with care. Depending upon the size of plant and the extent of contaminants, it may be discharged to the body of water, treated before being returned, or allowed to mix with other plant wastes, such as boiler blowdown, etc., and treated all in one installation.

An example of treatment is the removal of chromates by reducing them from hexavalent form to trivalent chrome with $FeSO_4$, then precipitated as $Cr(OH)_3$ by elevating the pH with lime (or an alkaline stream from somewhere else in the plant). The resulting sludge can be disposed of in various ways or reused. Another alternative is to use nonpolluting inhibitors, but these are of questionable ability and economics.

Raw Water Treatment

The raw water treatment facility will result in surplus water being produced during the backwash of the water pre-treatment filters. It is recommended that this water be discharged without treatment to the plant plantation irrigation system. Separated wastewater from the pre-treatment plant dewatering system will be recirculted back to the clarifier.

Demineralization Plant

The wastewater produced during the regeneration of the demineralization plant will be neutralized in a dedicated sump and discharged to a common effluent tank before off-site disposal.

The waste collected in an R.C.C. effluent tank will be discharged at a suitable disposal point away from the plant. It is recommended that effluents collected in this effluent tank should be treated as per local environmental regulations before disposal to any outside point (e.g. drainage basin or ground well).

Other Wastewaters

Wastewaters from other sources will include:

- Oily wastewater from collecting pits.
- Sanitary wastewater.
- The GT compressor washing water and boiler cleaning.

Oily wastewater will be collected to the oil/water separator skid. The wastewater will be transferred to the common effluent tank and separated oil will be collected in a drum for off-site disposal by EGPC.

Sanitary wastewater will be collected in local sanitary tanks. It is planned that wastewater will be allowed to overflow into soak pits and dirt collected over a period of time will be disposed off-site by sanitary road tankers. It is recommended, instead, that the power plant should be provided with sanitary wastewater treatment facility where sewage water effluents are treated and mixed, after treatment, with waters used for the plant plantation irrigation program.

The GTG wash water drains and boiler cleaning will be collected in an individual sump. These wastewaters, as per design considerations, will be discharged with a portable pump using flexible hose into a tanker for off-site disposal. It is important that disposal method and location must comply with stipulated regulations.

Disposal of Other Waste Effluents

Other waste effluents resulting from the operation of the facility will include:

- Storm water drainage via the site drainage system will feed to a drainage basin. Oil-contaminated storm water will be discharged via oil/water separator skid. No long-term impact on the aquatic environment is envisaged.

- All storage areas will be equipped with bunds and any fuel and hazardous materials spillages will be directed to the oil/water separator and then to the wastewater treatment system.

- Oil from collecting pits will be collected by the wastewater drainage system. Disposal and/or treatment of the oily waste will be by the EGPC.

- Sludge from potential sources will be collected for appropriate disposal, These sources include:
    - Oil and grit removal tank.
    - Wastewater treatment facility.

Management of Operational Discharges

Figure 6-5 shows liquid effluent management measures which is proposed to be implemented on site. The oil/water separators will operate continuously. Rain waters containing oil will be routed to the oil separator; rain waters without oil will be discharged directly to a drainage basin or a ground well.

All the process effluent, in combination with site drainage from areas at risk of contamination (power block areas, drains and sumps) should be treated and then disposed of to a drainage basin or a ground well. The discharge from the power plant will comply with the Egyptian and World Bank standards for discharge to River Nile and its branches as a minimum *(Table 6-* 13).

Table 6-13

Water Quality Guidelines and Standards Applicable to the Operation of the Plant (mg/l, unless otherwise stated)

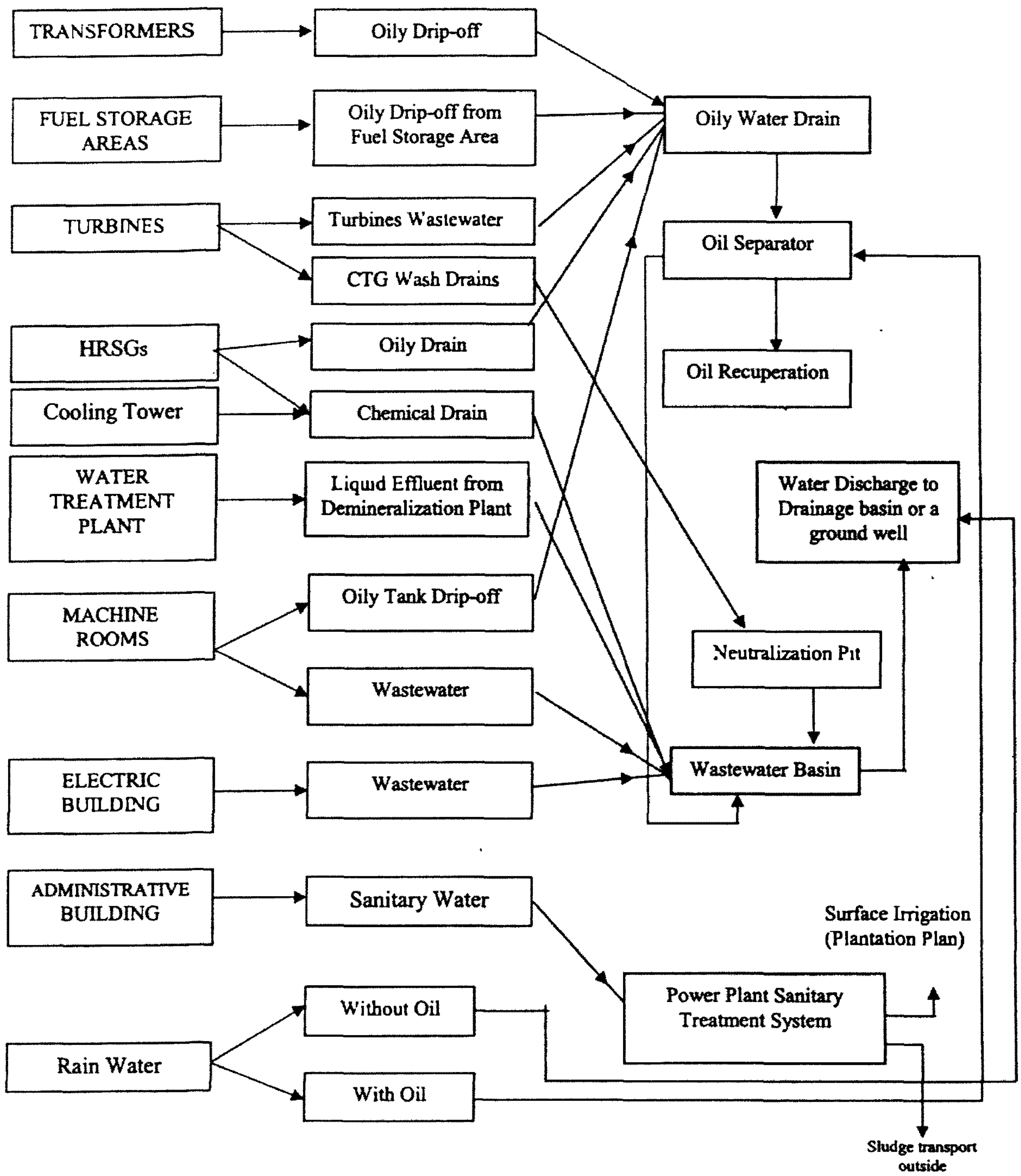
Parameter	Egyptian Standards[1]	World Bank Guidelines	Estimated Characteristics of Discharge
Biological Oxygen Demand	30	-	-
Chromium (total)	0.05	0.5	-
Copper (ppb)	1	0.5	< 0.5
Iron	1	1.0	<1
Oil and Grease	5	10	<5
Suspended Solids (total)	30	50	<30
Residual Chlorine (total)	1	0.2	<0.2
Zinc (ppb)	1	1.0	<1
pH (unitless)	6-9	6-9	6-9

Notes:

(1) Decree No. 8-1983; The Implementary Regulations for Law 48-1982 Regarding the Protection of the River Nile and Waterways from Pollution, Chapter 6, Art 61.

Figure 6-5

Proposed Management of Liquid Effluent at the ISCC Kuraymat power plant Site



In order to ensure compliance with Egyptian and World Bank/IFC water quality standards, an appropriate plant management system will be developed in order to monitor the quality of the discharge.

Impacts on Physical Aquagraphy

When water abstract from the Nile River, the presence of the intake structures will result in local changes to the current regime and attendant changes in scouring and deposition.

Physical aquagraphy has been investigated by the Hydraulics Research Institute (HRI). This work indicates that the impacts identified are however considered to be minor.

Therefore no mitigation measures are proposed.

Water Quality Related Impacts on Aquatic Ecology

Abstractions

The water intake, when water abstract from the Nile river, will result in the entrainment of fauna and flora. Because of the presence of grills, entrainment may result in death and/ or damage to larger organisms including fish which may escape entrainment. Once entrained the fauna are exposed to physical damage, increased temperatures and process chemicals, including biocides at concentrations intended to be lethal to fauna and flora whilst in the cooling system.

The potential for damage is related to the escape speed of the particular animal, the intake velocity and the size of the grills over the intake. It is the younger stages of fish species that are at particular risk from entrainment and damage.

The relatively low intake flow (approximately 0.075 m^3/s even at maximum abstraction rates) is unlikely to entrain a significant number of fish, though those which impinge on the intake screens will be removed from the population. Most of the commercially important invertebrates are benthic and thus less prone to entrainment.

Planktonic larvae may also be entrained, and will suffer increased mortality within the cooling water system, However, this mortality will be insignificant when compared to the natural mortality of planktonic larvae due to predation and other factors.

Discharges

Impacts on aquatic ecology during plant operation will largely be due to the quality of the discharged water.

Chemicals released into the discharge pipelines could potentially have chronic effects on the flora and fauna surrounding the discharge point, if released in sufficient quantities. Water treatment and management system employed at the plant and described above, will however ensure that effluents released do not threaten the ecosystems.

Whilst the impact of entrainment has the potential to be highly negative, it will occur over a very localized area. In addition, the velocity of water drawn into the culvert is considered moderate, which will further reduce the risk of fish entrainment.

Nile Bank Access

Once constructed, the intake structures will be buried in a pipeline across the Nile bank and it is expected that there will be no impacts on the use of the Nile bank as a result of the operation of the power plant.

Impact on Fishing and Navigation

The Nile river segment of the Kuraymat site is not considered to be of significant importance as a commercial fishery. The plant is not therefore expected to have any significant impacts on fishing activities.

Given that the intake structures will be constructed on the bank line, which is far from the navigation channel, therefore structures are not expected to present any hazard to Nile navigation.

6.4 NOISE AND VIBRATION

6.4.1 Introduction

The assessment of the potential noise and vibration impacts considers the following issues:

- noise and vibration from construction activities on the main site and for the cooling water infrastructure (pumping station, cooling water pipelines and intakestructures); and
- noise and vibration during operation, including from the main power plant and the pumping station.

6.4.2 Noise Sensitive Receptors

No more than one residential complex (Ezbet E-Hagg Ghanem) have been identified around the ISCC Kuraymat power plant site, which is about 2500 m south-west of the proposed site boundaries. Only the nearest land uses around the powerhouse will be the old power plant community housing complex, approximately 750 m to the immediate west of the power plant. Kuraymat village is about 3 km north-west of the plant site. *Figure 6-6* presents these noise sensitive receptors.

Due to the construction of the power plant, and irrespective of the rural/desert nature of the proposed site, the area is categorized as "Industrial area", given the existing thermal power plant, with respect to the Egyptian ambient noise standards and "Industrial commercial" with respect to the World Bank environmental guidelines.

6.4.3 Standards and Guidelines for Noise Assessment

In the absence of World Bank or Egyptian standards for construction noise, British Standard BS5228 has been considered to represent good international practice for assessing and controlling noise during the construction phase.

6.4.4 Evaluation of Construction Noise and Vibration

Noise Prediction Methodology

Noise levels from construction activities have been predicted and assessed based on the methods set out in the UK codes of practice (BS5228). Calculations of the combined sound power from all construction plant, adjusted for usage time, have been used to predict the highest potential noise levels for the peak period of construction.

Traffic noise predictions have been carried out using the methodology in the UK Department of Environment (as was) Calculation of Road Traffic Noise which is the standard method of predicting noise from roads in the UK and is considered to represent good international practice.

For the assessment, the following conservative assumptions have been made:

- fixed construction plant is located close to the center of the site;
- mobile construction plant has been assumed to use a haul route that follows the perimeter of the site; and
- no account has been taken of the attenuation in noise levels due to acoustically soft ground or due to screening from intervening buildings.

The type and number of plant assumed to represent the worst case during the peak period of construction, are presented in *Table 6-14*.

Table 6-14

Major Construction Plant on Site During the Peak Construction Period

Equipment	Number	Utilization Factor (1)	Day (D) Night (N) (2)
Tracked cranes (cranes, elevators, hoists, etc.)	9	50%	D, N
Air compressors	4	80%	80%D, 20%N
Bulldozers (bulldozers, IT-28, .. etc.)	5	75%	D
Truck cement mixers	3	50%	50%D, 20%N
Dump trucks (including rough terrain vehicles)	(3)	-	D
Diesel generators	3	20%	D, N
Welding equipment and generators	27	40%	60%D, 40%N
Batching cement plant	1	80%	80%D, 20%N
Grader (includes motor grader)	1	40%	D
Wheeled excavator / loader trucks	(3)	-	D
Lorries	(3)	-	D, N

Notes:

(1) Utilization factor is the percentage of time equipment is engaged in productive work and may generate significant noise,

(2) 'D' indicates daytime shift (07:00-17:00 hours) and 'N' indicates night time shift (17:00-07:00 hours). Percentage indicates the level of use in each shift,

(3) Equipment has been assumed to use the haul route / on-site road adjacent to the site boundaries. An average flow of 20 vehicles per hour has been assumed.

Noise from the Construction Site

Using the worst-case assumptions, the predictions of potential levels of construction noise at the nearest receptors during peak construction phase are presented in *Table 6-15*, together with applicable Egyptian noise standards. The Egyptian noise standards are applicable to long term (i.e. operational) noise levels, but are included for reference in assessing the potential magnitude of impacts from short term construction noise. Reference is also, made below to construction noise criteria used in the UK. It should be noted that no construction noise limits are published in World Bank guidance.

Table 6-15

Indicative Worst-case Construction Noise Levels at Nearest Receptors

Receptor	Distance from the Power house (m)	Egyptian Standard (dB(A))		Predicted Noise Level (dB(A))	
		Day-time	Night-time	Day-time	Night-time
Es-Saff/Beni-sueif Road (1)	1200	60-70	50-60	49	45
Ezbet El-Hagg Ghanem	2500	60-70	50-60	<50	<50
Community Housing Complex to the West of the Powerhouse	750	60-70	50-60	56	53

Notes:
(1) Categorized as "Industrial Area" in Egyptian Standards.

From *Table 6-15* it can be seen that in the absence of noise mitigation measures, construction noise levels are predicted to comply with the Egyptian standards. In the UK a daytime construction noise criteria of LAeq 70 dB is generally used to assess construction noise in rural areas. This level is not predicted to be exceeded. Hence no construction noise impacts are expected.

Noise from Construction Traffic on the Site Access Road

Assuming that a haul route will pass the residential properties east the power plant site at a distance of more than 200 m, the resulting predicted noise levels will be less than 46 dB(A). This noise level is within the Egyptian and UK standards and, hence, no significant impacts are predicted.

Noise from Construction Traffic on the Road Network

Noise levels from traffic on local roads have been predicted for the peak construction activity during 2005-2006, both with and without the potential construction traffic. Predicted noise levels at the roadside are shown on *Table 6-16* below.

Table 6-16

Roadside Noise Levels from Construction Traffic $_{LA10,\ 18hour}$ [(1)]

Receptor	Without construction	With Construction	Increasing
Es-Saff/Beni-sueif Road	66.4	66.7	+ 0.3

Notes:
(1) 18 hour traffic flows derived from average hourly flows.

The difference in noise levels at roadside receptors due to the construction traffic is only 0.3 dB(A). Increases in environmental noise levels of less than 2-3 dB(A) are not generally perceptible to the human ear, consequently no construction traffic noise impacts are predicted.

Vibration from Construction Activities

Measurements of vibration from construction plant have shown that, even from the worst case activity, i.e. percussive piling equipment, levels typically fall to imperceptibility beyond approximately 100m from the vibration source. Imperceptible levels are reached at much smaller distances from other sources of vibration, such as excavators, bulldozers and heavy goods vehicles (HGVs). Hence, because there are no receptors within 100 m of the site no vibration impacts are expected.

6.4.5 Evaluation of Operational Noise and Vibration

Noise Prediction Methodology

The potential noise emissions from the power plant have been modeled by Dr. M. El-Bardisi, Prof. of noise and vibration engineering, Ain Shams University using the Bruel and Kjaer "Predictor" noise model. The noise model breaks the plant down into individual point sources representing each item of equipment or structure that may produce a significant amount of noise. Sound power levels were assigned to each point source based on specified noise levels in the individual equipment purchase order, which should not exceed 85 dB (A). The noise sources area included in the model is shown in *Figure 6-7* and individual noise sources are listed below.

- Heat Recovery Steam Generators (HRSGs), units 1 and 2;
- Combustion Turbines, units 1 and 2;
- Steam Turbine;
- LCI/Generator Excitation Compartments;
- Main Transformers;
- Auxiliary Transformers;
- Demineralization Plant;
- Water Treatment Area; and
- Various types of Pumps and Fans.

Table 6-17 gives noise sources assumptions used in the modeling exercise.

Table 6-17

Noise Sources Assumptions (1)

Source	Center Frequencies (Hz)								LAeq	LAeq	Remarks
	63	125	250	500	1000	2000	4000	8000	dB	dBA	
GT Inlet Filter	100.7	93.1	82.4	75.0	84.0	80.8	85.0	77.1	101.7		Given by Vendors
A-Weighted	74.7	76.1	75.4	72.0	84.0	82.8	86.0	75.1		90.0	
GT Exhaust Duct A	103.3	97.6	90.2	89.8	79.3	78.9	65.5	58.1	104.7		Given by Vendors
A-Weighted	77.3	80.6	83.2	86.8	79.3	80.9	66.5	56.1		90.3	
Main Transformer	92.0	87.0	87.0	83.0	83.0	80.0	77.0	56.0	95.0		Assumed by MB
A-Weighted	66.0	70.0	80.0	80.0	83.0	82.0	78.0	54.0		88.0	
Step Down Transformer	81.0	86.0	83.0	79.0	70.0	67.0	62.0	56.0	89.1		Assumed by MB
A-Weighted	55.0	69.0	67.0	76.0	70.0	69.0	63.0	54.0		80.3	
Boiler Feed Pumps	90.0	97.0	98.0	100.0	102.0	99.0	65.0	87.0	107.0		Given by Vendors
A-Weighted	64.0	80.0	91.0	97.0	102.0	101.0	96.0	85.0		105.9	
CCW Pump	91.0	92.0	93.0	95.0	97.0	94.0	90.0	86.0	102.3		Given by Vendors
A-Weighted	65.0	75.0	86.0	92.0	97.0	96.0	91.0	84.0		101.1	
Gas Compressors	68.2	68.9	69.5	70.7	75.5	80.4	70.7	62.3	82.9		Given by Vendors
A-Weighted	42.2	51.9	62.5	67.7	75.5	82.4	71.7	60.3		83.7	

Notes:

(1) Individual point sources have been assumed as used in similar power plants with combined cycle.
(2) Background noise level at the site is 43.9 dB(A) measured at the project site on 15 June 2004).

Operational Noise

The noise model has been used to predict noise contours in the area around the site. These are shown in *Figure 6-8*. *Table 6-18* gives the predicted noise levels at two locations relative to the site boundary.

Table 6-18

Predicted Operational Noise Levels

Receptor	Egyptian Standard (dB(A))		World Bank Guideline (dB(A))(2)		Predicted Level (dB(A))
	Day-time	Night-time	Day-time	Night-time	
Fence of the Power Plant (1)	60-70	50-60	70	70	50-55
100 m away from the Fence of the Power Plant(1)	60-70	50-60	70	70	< 50

Notes:

(1) Categorized as "Industrial area" in Egyptian standards and as "Industrial and commercial" in World Bank guidelines.

(2) If the specified noise criterion is not met, the plant must not give rise to an increase in background levels of more than 3 dB(A) in order to comply with the guidance.

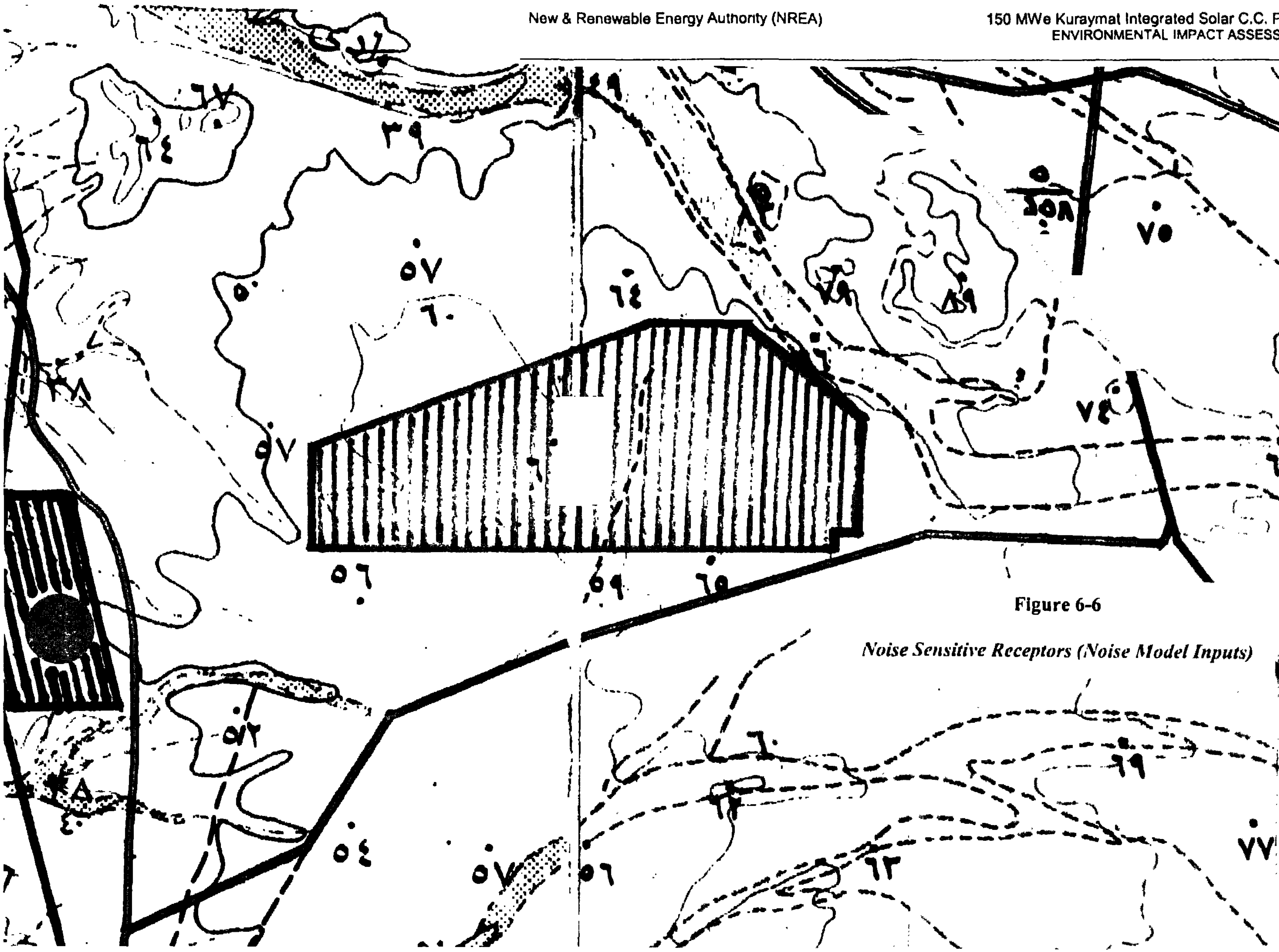


Figure 6-6

Noise Sensitive Receptors (Noise Model Inputs)

Figure 6-7

Individual Point Sources of a Significant Amount of Noise in the Power Plant

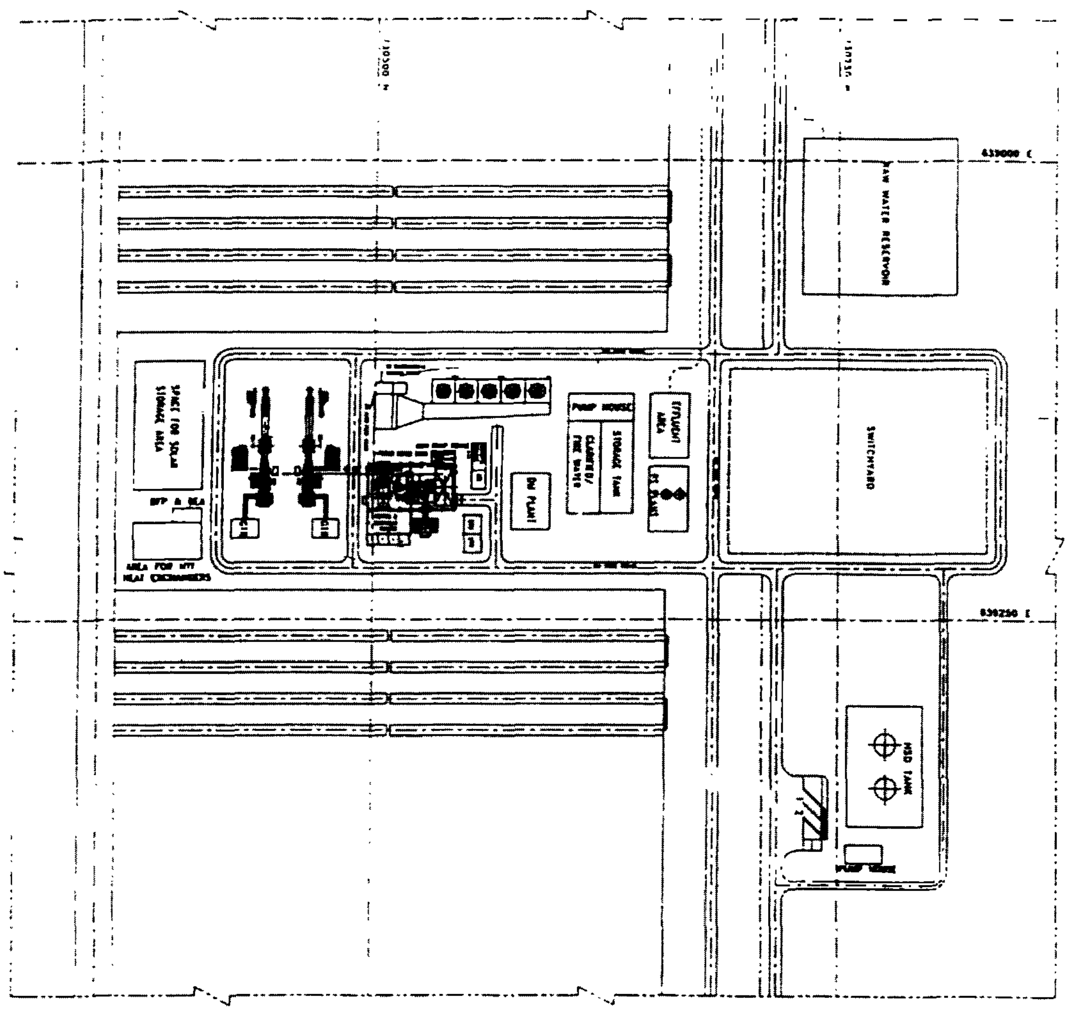
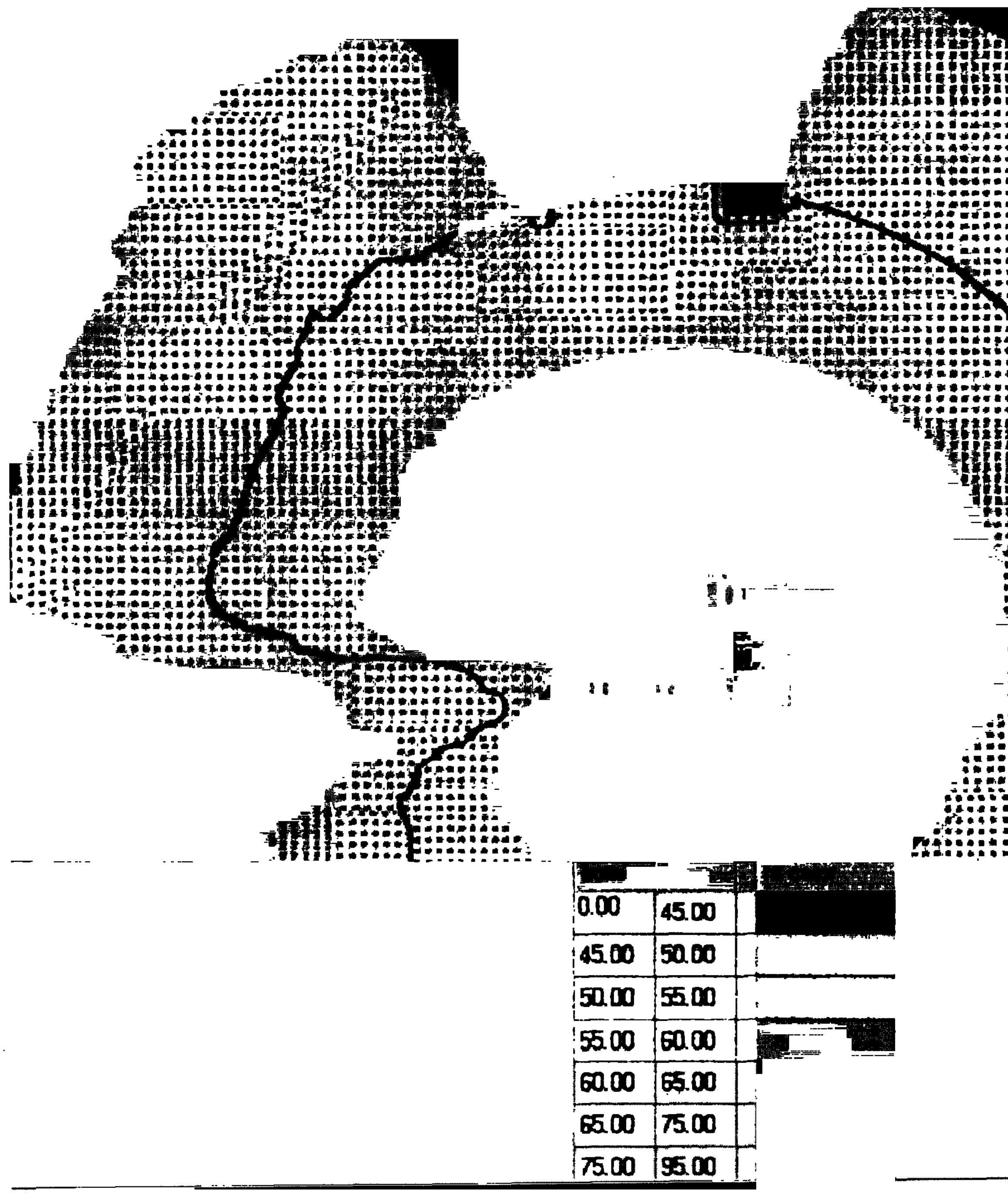


Figure 6-8

Noise Contours of the Output Result



The predicted operational noise levels at the site boundary are below the World Bank guidelines and the Egyptian Standards for both daytime noise and night-time noise. It meets not only the heavy industries criteria of the Egyptian Law but also the residential areas standard limit which does not exceed the 50dB(A) noise level.

In addition, it should be noted that the predicted noise levels are based on conservative assumptions for noise attenuation and weather conditions. Therefore, noise from the operating plant is not expected to give rise to any significant noise impacts at receptors in the area.

Traffic-related Noise During Operation

The percentage increases in hourly traffic flows during the operation of the power plant are about 3% on the section of the Es-Saff / Beni-sueif Road about 1200 m to the west of the power plant. These increases are not sufficient to give rise to any perceptible change in traffic noise.

Operational Vibration

The design of the power plant will ensure that all rotating machinery is correctly balanced and that reciprocating equipment is vibration isolated, to ensure that vibration will be imperceptible beyond the site boundary. Since the nearest receptor is some distance from the site there will be no vibration impacts from the operating plant.

6.4.6 Conclusion

Predictions of unmitigated construction noise indicate that Egyptian and UK standards are met at all times and there will be no construction noise impacts. Neither will there be vibration impacts because the nearest receivers are some distance from the site.

Egyptian and World Bank standards for operational noise are met at all receptors during daytime and night-time. Therefore, no significant noise impacts are expected.

6.5 FLORA AND FAUNA

6.5.1 Introduction

The assessment has examined the potential impacts of land take and disturbance of the proposed power plant on flora and fauna.

6.5.2 Potential Impacts

As described in Section 5.7 of this report, the project will be built on a matrix of uncultivated land and the area surrounding the site is partially cultivated with normal plants and crops usually grown in such area.

The main natural resources within the plant hinterland are agriculture and chalky limestone. Within the site hinterland, fisheries are considered a minor resource to harvest by the locals.

On the other hand, the only important habitat within the project hinterland is the Nile. The project interacts with significant habitat through water intake with the necessary infrastructure. Therefore the Nile is the most significant ecological concern of the proposed project.

Within the site itself, no flora, fauna or habitats of ecological or conservation importance were identified. No natural vegetation or any habitats or ecological components of significance was found on site.

A large number of insect species were collected on site. They represent the largest number of the animals collected. This is always the case since insects are one of the richest and most resilient species found on earth. The insect fauna represents some ecological balance within this habitat. However, due to the presence of the agricultural lands to the south of the site, these species would find similar/alternate habitats in such lands.

In general, no significant impacts are expected to occur during the construction phase of the project since no important habitats or biota were observed. The only important habitat is the Nile itself. So, care should be taken when erecting any structures close to the Nile. Geo-textile curtains should be employed around any construction activities to reduce turbidity in water columns. No dumping of waste whether solid or liquid should be allowed to the Nile.

Several species of fresh water molluscs (snails) were collected at the water intake of the present power plant along the Nile. Many of them are intermediate hosts/vectors of human and/or animal disease. They represent harm to workers when they come in direct contact with them only.

Water vegetation constitute a problem to water intake since they aggregate in large quantities. They also form a suitable habitat for the snails and other harmful mollusks. So, these plants require continuous clearance and collection to maintain the water intake and prevent the collection of large numbers of snails. The present boom installation represents a reasonable measure to help reduce the quantities of the water vegetation.

Given the relatively small scale of the power plant development, and given that the land flats are unlikely to be affected after construction of the plant, the impacts will be localized and should not adversely affect the number of birds using the area.

6.5.3 Effects of Construction on the Proposed Site and Surrounding Areas

Construction of the power plant will remove approximately 2,772,000 m^2 of land from the existing ecosystem (see Annex D: Kuraymat Project Land Acquisition). The installation of intake structures will not result in the loss of an area of cultivated landflats, however the surrounding landflat areas provide areas for birds and significant impacts are considered unlikely.

Construction works, which are likely to occur over a 37 month period, will generate increased noise, dust and movements of construction workers and equipment around the site. Any bird species and other fauna which use or are resident in the area, are likely to be displaced and will maintain a standoff distance. Areas in the immediate south of the plant provide an alternative habitat for displaced species. The long-term impacts are therefore not predicted to be great.

Negative impacts on flora and fauna during construction are not therefore considered to be significant. Any disturbance during construction will be minimized through the mitigation measures described in Section 6.5.5 below.

6.5.4 Potential Impacts as a Result of Power Plant Operation

It is not anticipated that there will be any further impacts to fauna and flora as a result of the operation of the power station.

The stack measuring 35 m in height would not present an obstacle given that the area is not an area of migrating birds. However, with the inclusion of measures such as lighting, to increase the visibility of stack at night or during weather conditions with poor visibility, this impact is not expected to be significant.

6.5.5 Mitigation Measures

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during construction and operation, and will dissipate with distance from source. Any disturbance during construction and operation will therefore be localized (see Section 6.4);

- run-off from construction activities and any movement of contaminants disturbed along the land flats, will be attenuated and disposed of in a controlled manner (as described in Section 6.3) to ensure that surrounding species/habitats are not significantly affected;

- Proper mitigation measures will be incorporated in the design of the water intake to avoid negative impacts. Such mitigation measures are currently standardized worldwide (e.g. World Bank, 1991 & 1996);

- Appropriate measures should be adopted, in cooperation with UEEPC, to reduce sand erosion off the island facing the water intake since the sand interferes with the operations of the intake system. This may be in the form of sand stabilization, planting or lining; and

- Continuous collection and clearance of water vegetation around the water intake should be carried out to prevent accumulation of snails and other harmful molluscs.

6.5.6 Conclusion

Since the site itself is poorly vegetated and southern areas are normally cultivated, the significance to flora and fauna is considered to be limited. Given that the potential impacts of construction and operation of the proposed power plant are localized, there are no predicted significant effects.

6.6 LAND USE, LANDSCAPE AND VISUAL IMPACT

6.6.1 Land use

The surrounding land uses in the area constitute normal desert, limited agriculture, small low-rise urban-type residential community and a small discreted low-rise rural-type residential buildings in the wider area. To the immediate north of the site runs a 20 inch gas line from the north of old Kuraymat power plant, parallel to the existing mazout line, to the highway running through the Eastern Desert to Zafarana (*Figure 6-9*). Across the gas line to further north of the proposed site is the 500 kV transmission line corridor associated with the old ISCC Kuraymat power plant from its site to new Tebbin south of Cairo. Kuraymat / Zafarana road runs to the very north of the site, beyond transmission lines, and across beyond it some small villages (e.g. El-Burumbul). To the south of the site is an agricultural land and to the west, about 750 m from the western fence, a little bit to the south direction, is the boundary of the residential community associated with the old (existing) ISCC Kuraymat power plant.

In general, land use conflicts between the proposed power generating facility at Kuraymat and adjacent land uses will be minor. Agricultural lands along eastern side of the Helwan/Ben-sueif road immediately south of the site boundary may be subjected to minor amounts of construction dust but will not be affected by any land use conflicts after operation is initiated. No access restrictions or interruption of existing activity practices will occur on adjacent lands. No land use conflicts, encroachment, or interruption of services or access will occur around the site area at Ezbet-El-Hagg Ghanem and Dayer al-Maymun and the El-Wasta cemetery, as a result of the presence and operation of the facility.

No adverse impacts to the residential spots are anticipated. Potential impacts to the surrounding land uses include the effect of air emissions and the discharges to the aquatic environment, including any wastewater or thermal discharges. These impacts are addressed in the air quality and aquatic environment sections (Sections 6.2 and 6.3). Landscape and visual impacts are discussed below.

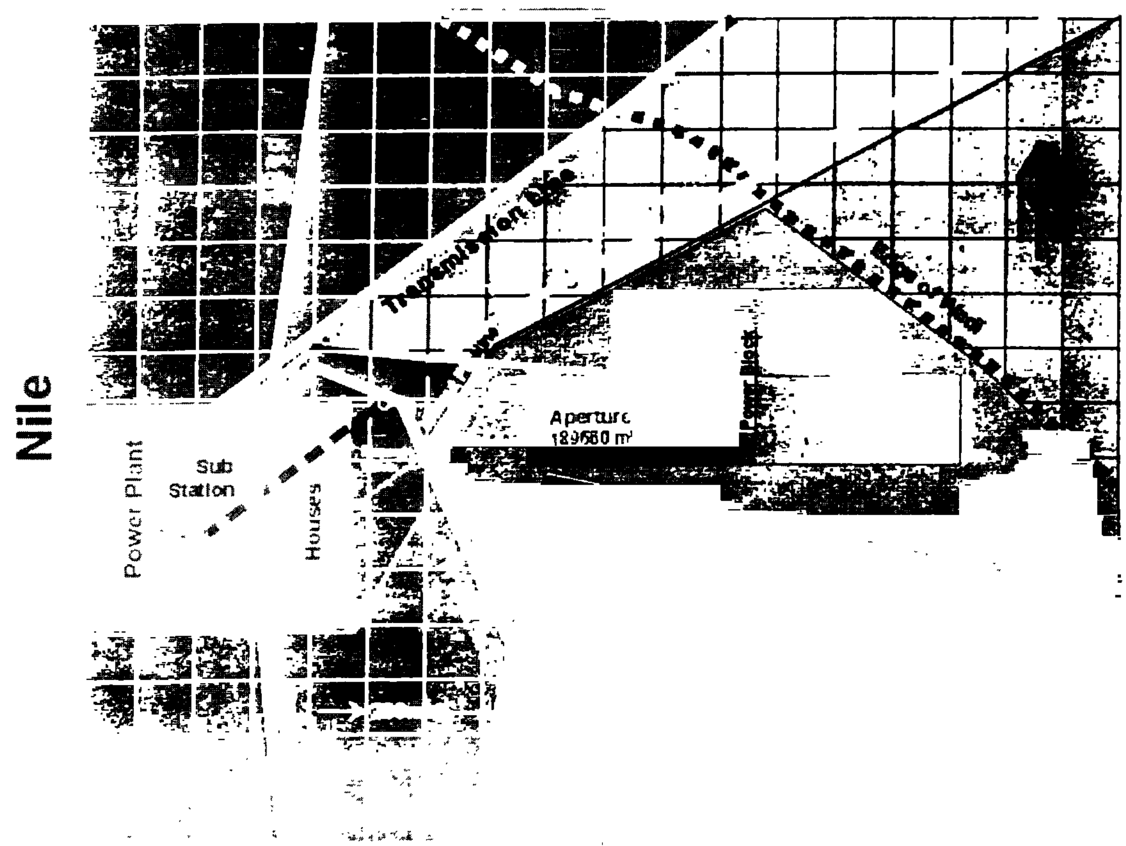
6.6.2 Landscape and Visual Impact

The power plant will be a substantial structure with a stack height of 35m, which, within the surrounding flat desert or agricultural land, will be highly visible for 3km along the main Helwan/Beni-sueif road, and few kilometers inland.

All existing views in the area may be strongly influenced by the construction of the power plant. The proposed power plant will emphasize an industrial appearance and scale of the local area complex. However, the potential visual impact is acceptable by the local people given the advantages that the power plant project will bring to their life. The wider character of the area may also absorb that visual intrusion due to wideness and expanded landscape.

Figure 6-9

Site Surroundings



The one sensitive receptor in the area is the residential complex of the existing thermal power plant. From these premises the power plant will be seen in context with the new intruded industrial nature of the area created by the existence of the power plant, given the future plans for Kuraymat as an investment area, therefore although visible from this area the power plant may not regarded as being intrusive.

Also, the plumes from the cooling towers, will extend beyond the height of the plant buildings. The visibility of the plumes from the cooling towers will greatly depend on the prevailing meteorology, but might extend up to 20 m beyond the mouth of the towers. Given other features such as the existing transmission lines as well as plans for industrial developments, the visual impact of the power station is not expected to be significant.

Thus, while the power plant will be visible and the sensitivity of the landscape is not limited, it is anticipated that the large scale of the flat land surrounding the power plant will be able to visually accommodate the structures of the plant in an acceptable context.

6.6.3 Conclusion

Due to the large scale of the flat land surrounding the project, the new industrial infrastructure of the power plant that will be created in the area would be acceptable from local people, given the benefits they will gain from the project. Thus the potential landscape and visual impact of the project will be minor.

6.7 SOILS, GEOLOGY AND HYDROGEOLOGY

6.7.1 Introduction

The assessment of the impact of the proposed development on the soil, geology and hydrogeology has considered the following issues:

- physical effects of construction activities on the soil profile;
- potential contamination from construction and operation of the proposed power plant; and
- effects on groundwater resources.

The risk of seismic activity is discussed in Section 6.11.

The assessment is based on information obtained from reports prepared by National Research Institute of Astronomy & Geographics, Struc. & Geotec. Research Center, and Enviro-Pro describing the geology and geophysical structure of the site and its surroundings.

6.7.2 Effects on Soils and Geological Features During Construction

There are no special, sensitive or protected soil or geological features or mineral deposits within the site, hence the development of this area of land will not have any significant impacts on soil or geological features or on mineral resources.

Construction activities can potentially alter the physical make up of the soil through a number of construction processes, including:

- site preparation;
- top soil removal and temporary mounding;
- excavation for foundations;
- provision of temporary drainage systems;
- excavation for laying of pipes; and
- excavation of trenching.

These activities can alter the soil's make up through compacting the soil (reducing infiltration and aeration) and by changing the surface topography. These changes to the site may also potentially affect recharge and drainage rates to local groundwater resources. However, given that ground water recharge rates at and around the project site are minimal and groundwater if abstracted in the project area will be under good engineering practice considerations, the impact of power plant construction on local water resources is considered to be insignificant.

The potential for the direct impacts on the soil mentioned above, is however largely dependent on the management of the construction site and construction activities. A range of mitigation measures will be implemented to protect soils and, as a result, the groundwater resources, from the direct impacts of constructing the proposed power plant. These measures include the following:

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;
- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil;
- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site, will be disposed of by a licensed contractor and the procedures for disposal will be audited by the NREA or their consultant.

The inclusion of the above mitigation measures means that there will be no significant direct impacts on soils or geological features from construction activities.

6.7.3 Risk of Ground Contamination

Following geotechnical investigations carried out earlier, according to the Dutch Guidelines (*Table6-8*), the topsoil cover has been investigated to a normal depth and found clean. The site, accordingly is considered to be uncontaminated (being an unused area). However, the construction and operation of the proposed power plant has the potential to cause some contamination through spillages and leaks, especially around fuel storage areas during construction and fuel and chemical storage areas and supply lines for any hazardous substances during operation.

Potential contaminating substances which will be present on the site during construction and operation will include fuels, lubricating oils, hydraulic fluids, water treatment chemicals, plant cleaning chemicals, sanitary effluent and detergents.

The risk of land contamination will be minimized through a range of mitigation measures. These are considered below as appropriate to the construction and operation phases of the power plant.

During Construction

Land contamination will be minimized through the following mitigation measures:

- provision of engineered site drainage systems during construction and operation to collect, balance, treat as required and control the discharge of site run-off;

- protection of the soil from accidental pollution by bunding around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;

- provision of oil interceptors, such as oil/water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;

- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed sanitary landfill sites;

- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and

- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

The potential for contaminated sediments to be excavated during construction of the water intake structures is discussed in more detail in Section 6.3.2.

During Operation

Ground contamination during operation will be minimized through implementation of the following mitigation measures:

- Bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system.

- Oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank.

- Areas for unloading oil and hazardous chemical materials will be isolated by curbs and provided with a sump. Removal of such material will be via manual action, and not via an automated control..

- The transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water quantity in accordance with NFPA criteria. Alternatively, each oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain 110% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber an oil separator will be constructed which will normally function to separate any oil from the storm water collected within the transformer foundations and the clean water drained to the discharge facility. The transformers will not contain PCBs.

- Stormwater runoff from equipment slabs that may be subject to oil contamination exposure will be collected and channeled through an oil/water separator prior to discharge into the discharge facility.

With these mitigation measures in place, the construction and operation of the proposed power plant is not predicted to cause any ground contamination on-site or of the surrounding land.

6.7.4 Groundwater Quality and Recharge

The volume of water entering the aquifer from the proposed site is currently considered to be negligible. Creation of areas of impermeable hardstanding on the site will not therefore significantly affect groundwater recharge in the area.

The mitigation measures set out in Section 6.7.3 will minimize the risk of contamination of groundwater from the proposed power plant during its construction and operation. As a result, no significant impacts on groundwater resources under the site are predicted during construction or operation.

6.7.5 Conclusion

Due to the characteristics of the soils and geology of the site, in particular the lack of any sensitive features, and the mitigation measures proposed as part of the construction and operation of the power plant, no significant impacts are predicted to occur. In addition, after thorough geotechnical investigations for the site topsoil cover has been found uncontaminated.

6.8 TRAFFIC

6.8.1 Traffic Assessment Methodology

Analysis of traffic impacts during construction and operation of the power plant utilized both historical and field data. The statistical analysis, undertaken and reported in detail in baseline study performed by the Egyptian National Institute of Transport (ENIT) for this EIA report requirements, considered an analysis of traffic speed and growth.

The assessment considers the main roads linking the site with the surrounding road network as well as the regional roads, as indicated in Section 5.10.

There are no Egyptian standards or World Bank guidelines with respect to assessing the significance of changes in traffic flow on road networks. The analysis presented here and undertaken by ENIT compares the anticipated impacts with guidance reported in the Highway Capacity Manual (HCM), 2000 of the US Federal Highway Administration (FHWA).

6.8.2 Traffic Analysis During Construction

The schedule for construction works, the anticipated volume of traffic generated and the routes used, is discussed in Section 4.7 of this report.

Three mathematical models were developed in order to estimate projected growth of the existing traffic flows to the year during which peak construction activity is likely to occur (2005-2006) and the year of completion 2007. The traffic growth rates derived from the models were used to estimate traffic volumes for 2005/2006

Current Level of Service (LOS)

The traffic analysis is based on estimating the Level of Service (LOS) of the Kuraymat / Ben-sueif Road and Giza / Beni-sueif Road. LOS is a qualitative measure that describes the operational conditions within a traffic stream and the perception by motorists and passengers. The LOS analysis was carried out by ENIT, as described by the Highway Capacity Manual (HCM), last edition, published by the US Federal Highway Administration (FHWA) in 2000 for two-way two-lane highways. In addition, speed analysis was used to estimate the average travel speed along the two roads and to assess the variation of the average speed.

The LOS is classified using a lettering system as set out below.
To conceive the traffic operating conditions under any of the levels A, B, C, D or E the following descriptions are used by the HCM.

- LOS A; describes completely free-flow conditions, i.e. the operation of vehicles is virtually unaffected by the presence of other vehicles.
- LOS B; describes free flow, although the presence of other vehicles begins to be noticeable.
- LOS C; average speed is about 85 km/hr on level terrain; unrestricted passing demand exceeds passing capacity; percent time delay up to 60%; service flow rate starts from 750 up to 1200 passenger car per hour (pcph) in both directions.
- LOS D; average speed of 80 km/hr can still be maintained under ideal conditions; unstable traffic flow is approached; passing becomes extremely difficult because passing capacity approaches zero; percentage time delay approaches 75%; maximum service flow rates of 1800 (pcph) in both direction.
- LOS E; Speeds will drop below 80 km/hr under ideal conditions; passing is virtually impossible; capacity is 2800 (pcph) in both directions; percentage time delay exceeds 75%.

A volume-to-capacity ratio is calculated and related to the level of service. This analysis is carried out for two different sections of Giza / Beni-sueif Road, which is the only road concerned in this study: the first section is between Kuriemat and Beni-sueif while the second section near El-Ayyat.

For the regional roadway sections, the general peak hour rate is given as 10% of the daily traffic volume. This rate is applied to be the section of Giza/Beni-sueif Road near El-Ayyat, after expanding the year 2002 data to the year 2003 using a nominal growth rate of 4.5%. This rate is based on the average annual growth rate of the AADT during the period 1992-2002 (presented in Section 5.10). For the road section between Kuraymat and Beni-sueif, the 16-hour traffic count conducted was adjusted [(1)] to estimate the AADT on this section for the year 2003. Then, peak traffic was taken as 10% of the AADT. Since the percentage of heavy trucks along this road is very high (23%), Peak traffic volumes are therefore expressed in Passenger Car Units (PCU) based on the equivalent factor [(1)] for each vehicle type and its percentage in the traffic composition along that road (presented in details in Section 5.10).

(1) The adjustment process is based on three different correction factors estimated from the AADT, monthly variations and hourly variations during the weekdays for the road section near El-Ayyat in the year 2002 (which were presented in Section 5.10). The estimated values for the 16-hour traffic count correction factor, the weekly adjustment factor for Tuesday, and the monthly adjustment factor for September are 1.32, 1.026, and 0.948 respectively.

Table 6-19 illustrates the volume-to-capacity ratio (V/C) for two different sections along this road. The values of V/C rations indicate that Kuraymat / Beni-sueif section currently operates at a level of service (A), while the road section near El-Ayyat operates at a level of service (D), which is considered not acceptable at the regional level and needs to be immediately upgraded

Table 6-19

Volume-to-Capacity Ration for the Two Main Access Roads,2003

Regional Roadway Section	Peak Traffic Volume (PCU / hour)	Volume-to-Capacity Ratio (V/C)[1]
Kuraymat / Beni-sueif section	525	0.19
El-Ayyat Section	2153	0.77

Notes:

(1) The capacity of these two sections is estimated as 2800 vehicles per hour in both directions of travel.

As for the regional roads, the general peak hour rate is given as 10% of the daily traffic volume. This rate is applied to the two regional roads providing access to the study area, after expanding the year 2001 data to year 2003 using a nominal growth rate of 6%, as an expected gross domestic product (GDP) annual rate of growth *Table 6-20* illustrates the volume-to capacity ratio for both Cairo/Alexandria Agriculture Highway and Cairo/Alexandria Desert Highway during the peak hour.

It can be seen that Cairo/Alexandria Desert Highway operates at a level of service "C", which is considered acceptable at the regional level, while Cairo/Alexandria Agriculture Highway runs near its capacity.

(1) PCU equivalent factors are taken as 1.0, 1.25, 1.25, 2.0, 1.75, 2.5 and 0.75 for private cars/taxis, microbuses/ minibuses, vans/pick-ups, buses, light trucks, heavy trucks, and others respectively (Reference: "PCU Equivalent Factors for Egyptian Road Network", Scientific Research Academy and Faculty of Engineering-Ain Shams University (1988)).

Table 6-20

Volume-to-Capacity Ratio for the Two Regional Roads

Regional Road	Volume-to-Capacity Ratio
Cairo/Alexandria Agriculture Highway[(1)] - to Kuraymat	0.79
Cairo/Alexandria Desert Highway[(2)] - to Kuraymat	0.33

Notes:
(1) The capacity of Agriculture Highway is estimated as 6600 vehicles per hour in both directions of travel (i.e. 1500 vehicle/hour/lane).
(2) The capacity of Desert Highway is estimated as 5600 vehicles per hour in both directions of travel (i.e. 1300 vehicle/hour/lane).

Traffic Generation

An important step in conducting the traffic impact analysis is to estimate the traffic generated from the new ISCC Kuraymat power plant during peak hours. The amount of traffic generation is directly related to the type and characteristics of the new power project of the Kuraymat.

In this respect, two cases of generation: during construction and post construction (i.e. during normal plant operation) should be considered. Summary of peak construction traffic is given in *Table 6-21.*

The distribution of traffic generation to the surrounding street network is related to location context within the study area as well as the entry/exit points from the site to the surrounding access roads (i.e. local roads).

Table 6-21

Summary of Peak Construction Traffic

Vehicle Type	Traffic Generation			
	Day Shift		Night Shift	
	Peak	Total	Peak	Total
Heavy Goods Vehicles	10	100	0	0
Construction Workers Vehicles	82	164	77	88
Abnormal Loads	0	0	2	4
Total	**92**	**264**	**79**	**92**

Traffic Impact Analysis

The impact assessment usually establishes the peak hour situation with the project after completion in the inauguration year. In this case, the results of the traffic data for regional and local roads (previously detailed) are expanded to the construction and opening years of the power plant (2005-2007), and then combined with generated traffic from the power plant. The roads level of service with the site traffic is then estimated for these years. A comparison of the level of service would show the amount of impact envisaged by the power plant during and post the construction phase.

The analysis is conducted for the two regional roadway sections along Giza / Beni-sueif road, which provides access to the power plant (i.e.Section 1: the section between Kuraymat and Beni-sueif, and Section 2: the section near El-Ayyat). Roadway or traffic operational improvement would be addressed as alternative site improvements, and would be evaluated for peak hour effectiveness.

"During Construction" case, the traffic associated with the plant project will be superimposed on the existing traffic during construction years (2005 and 2006) [(1)] as summarized in *Table 6-22.* The amount of peak hour traffic generated during construction is given as 10 trucks/hour and 82 vehicles/hour (i.e. 92 vehicles/hour in total). This would increase peak traffic for Section 1 during 2005 by 25%. Thus, the value of (V/C) ratio increases from 0.21 to 0.26, and consequently its current LOS would remain unchanged at LOS (A). For Section 2, construction traffic would increase the peak traffic by 6% for year 2005. Thus, the value of (V/C) ratio increases from 0.84 to 0.89, and consequently its LOS without the plant construction for the year 2005 would also remain unchanged at LOS (E). Accordingly, this section is recommended to be doubled by before 2005.

Table 6-22

Peak Hour Traffic for with and without the Power Plant Project, in PCU/hr

Road Section	2004		2005		2006		2007	
	Without Project	During Const.	Without Project	During Const.	Without Project	During Const.	Without Project	With project
Section 1	548	694	574	719	599	645	625	675
Section 2	2250	2395	2351	2496	2457	2503	2568	2588

(1) An average traffic growth rate of 4.5% per annum is considered in this context which is based on the average annual growth rate of the AADT during the period 1992-2002 (Section 5-10).

"Post Construction" case indicates that the existing traffic on the two sections along Giza/Beni-sueif road is forecasted for the year 2007 (inauguration year). Therefore, all the base year counts (year 2003 counts) are expected to year 2007 by 4.5% per annum. The expected peak traffic for 2007 for with and without the power plant project is depicted in *Table 6-22.*

Generally speaking, the peak plant-generated traffic in the post construction case (i.e. 29 vehicles per hour) is considered very small. Moreover, this figure represents only one-third the peak traffic generated during the construction period. Hence, the traffic impact of the power plant project on the two road sections in this case is less critical than the construction case.

However, the forecasted peak traffic for the year 2007 on Sections 1 and 2 is expected to increase by 7.7% and 1.9% respectively as a result of the peak plant-generated traffic in the post construction case. This small percentage of increase would have a limited effect on the existing level of service of the two sections. For Section 1, V/C ratio would increase from 0.21 to 0.23, and the LOS would remain unchanged at LOS (A). For Section 2, V/C ratio would slightly increase from 0.88 to 0.89, and the LOS without the plant also remains unchanged at LOS (E) after the plant is put for full operation in 2007. As such, no significant changes in the traffic operation would be expected due to the construction and operation of the power plant.

6.8.3 Traffic Assessment Conclusion

The expected traffic generated from the power plant project (in both cases: during construction and after inauguration) is then superimposed on the existing flows on both roadway sections. It was concluded that the additional traffic would have a little effect on the level of service of two roadway sections particularly in the morning peak during the second year of construction (i.e. year 2006). Accordingly, the current LOS of Section 1 would remain unchanged at LOS (A), whilst LOS for Section 2 would reduce from its current LOS (D) to (E). However, this reduction is mainly referred to the normal traffic growth during the two peak construction years and the inauguration year (i.e. is not referred to the power plant generated traffic). Therefore, it can be concluded that the traffic will continue to operate at a good level of service on the Kuraymat/Beni-sueif section until the inauguration year of the power plant (year 2007).

(1) This is based on a total space of 35 sq m required for each parking space, taking into consideration the standard dimension of vehicles (private cares, buses and trucks) as well as the spaces needed for isles and other concerned services associated with car parks, e.g. toilets, kiosks, etc.

Concerning parking demand, some 70 more parking spaces are required to accommodate the additional traffic generated from the power plant. These spaces are expected to occupy a total area of around 2500 square meters (i.e. only 3.5% of the total area assigned for the project).

In order to increase accessibility to the power plant, it is recommended to extend the two bus lines operated by Greater Cairo Bus Company [(1)] to end very close to the power plant instead of ending at Es-Saff (an additional distance of around 30km). This would also help people staying the at employees' camp to be connected with Kuraymat village and Es-Saff town.

Traffic Management System and Mitigation Measures

Although the effects of construction traffic are likely to be limited, a number of good management measures will be undertaken. These comprise:

- construction workers will be transported to the site by minibuses;
- prescribed routes for construction traffic will be agreed with the appropriate authorities, particularly with respect to HGV traffic and abnormal loads if required by the CAA; and
- abnormal load movements will adhere to prescribed routes to be agreed with the appropriate authorities - these will be scheduled to avoid peak hours on local roads and published in advance to minimize possible disruption if required by the CAA.

With the inclusion of the mitigation measures, the potential impacts upon the affected roads will not be significant.

6.8.4 Operational Traffic

Construction and commissioning of the power plant is expected to be complete in 2007.

Operational Workers

The power plant will operate 24 hours a day, 7 days a week and will employ approximately 300 people. During a normal working day it is understood that 225-265 employees will access the site at the beginning and end of the working day. Peak vehicular activity of 67 movements will occur at the start and end of the normal

(1) These two lines are operated from Helwan and Et-Tebbin to Es-Saff City.

working day, assuming that all workers travel to the power plant by private motor vehicle with a vehicle occupancy rate of 4 . During night-time and official holidays, 48-55 employees will be on-site.

Heavy Goods Vehicles (HGV's)

All delivery of gas will be via a pipeline. Therefore, the only HGV movements arising from the operation of the power plant will be associated with the delivery of fuel oil (sollar), process materials or maintenance equipment. Delivery of these materials is estimated to generate approximately three HGVs, or five HGVs movements, per day.

Assignment of Operational Traffic

Operational staff are likely to originate from Es-Saff and surrounding areas (wider Giza Governorate) and will mostly access the site via the Giza/Ben-sueif road.

A summary of generated traffic is given in *Table 6-23.*

Table 6-23

Summary of Generated Operational Traffic

Type Vehicle	Peak Period	Daily
HGV	3	5
Car/LGV	67	115
Total	**70**	**120**

6.8.5 Operational Traffic Impacts

Percentage increases in hourly traffic flows during the operation of the power plant are about 7.7% on the Giza/Beni-sueif Road to the site of the power plant.

These small increases in road usage are insufficient to cause any noticeable impacts on traffic conditions, cyclists or pedestrians and, therefore, no significant effects are predicted.

6.8.6 Conclusion

The assessment of traffic and transport covers the changes in traffic conditions in terms of delay and congestion during construction and operation.

The greatest potential for traffic impacts to occur arises during the short period of peak construction. There is some potential for increased congestion on the main roads to the power plant, however the impacts will only occur during the peak construction phase and during peak hours. The overall impact is therefore not predicted to be significant. Mitigation measures will be put in place to reduce the potential for impacts to arise.

During operation, a small number of workers and HGVs are associated with operating the power plant and no impacts are predicted to occur.

Overall, the traffic impacts associated with the construction and operation of the power plant are considered to be minor and not significant.

6.9 SOCIO-ECONOMIC EFFECTS

6.9.1 Introduction

The administrative structure within which the power plant is situated is explained in Section 5.12 of this report.

This section addresses the socio-economic impacts associated with the construction and operation of the ISCC Kuraymat power plant. The nearest permanent settlements to the boundaries of the proposed plant is about 750 m west of the power plant site, residential community of the existing Kuraymat plant, and about 2.5 km south-west of the site, Ezbet El-Hagg Ghanem as well as Kuraymat village (3km) and El-Burumbul village (3.5 km) north-west and north-north-west of the proposed power plant site respectively. The cities and towns around the site (e.g. Es-Saff and Beni-sueif)are likely to experience the greatest positive and negative socio-economic impacts from the construction and operation of the plant due to its proximity to the plant.

The assessment of impacts draws upon baseline data collected and provided by E & E and New and Renewable Energy Authority (NREA) during preparation of their documentation for local environmental permitting requirements and preparation for this EIA report. No information on existing income levels was available from the Giza Governorate, Kuraymat zone (Es-Saff & Atfieh) authorities.

6.9.2 Resettlement

As there will be permanent staff settlements within the Kuraymat project region, no resettlement or displacement of people is envisaged. People will not be displaced by construction therefore there is no resettlement associated with this project.

Conversations between E & E, NREA and the World Bank have resulted in a strong commitment to resolve any compensation based on fair and equitable value for the loss of the use of the land if it were happened.

6.9.3 Land Acquisition

The plant is sited on land given by Presidential Decree to NREA who have assigned the land for development of the power plant. Historically, all land in Egypt belongs to the state and is assigned to specific owners via Presidential authorization (see Annex D).

6.9.4 Employment Generation

A key positive socio-economic impact of the development of the power plant will be the generation of employment during it's construction and operation. NREA proposes to operate a policy of preferential employment of locally resident workers depending on skills and availability in order to maximize local employment benefits. This local workforce will be drawn from the wider Kuraymat zone and the neighboring cities/towns in the Giza and Beni-sueif Governorates.

It should be noted that construction work within the Giza Governorate is traditionally undertaken by migrant labor from Upper Egypt. Migrants are attracted to the area by the availability of manual work which is traditionally not undertaken by indigenous residents. Migrants find accommodation within Kuraymat zone and its surrounding zones and remain in the area until employment prospects elsewhere draw them away. Given the growth of construction activity ongoing in the Giza Governorate, the number of workers available for construction of the power plant, is likely to be reasonable.

Available employment data described in Section 5.12 of this report, suggests that unemployment in the whole Governorate of Giza lies around 4.49% and in the Giza Governorate, around 1,449,922 people form the active workforce. Statistics suggest that approximately 30% of this labor force is comprised of industry and construction workers and around 65% of the Giza's workforce are categorized as skilled, having been trained in various disciplines.

The estimated employment generated by the plant is anticipated to be as follows:

- 80 workers provided by the Architect Engineer;
- 600 local employees for the civil work; and
- 700 local employees for mechanical and electrical work.

Local workers will represent approximately 75% of the civil and mechanical construction work.

In addition, the Architect Engineer will provide approximately 45 persons who will manage 45 other local personnel who will in turn manage local teams. Local employees to cover management activities will represent approximately 60% of the staff.

No worker housing or associated facilities will be erected on site during construction or operation of the power plant to accommodate workers. Following general practice in the area, minibuses will be provided to bring construction workers to the site from Kuraymat area and surrounding cities.

Following construction of the power plant, the majority of manual jobs will become redundant, however given the large number of other construction activities in the wider area, this is not anticipated to present any negative impacts to the local workforce.

During operation of the power plant, both skilled and unskilled staff will be recruited from the local workforce. Unskilled positions will include drivers, cooks, cleaners, clerks and secretaries and security guards. Women could fill many of these jobs. The NREA Authority will employ people with due regard to their equal opportunities policy.

The construction and operation of the power plant is therefore anticipated to provide significant employment opportunities within the Giza Governorate, including Kuraymat area. The employment generated by the power plant will be an important positive impact of the proposed project.

6.9.5 Direct and Indirect Income Effects

Direct Income Effects

The potential direct income effects during construction and operation of the power plant include:

- income from the permanent and temporary jobs that will be provided during the construction and operation of the plant. Market rates will be paid to all workers who will, in turn, spend a considerable portion of the money in the local economy through goods and services bought in the area;

- income from locally placed orders for goods and services during construction and operation phases including contracts for the provision of construction materials and services, maintenance repairs and equipment servicing, and the establishment of supply contracts (e.g. security, waste disposal, food, cleaning, catering, transport, laundry etc.).

The average wage of an unskilled and skilled employee is 40 and 120 Egyptian pounds per day ($6.15 - $18.46). Typically about 30% of the capital cost of the plant is likely to be expended in the region, covering payroll, civil construction materials, erection works, local plant and equipment hire/ purchase, general construction materials etc.

The typical annual operational expenditure of the power plant will be in the region of US$ 2 million, although in years where substantial maintenance is carried out, expenditure can be expected to rise to US$ 3 million.

Approximately, 70% of this operational expenditure will be spent locally on labor, consumables, equipment and general maintenance.

Indirect Income Effects

Indirectly, the power plant is likely to raise the profile of the region, and in securing the supply of power to the region will attract economic and social investments resulting in jobs, improved infrastructure and service provision. Whilst this could be perceived as having potential negative long-term effects on local culture, the area has a long established local culture associated with small manufacturing activities of the Kuraymat Region. In addition, long term development plans of the Government of Egypt may add some future expansions. The power plant is therefore central to attracting this investment and the positive income-generating potential of these developments is likely to outweigh any negative impacts.

6.9.6 Public Services

A potential adverse effect of the power plant is increased demand for public services, such as water and wastewater provision, housing, education, health services, etc. An assessment of these impacts however does not suggest that any negative effects will be experienced.

During plant construction, sanitary water will be provided also via local water system. During operation, all water for sanitary purposes will be supplied by the plant water system. Sewage generated at the power plant will be disposed of via the plant sewer system.

As discussed in Section 5.12.3, migrant labor is traditionally attracted to the region and public services are considered by public officials to be more than adequate to absorb them. No provision of additional services is therefore considered necessary during construction or operation of the power plant.

6.9.7 Cultural Effects

As the larger project area (South Giza & North Beni-sueif) is already dominated by large scale agricultural activity, no significant cultural impacts are anticipated as a result of the power plant development. In addition, migrant manual labor is traditionally welcomed in the region resulting in no social or community problems.

6.9.8 Conclusion

It is anticipated that the power plant will provide a net positive socio-economic impact through the provision of employment opportunities and attraction of economic investment into the area.

In addition, the use of local labor wherever practicable, will maximize these positive impacts through the development of the local skill base and will also generate increased demand for local services, materials and products.

6.10 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

6.10.1 Introduction

This section assesses impacts on archaeological, historic and cultural resources as a result of the construction and operation of the ISCC Kuraymat power plant.

6.10.2 Known Archaeological, Historic and Cultural Remains

The baseline study completed previously, found no available information to identify any archaeological, historic or cultural remains on the site or in the surrounding area. No buildings or remains of archaeological, historic or cultural significance are known to exist along the access road to the site or in the surrounding area. This is supported by consultation undertaken by E&E and NREA with officials of the Supreme Council of Antiquities, indigenous people, local officials and experts, during which it was stated that there are no identified archaeological monuments at the proposed power plant site.

6.10.3 Conclusion

It is concluded that the construction and operation of the power plant will have no impact on any known archaeological, historic or cultural resources. Consultation undertaken with local officials and experts in Cairo and Giza verified that the site is not of archaeological interest.

In the event however, that remains being found construction will cease and the advice of the Supreme Council of Antiquities will be sought. Appropriate measures will be put in place to protect and/or excavate the remains, including the following procedures:

- where possible, remains will be protected in-situ;
- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;
- any finds of archaeological, historic or cultural significance will be given to the Supreme Council of Antiquities; and
- preparation of a Chance Finds Procedure which lays out the steps to be taken if archaeological, historical or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

The incorporation of these precautionary measures into the construction program will ensure that all potential remains of significance are recorded and are accorded the required protection where considered necessary.

6.11 NATURAL DISASTER RISK

6.11.1 Seismic Risk

The Power Station site is vulnerable to small to moderate kinds of earthquakes (<3 – 5.7 on Richter scale). This should be taken into consideration in selection of the appropriate building code and in engineering designs (*Figures 5-23 and 5-24*).

The power plant has been designed to conform to the Uniform Building Code (UBC), Division V-Earthquake Design, for Seismic Zone 2A, according to US regulations for earthquake. These design criteria are therefore considered sufficient to withstand the level of seismic activity experienced in the Area.

The potential environmental impacts of a seismic event during power plant operation are not anticipated to be significant.

6.11.2 Flood Risk

The risk of flash flooding in the project area, as indicated in Section 5.2 of this report, is considered to be low, hence the proposed power plant is largely located in an area classified as not representing significant flood risk.

The site of the present Kuraymat power plant is conveniently protected against flash flooding (*Figure 5-12 and 5-22*). However, if further need arises to protect the site of the new ISCC Kuraymat power plant against potentially more severe floods, special measures need to be taken at the lower reach of Wadi Ramlyyah and possibly Wadi Atfieh (*Figure 6-10*). These measures commonly include construction of man-made dykes or gabions at selected sites of the larger tributaries of the wadi basins. Dykes may be constructed by bulldozing large stones and cobbles of the wadi bed or bedrock foot slopes (wadi banks) either into several lines of heaps across the main tributaries or into successive incomplete stone dykes arranged in a zigzag fashion. After a strong flood these structures may need limited or major restoration.

Instead of these loose stone dykes, gabion stacks may be constructed. A gabion is a box made up of wire mesh and filled in situ with large stones and cobbles of nearly the same size. They are arranged side by side in raws. The height of the barrier may be increased by construction of other tiers of gabions at higher levels.

In order to further reduce any potential impacts of flooding during construction and operation, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding;

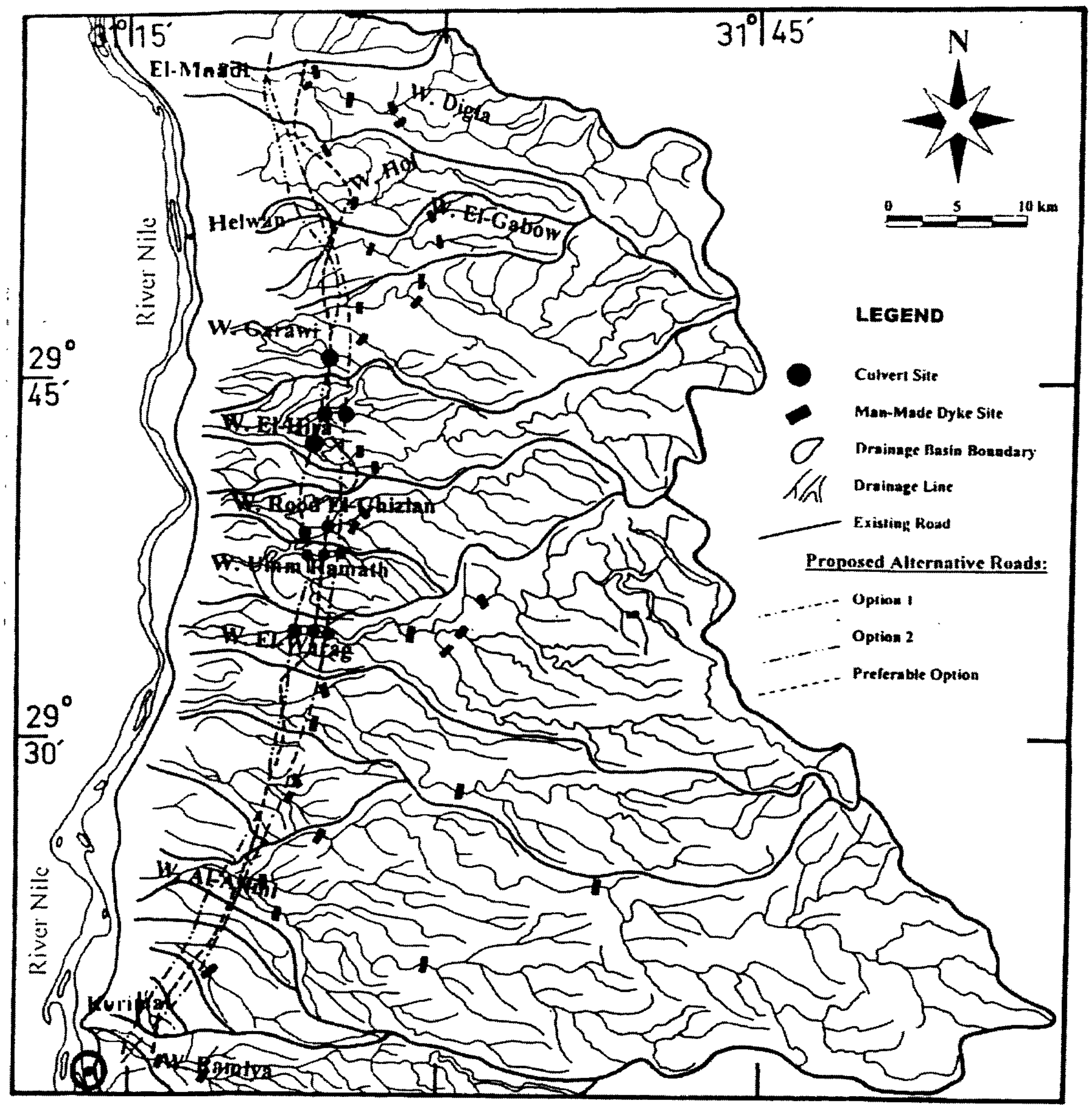
- site drainage will be constructed in such a way as to dissipate flood waters away from the main plant areas and to discharge clean waters to a natural drainage basin or drainage wadi in the area or to the treatment system of the power plant, with any potentially contaminated waters, via the oil interceptor;

- the access road will be culverted to allow adequate transit of flood waters.

With these provisions for controlling the impacts of the plant as a result of heavy rainfall, no significant flood risk impacts are predicted to occur.

Figure 6-10

Proposed Sites for Recommended Man-made Dykes and Culverts for Cairo/Beni-sueif Stretch



6.12 MAJOR ACCIDENT HAZRDS

6.12.1 Introduction

A major accident is defined as a physical situation with a potential for harm to individuals, infrastructure and buildings, or for impairment and environmental damage. Major accident hazards of concern with respect to the construction and operation of the power plant are those with the potential for injury, impairment and/or damage external to the power plant perimeter.

6.12.2 Assessment of Major Accident Hazards

An assessment of major accident hazards associated with the construction and operation of the power plant should consider the following issues:

- the potential risk to third party hazardous industry, facilities or populations of the operation of the power plant; and
- the potential risk to the power plant posed by third party hazardous industry or facilities.

Given the land uses surrounding the ISCC Kuraymat power plant and the measures incorporated into the design of the plant to minimize the risk from fire and explosion, the plant is not anticipated to pose a potential risk of any significance to any third party facilities. Furthermore, none of the third party commercial or manufacturing facilities and activities within 2 km of the site represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

In addition, since natural gas will be delivered to the plant by pipeline, there will be no natural gas storage facilities on site. Furthermore, no hazardous chemicals will be held on site in quantities sufficient to pose a major hazard.

Potential accidents may however occur as a result of ruptures to the gas pipeline during any future development of the area. Whilst the pipeline connection is the responsibility of GASCO, the following mitigation measures are recommended to avoid damage to the pipelines:

- the minimum reinstated cover should be 1.2m above the pipeline;
- above ground markers should be installed so as to clearly indicate the routes for all pipelines; and

- valves should be located within the pipeline so that flow can be halted in the event of a rupture.

6.12.3 Risk of Major Accidents on the Power Plant Site

Fichtner Solar GmbH identified fire risks during design of the power plant and in particular with regard to the following areas of the plant:

- the gas turbines;
- the Heat Recovery Steam Generators (HRSGs);
- fuel oil storage tanks[(1)];
- transformers;
- turbine oil tank;
- electrical rooms.
- administration building, and
- yard area.

The power plant has been designed to be in conformance with the international code of the National Fire Protection Authority (NFPA), which requires particular specifications for fire protection[(2)] and compliance with local fire protection systems. A Fire Safety Plan is currently being developed and will be implemented prior to power plant commissioning. A permit from the Egyptian Civil Defense Authority is required prior to plant operation.

An Industrial Hazard Assessment has not been undertaken and is not considered necessary since:

- measures have been incorporated into the design of the plant to minimize the risk from fire and explosion; and

- the third party commercial or manufacturing facility within 2 km of the site does not represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

(1) Flash Point is 55°C: Normal storage temperature for the fuel will be 35°C.
(2) NFPA 850: Recommended Practice for Fire Protection for Electric Plants and High Voltage Direct Current Converter Stations, 1996.

6.13 SOLID WASTE MANAGEMENT

A natural gas power plant produces no ash and only a low quantity of other solid wastes during construction and operation. These include the following:

- *Construction waste*: contaminated spoil, oil drums etc.;
- *General plant wastes*: oily rags, broken and rusted metal and machine parts, defective or broken electrical parts, empty containers, miscellaneous refuse;
- *Raw water pre-treatment sludge*: from build-up of solid residues in the raw water pre-treatment system;
- *Tank sludge*: solid residues which build up in process chemical storage tanks;
- *Oil Interceptor sludge*: from drainage interceptors used to remove solids and oils and grease from effluent;
- *Packaging waste*: from operational consumable supplies; and
- *Commercial wastes*: from offices, canteen and staff facilities.

Wastes generated at and by the plant will be evacuated from the site by licensed contractors. Final disposal of wastes will be to waste treatment plants or local landfill sites, as agreed by the relevant competent administrative authority.

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction and operation:

- all waste taken off site will be carried out by a licensed waste contractor and NREA will audit the disposal procedure;

- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;

- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and

- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

The environmental engineer of the power plant will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

With the adoption of these mitigation measures, the impacts of solid waste generated by the construction and operation of the power plant are not predicted to be significant.

6.14 PUBLIC HEALTH

6.14.1 Air Pollution

The key issue in relation to public health is the potential effects of air pollution from the plant's stack emissions. The assessment of air quality impacts presented in Section 6.2 demonstrates that ground level pollutant concentrations as a result of emissions from the power plant will not significantly affect air quality. Hence, the health risks from stack emissions are not considered to be significant.

6.14.2 Disease Vectors

The proposed power plant includes a range of mitigation which will prevent the encouragement of disease vectors, such as rodents or insects. These measures include the following:

- provision of sanitation during construction and operation;
- control and management of solid wastes;
- provision of potable and process waste supplies; and
- disposal of site drainage and effluent.

With these mitigation measures, the potential for encouragement of disease vectors is low.

6.15 OCCUPATIONAL HEALTH AND SAFETY ISSUES

6.15.1 Safety Issues

The proposed ISCC Kuraymat power plant site is currently unused and no environmental features or characteristics have been identified which could cause special occupational health and safety impacts. In particular, as an unused area, ground cover to a depth of more than 2m is clean, therefore no soil contamination is present and no special construction techniques are expected to be required to build the power plant.

In addition, there are no commercial or industrial activities bordering the site and therefore no safety issues associated with third-parties are anticipated.

The NREA will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant. Emergency and accident response procedures will also be included in the operation manual for the power plant. In particular, construction and operation activities will be carried out on the following basis:

- compliance with international standards for good construction and operational practices;
- adherence to local and international guidance and codes of practice on EHS management during construction and operation;
- management, supervision, monitoring and record-keeping as set out in the plant's operational manual;
- implementation of EHS procedures as a condition of contract with contractors and their sub-contractors;
- clear definition of the EHS roles and responsibilities of the companies involved in construction and to individual staff (including the nomination of EHS supervisors during construction and an EHS coordinator during operation);
- pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;

- provision of appropriate training on EHS issues for all construction and operation workers, including initial induction and regular refresher training, taking into account local cultural issues;

- provision of health and safety information;

- regular inspection, review and recording of EHS performance; and

- maintenance of a high standard of housekeeping at all times.

Given the provision of this high standard of health and safety management on site, construction and operation of the power plant in accordance with good industry practice and the lack of any adverse features/characteristics of the site, the occupational health and safety risks associated with construction and operation of the power plant will be minimized.

6.16 ASSOCIATED INFRASTRUCTURE

Connections to existing gas and electrical infrastructure will be the responsibility of GASCO and NREA, in collaboration with EETC, respectively. The first will not require permit from the EEAA as the gas pipelines already pass adjacent to the immediate north of the power plant boundary and will provide the proposed ISCC power plant with natural gas. Key potential impacts that will be considered include:

- land use; and
- existence of residential communities.

6.16.1 Gas Pipeline

An existing gas pipeline network runs to the gas pressure reducing station of the present Kuraymat power plant at the north-east point within the plant boundary. It is intended that a new connection pumping station will be taken from this pipeline network to feed the proposed ISCC power plant with natural gas. Any environmental impacts will be identified and mitigated / managed by GASCO.

The potential impacts of a seismic event rupturing the gas pipeline have not been assessed in this EIA report, as the pipeline does not form part of NREA's project. However, it is recommended that at a minimum, automatic shut-off valves should be fitted at regular distances along the length of the pipeline allowing gas flow to be halted in the event of seismic activity.

6.16.2 Transmission Lines

The ISCC Kuraymat power plant will be connected to the existing transmission facilities of the Egyptian Electricity Transmission Company's (EETC) (an affiliate company to the EEHC) network via connecting Transmission lines.

As mentioned earlier (Section 4.6.5), 220 kV switchyard is preferred for the power evacuation considering the size of the power plant and the existing 220 kV/500 kV substation at a distance of about 2 km from the project site in the nearby steam power plant. A 220 kV switchyard will be located in the ISCC-KPP. Interconnection of this switchyard with the nearby switchyard and providing additional outgoing line feeder for evacuating power if required is most probably be decided in the course of further engineering.

The 220 kV substations are of the outdoor type. Generally, normal two winding transformers are used for the generator units and autotransformers in the network substations (interbus transformers). The autotransformers are equipped with high-side load-changing taps which can be operated also off-load and manually. The circuit breakers, are of the air-blast type.

As can be seen on the ISCC Kuraymat General Site Description, the overhead lines going out from the power plant encounter mostly desert area typical for the Upper Egypt zone. Land acquisition for connecting line construction does not present any problems. High attention must be paid to line route access during the transmission connecting line construction because of the exiting land uses and the road. No line route problems which are specific to the ISCC Kuraymat site are to be considered in the implementation phase.

The proposed tie in overhead lines in the case of the ISCC Kuraymat site will terminate into existing substations which have to be correspondingly extended.

7. MITIGATION OF ENVIRONMENTAL IMPACTS

7.1 INTRODUCTION

The New and Renewable Energy Authority (NREA) is committed to constructing and operating the ISCC Kuraymat power plant to high environment, health and safety (EHS) standards.

This section provides a summary of mitigation measures, as well as environmental enhancement opportunities, for the key EHS impacts which have been identified through the EIA process. The mitigation measures represent a synthesis of those measures which are part of the basic power plant design and those that have been recommended in Section 6 of this report for both the construction and operational phases of the power plant.

The mitigation measures discussed in this section are summarized in *Tables 8-1and 8.2* in *Section 8*, together with respective environmental monitoring and management arrangements. It should be noted that many of the mitigation measures presented below for the construction phase, will be carried forward into plant Operation.

All the mitigation, monitoring and management measures proposed below and in Section 8 of this report (the Environmental Action Plan (EAP)), will be adopted by the NREA and imposed as conditions of contract on the contractor and any sub-contractors employed to build or operate any part of the power plant. Since many of the mitigation measures presented are considered an essential, integrated component of the construction and operation works, it is not possible to separate the specific costs of their implementation from the overall construction costs.

7.2 MITIGATION MEASURES DURING DESIGN AND CONSTRUCTION

7.2.1 Dust Emissions during Construction

As described in Section 6.2.2, dust generated by construction activities could be significant locally, not only in terms of air quality, but also with regard to visibility and traffic safety. To minimize dust nuisance, certain good site practices will be employed as follows:

- roads will be kept damp through use of water bowsers;
- stockpiles of friable materials will be sited and maintained appropriately (including the use of sheets) so as to minimize dust blow (such as balancing of cut and fill operations);
- drop heights for material transfer activities such as unloading of friable materials shall be minimized;

- the construction phase will begin with the construction of access roads;
- roads created during construction will be compacted and graveled if necessary;
- roads used on site will be maintained in good order;
- access into the site will be regulated;
- vehicle speed limits of less than 35 km/hr on unmetalled roads will be enforced on site; and
- lorries and vehicles will be sheeted during transportation of friable construction materials and spoil.

In addition, to ensure that pollutant levels resulting from transport operations are kept to a minimum during construction activities, all vehicles being used on site will meet pollutant emission standards.

7.2.2 Aquatic Environment during Construction

Construction impacts on the aquatic environment are likely to arise as a result of:

- dredging;
- construction of the intake facilities;
- surface water runoff; and
- pipeline construction across the Nile river bank.

As discussed in Section 6.3, these activities are likely to result in impacts to water quality and aquatic ecology.

Given the mitigation and management measures described below, impacts will be minimized and are not expected to be significant.

For construction activities in the Nile river:

- dredged areas will be limited to the minimum area required for construction purposes; and

- dredged sediments will be disposed of at a site agreed between the NREA's developers and the relevant local authorities prior to the commencement of construction activities.

For construction activities on site:

- no effluents will be discharged into the water body during normal construction activities, unless effluents quality has been checked and meets the Egyptian environmental Law 4 requirements as well as the requirements of Law 48 /1982;

- a site drainage plan will be developed to ensure that if any erosion occurs during storm events, minimal amounts of sediment will result by reducing the flow velocity and sediment load before discharge;

- temporary stockpiles of soil should be protected from erosion by using a reduced slope angle where practical. This can be addressed by a site drainage plan as described above; and

- good site management practices will be enforced to ensure that the construction site is kept clean and tidy.

In addition, to ensure access to the Nile river bank is not restricted for public use (as decreed by Egyptian Law) and navigation activities are not jeopardized, the following measures will be implemented:

- the bank across which the intake pipes are constructed will be returned to its original state following construction; and

- warning signs will mark the intake structures.

All construction teams employed and contracts commissioned will incorporate these mitigation measures as part of Operational Procedure in contracts and briefs (see the EAP Section 8).

7.2.3 Noise Emissions during Construction

Specific noise mitigation measures for the construction phase reflect standard good site management practices and include:

- enforcement of vehicle speed limits, strict controls of vehicle routing and prohibition of heavy vehicle movements during night;

- diesel engine vehicles and compression equipment will be equipped with effective silencers;

- activities with highest noise emissions (e.g. piling) will be undertaken only during the day shift (0700 hours - 1800 hours) and between Saturday and Thursday and not during official holidays; and

- personnel will use hearing protection when using or working in the vicinity of noisy equipment.

7.2.4 Flora and Fauna during Construction

Negative impacts on flora and fauna during power plant construction were described in Section 6.5.2 and are not considered to be significant. However, species on or close to the site may be disturbed and displaced as a result of increased noise, dust and human activity. Good site management practices as discussed elsewhere in this section, and implementation of the following mitigation measures, will ensure that any disturbance is reduced to a minimum:

- run-off from construction activities will be attenuated to ensure that surrounding species/habitats are not significantly affected;
- sediments removed during construction across the Nile river bank and river bed which may be contaminated, will be disposed of in a controlled manner, as described in Section 6.3; and
- personnel and vehicles will be restricted to within the boundaries of the construction site, lay down areas and access roads, and will not be permitted to enter surrounding land.

7.2.5 Soils and Hydrology during Construction

The potential for direct impacts on soil and groundwater during construction, is largely dependent on the management of the construction site and construction activities. A range of mitigation measures will be implemented to protect soils (and, as a result, any of the groundwater resources) from the direct impacts of constructing the proposed power plant. These measures include the following:

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;
- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil; and
- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site, for example for landscaping, will be disposed of at an appropriately licensed sanitary landfill site.

In addition, the potential for any transfer of existing contamination will be minimized through the following mitigation measures:

- protection of the soil from accidental pollution by bordering around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;

- provision of oil and interceptors, such as oil/ water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;

- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed landfill sites;

- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and

- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

7.2.6 Traffic and Transport during Construction

Construction activities will generate additional traffic on local roads and in particular, significant volumes of heavy plant traffic and occasional abnormal loads. To minimize any inconvenience, hazards and damage caused to other road users, local people and the local road network, the following mitigation and management measures shall be implemented:

- abnormal load movements will be confirmed with the Competent Administrative Authority (CAA) and will adhere to prescribed routes. Their movement will be scheduled to avoid peak hours and notices will be published in advance to minimize disruption if required by the CAA;

- consideration will be given to staggering construction shifts to split arrival and departure times;

- scheduling of traffic will be undertaken to avoid the peak hours on the local road network wherever practicable; and

- construction workers will be transported to the site by contract bus.

7.2.7 Socio-economic Effects During Construction

The assessment of impacts showed an overall positive impact on the local society, culture and economy. Given that the use of local labor will be prioritized during construction, no mitigation measures are proposed.

7.2.8 Archaeology During Construction

Whilst careful examination of existing literature and data did not reveal any sites of archaeological or cultural heritage importance on or around the site, the existence of archaeological remains cannot be ruled out. Remains could be unearthed and damaged during construction of the power plant and ancillary buildings, pipelines, cables and the intake and discharge facilities.

Construction works will therefore be monitored to ensure that in the event of remains being found construction activities will be stopped and the Supreme Council of Antiquities will be consulted on the most appropriate measures, which could include the following:

- where possible, remains will be protected in-situ from construction activities, by relocating non-essential activities ;
- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;
- any finds of archaeological, historic or cultural significance will be given to the appropriate CAA; and
- preparation of a Chance Finds Procedure which lays out the steps to be taken if archaeological, historical or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

7.2.9 Flooding During Construction

Section 5.11.2 identified that as the site lies on the western edge of the eastern desert, there is a potential for the power plant site to be affected by occasional flash flooding. In order to reduce any potential impacts of flooding during construction, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding;
- site drainage will be constructed in such a way as to dissipate flood waters away from the main plant areas and to discharge clean waters to a natural drainage basin or a ground well and any potentially contaminated waters to the surrounding land and any potentially contaminated waters to the discharge facility via the oil interceptor;

- desert lands to the east of the site will be re-inforced to ensure that erosion does not take place; and
- the access road will be culverted to allow adequate transit of flood waters.

7.2.10 Solid Wastes During Construction

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction:

- all waste taken off site will be carried out by a licensed waste contractor and NREA will audit the disposal procedure;
- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;
- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and
- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

An engineer with responsibility for environmental aspects will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

7.2.11 Occupational Health and Safety During Construction

NREA will ensure that construction activities are undertaken in a manner which does not present hazards to workers' health and safety. In particular, the NREA will establish and integrate policies and procedures on occupational health and safety into the construction and operation of the power plant. Emergency and accident response procedures will also be included in an EHS manual for the power plant.

The following measures will be carried out in both the construction and operational phases:

- compliance with international standards for good practice;
- adherence to local and international guidance and codes of practice on EHS management;

- management, supervision, monitoring and record-keeping as set out in the plant's operational manual;
- implementation of EHS procedures as a condition of all contracts;
- clear definition of the EHS roles and responsibilities of the companies contracted to work on site and to all their individual staff (including the nomination of EHS supervisors and coordinator);
- pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;
- provision of appropriate training on EHS issues for all employees on site, including initial induction and regular refresher training, taking into account local cultural issues;
- provision of health and safety information;
- regular inspection, review and recording of EHS performance; and
- maintenance of a high standard of housekeeping at all times.

7.3 MITIGATION MEASURES DURING OPERATION

7.3.1 Introduction

Mitigation measures introduced into the design and construction phase of the power plant will be carried forward into the operational phase by the NREA. Many mitigation measures, as described in Sections 4 and 6 of this report, have already been integrated into the design of the power plant in order to minimize any operational impacts on the environment. Mitigation measures such as low NOx combustors, noise silencers and water discharge controls are for example considered integral to the design of the power plant.

The following section builds on the design criteria for the power plant in order to reduce to a minimal level any further potential negative impacts. Areas where positive impacts can be introduced or maximized are also considered.

7.3.2 Air Quality During

Operation

Emissions Guidelines

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as its main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions).

In order to reduce NOx emissions when firing natural gas, low NOx combustors are used on the gas turbines. In addition, a stack measuring 35m high has been designed to allow maximum dispersion of emissions into the surrounding atmosphere.

Stack emissions to the air from the proposed plant are therefore within the Egyptian, as well as the World Bank guidelines' . However, the IFC has indicated that its emission guidelines must be met for at least 95% of operating time. Given that NREA is committed to burning natural gas only, the plant will operate well within the SO_2 emission guidelines, and no further mitigation is proposed.

Air Qunlity Guidelines

To investigate the issue of atmospheric emissions from the power plant and their impact on ambient air quality, dispersion. modeling has been undertaken and the results of the modeling were presented earlier in Section 6.2. The modeling indicates that the predicted off site maximum annual and 24 hour mean ground levels of NO_2 and PM concentrations, do not exceed the Egyptian as well as the World Bank ambient air quality guidelines when natural gas is burned. As described above, NREA is committed to using natural gas for more than 100% of operating time in a year.

No further requirement for mitigation of the emissions to air from the power plant is proposed.

7.3.3 Aquatic Environment During Operation

The main impacts of the power plant on the aquatic environment during power plant operation are likely to derive from:

- discharge from cooling towers and discharge of process water into the ambient environment;

(1) World Bank/IFC Pollution Prevention and Abatement Handbook - Part III: Thermal Power - Guidelines for New Plants, July 1998.

- disruption of navigational transport due to intake structures and water abstraction from the Nile .
- entrainment of fish and mobile organisms of the Nile water in the intake structure

The design of the intake structures has incorporated measures to reduce impacts on the Nile environment. Other measures include:

- wastewaters including drainage from treatment plant_ HRSG blow down, HRSG area equipment drainage, cooling towers blow down and sample cooler will be treated first in a common effluent tank for treatment before off-site disposal through discharge, by means of 2x 100% effluent disposal pumps, to a natural drainage basin/wadi or a ground well;

- effluent treatment plant will receive wastes from combustion turbine area floor drain, ST lube oil centrifuge, tank farm area, ST area floor washing and transformer area drain and process them into an oil/water separator where waste waters are channeled to the common effluent tank for treatment before discharge to a natural drainage basin/wadi or a ground well;

- GTG wash water will be collected in an individual sump and discharged with a portable pump to a tanker for off-site disposal via a licensed contractor;

- Waters contaminated by chemical wastes will be channeled from neutralization pit and combustion turbine compressor wash effluent to the common effluent tank for treatment before off-site disposal;

- Sanitary wastes will be collected via plant sewage and sewerage lines in a local sanitary treatment plant where the treated waters will be re-used in the plant plantation irrigation program while the dirt will be collected for off-site disposal by sanitary road tankers of a licensed contractor;

- Solar field will be provided with an emergency strategy for immediate response to any accidental spillages, operational leakages or droplets of thermal oil to allow collection and control as required;

- Water spillage from mirror washing and cleaning will be monitored and controlled;

- bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system;

- oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank;

- areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump; equipped with a manually operated valve;

- transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Alternatively, each main oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain 110% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber will be constructed an oil separator which will normally function to separate any oil contaminated to the storm water collected from within the transformer foundations and the clean water drained to the discharge structure. The transformers will not contain PCBs; and

- stormwater runoff from equipment slabs that may be subject to oil contamination exposure, will be collected and channeled through an oil/water separator prior to discharge into the discharge structure.

In order to minimize potential impacts to water quality, NREA will ensure implementation of good site management practices including the following measures:

- wastewater will be collected and treated before being discharged into the discharge system, the main water treatment steps include:
  - neutralization of any wastewater that has a pH outside the range of 6 to 9;
  - oil separation of any wastewater that may be contaminated with oil or grease; and
  - filtration of any wastewater that may contain high concentrations of suspended solids.
- no solid wastes will be discharged into the drainage basin/wadi or the ground well;

- drainage systems have been designed on site to prevent any contaminated surface run-off from being discharged into the discharge system without prior oil separation and neutralization of any other contamination; and

- all effluent discharges will comply with local Egyptian and World Bank standards.

7.3.4 Noise Emissions During Operation

A number of noise mitigation measures have been built into the design of the plant in order to ensure that noise levels are minimized and that all items of plant are operating to local and international standards.

Specific design mitigation measures include:

- gas and steam turbine generators, air compressors, pumps, and the emergency diesel engines are enclosed in sound enclosure;

- air compressors are equipped with air silencers; and
- noisy outdoor equipment have been designed to a noise limit of 85 dB(A) at one meter.

In addition, all personnel working in noisy areas will be required to wear hearing protection.

7.3.5 Flora and Fauna during Operation

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during operation, and will dissipate rapidly with distance from source. Any disturbance during construction and operation will therefore be localized (see Section 6.4); and

- personnel and vehicles will be restricted to within the boundaries of the site and access roads, and will not be permitted to enter surrounding land.

7.3.6 Visual Impact during Operation

Landscaping will include tropical shrubs (trees, grass, palm groves) around the site. All plants will be indigenous species.

7.3.7 Soils and Hydrology during Operation

During plant operation, the main potential for impacts to occur to soils and hydrology (including run-off into the surrounding lands), are likely to arise as a result of spillages and storage of chemicals and fuels on site. Good site management practices such as those described under Section 7.3.3 "Aquatic Environment" will minimize potential impacts.

7.3.8 Solid Waste Impacts During Operation

The mitigation and management measures during construction described in Section 7.2.10 above relate to both the construction and operation phases.

7.3.9 Health and Safety During Operation

The following mitigation and management measures will ensure that the health and safety of staff and any visitors on and to the site is not jeopardized during operation of the plant:

- development and implementation of an Operational Health and Safety Plan with appropriate training;
- provision of training in use of protection equipment and chemical handling;
- clear marking of work site hazards and training in recognition of hazard symbols;
- development of site emergency response plans;
- all personnel working or standing close to noisy equipment will be required to wear noise protectors; and
- drinking water will be supplied to the plant via plant water supply system which will be complying with drinking water standards published by the World Health Organization

In addition, the operational health and safety measures during construction described in Section 7.2.11 above, will be carried forward into the operational phase of the power plant.

7.4 COMPENSATION FOR AFFECTED PARTIES

No indigenous populations or legally entitled landowners will be affected by the development of the power plant, therefore no affected parties require compensation. Day to day practice normally confirms fair compensations that should be paid to people who are likely to be affected by of site associated infrastructure including cooling water intake and discharge pipelines as well as overhead transmission lines going out from the power plant and connecting it to the national unified power system.

8. ENVIRONMENTAL MITIGATION, MANAGEMENT AND MONITORING PLAN:

ENVIRONMENTAL ACTION PLAN (EAP)

8.1 OBJECTIVES OF THE PLAN

The NREA is committed to implementing an environmental management and monitoring plan which will ensure that the construction and the operation of the ISCC Kuraymat power plant (ISCC-KPP) involves full implementation of all proposed mitigation measures and complies with high environmental standards, the requirements of the environmental legislation and guidance notes as applicable in Egypt, and the procedures and guidelines of the World Bank/ IFC.

Previous sections of this report have outlined the baseline environmental and socio-economic conditions in the area of the proposed development, have identified the potential impacts on these baseline conditions which could result from both construction and operational activities and have proposed measures to minimize and mitigate against any negative impact identified. To complete the environmental evaluation, this section presents an Environmental Action Plan (EAP) which summarizes the mitigation measures suggested and discusses initial and ongoing monitoring and management of significant impacts of the proposed plant.

The EAP covering construction and operation of the power plant is summarized in *Tables 8.2 and 8.3* respectively. For further detail on the mitigation measures to be undertaken, reference should be made to Section 7 of this report. Details of pre-construction/operations monitoring and management activities summarized in the tables are discussed in more detail below.

The EAP includes the definition of the following measures to minimize environmental effects:

- **construction management,** including control of construction traffic, site drainage, construction waste and spoil etc.;
- **engineering design measures** directly incorporated into the power plant as good design practice, through the selection of appropriate plant and equipment and choice of construction materials;
- **specific mitigation measures designed to prevent or minimize releases** from the process, such as the use of low NOx Combustors, closed loop cooling system;
- **operational control systems,** such as the use of water treatment chemicals; and
- **operational management,** which includes staffing levels and staff training.

The effectiveness of these environmental management and mitigation measures will be monitored throughout the construction and operation of the power plant.

Monitoring will be carried out by NREA using standard techniques and equipment agreed with the Egyptian Environmental Affairs Agency (EEAA), which will be calibrated, operated and maintained in accordance with the manufacturers specifications.

Monitoring data will be analyzed and reviewed at regular intervals by NREA/ISCC-KPP and compared with the relevant standards so that any necessary corrective actions can be taken in a timely manner. Records of monitoring results will be kept in an acceptable format and reported to the responsible government authorities and relevant parties (including the WB).

8.2 ENVIRONMENTAL MANAGEMENT

8.2.1 Environmental Management Organization

***During Design** and Construction*

Suitably qualified and experienced contractors will be responsible for the detailed design and construction of the power plant. Construction workers will be required to demonstrate appropriate skills, qualifications and/or experience prior to employment.

During construction, NREAIISCC-KPP will ensure that all contracts with Contractors and sub-contractors stipulate all construction management measures (as given in this EAP), operational design criteria and environment, health and safety standards which must be implemented at the project site.

Implementation of these measures will be enforced and supervised by the Assistant Plant Manager who will have direct responsibility for the Environment, Safety and Quality Assurance program on site during construction and operation. The Assistant Plant Manager is responsible for ensuring that construction works comply with the requirements of the EAP and all environmental permits. His key roles will be to:

- assume the interface with authorities for environmental authorizations and permits;
- act as the Assistant Plant Manager for local authorities, industrial and commercial interests and any other interested parties;
- ensure that mitigation measures to reduce impacts during the construction phase are implemented;
- ensure that monitoring to be undertaken during construction is implemented;
- ensure compliance with the environmental management plan; and
- ensure that health and safety requirements are respected.

During Power Plant Operation

During operation, direct responsibility for environmental compliance and the implementation of the mitigation, management and monitoring measures described in this section and in Section 7 of this report, will continue to be with the Assistant Plant Manager. This position, will report directly to the Chairman/General Manager of NREAJISCC-KPP.

The Assistant Plant Manager will be based at the site and will be responsible for recruiting, training and managing his staff. He will be responsible for implementing the mitigation and management measures described above and for monitoring and record keeping of the following:

- stack emissions;
- air quality;
- noise emissions;
- quality of water discharge; and
- waste management.

In this role, the Assistant Plant Manager will also be responsible for maintaining any pollution control equipment and for developing and implementing procedures for safe handling and storage of any hazardous materials used on site.

The Assistant Plant Manager will also have lead responsibility for maintaining a written Environmental Register with respect to environmental impacts as required under Egyptian and World Bank guidelines. The written records will identify the characteristics of discharges and emissions, details of periodic testing including results, procedures for follow-up environmental safety actions and the person in charge of this follow-up. Should any prescribed standards be breached, NREAIISCC-KPP, through the Assistant Plant Manager, will immediately inform the EEAA and disclose the procedures being taken to rectify nonconformity.

Results of environmental monitoring as described above, shall be recorded and submitted to the EEAA and to any other party (i.e. WB) as required. The EEAA and WB are entitled to audit the NREA in order to ensure conformity with environmental standards and requirements.

In addition, the NREA must keep a record of any significant environmental incidents occurring at the plant including accidents and occupational illnesses, spills, fires and other emergencies. The Assistant Plant Manager will be responsible for ensuing that these records are maintained up - to - date and are available on site.

8.2.2 Environmental Training

The NREA will ensure that the power plant is manned 24 hours a day, 7 days per week. All staff employed at the plant will be trained in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

Training will include:

- induction training on appointment;
- specialist training (as required for their prescribed job role); and
- refresher training as required.

The training program will be designed to ensure that appropriate skilled staff are used to operate the power plant at all times. Aspects of occupational health and safety and emergency procedures are described below.

8.2.3 Occupational Health and Safety

NREA/ISCC-KPP will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant which meet the requirements of Egyptian and World Bank guidelines as given in Section 2 of the report. The policies and procedures will also be designed to comply with all manufacturers safety data sheets for chemical storage and usage, so as to provide a safe and healthy working environment.

Occupational health and safety programs will be supported by staff training for the power plant and the appointment of the Assistant Plant Manager. The training will include, but will not be limited to, the following:

- general area safety;
- specific job safety;
- general electrical safety;
- handling of hazardous materials;
- entry into confined spaces;
- hearing conservation;
- repetitive stress disorders;
- Code of Safe Practices;
- use of personal protective equipment; and
- first-aid.

The training will include induction courses when staff are first employed at the power plant, with specialist and refresher training as required by the job role. Training will be updated annually and occupational health and safety procedures will be included within the Operations Manual for the power plant.

The safety record at the power plant will be reviewed each month at a formal meeting, led by the Assistant Plant Manager, where the agenda items, comments and attendance will be recorded and kept on file.

In addition, periodic safety audits will be conducted to verify compliance with safe working practices, which will comprise physical inspections, review of plant records and interviews with staff. The audits will assign responsibility for any corrective action necessary to mitigate a potential hazard and allow the tracking of the completion of the corrective measure.

8.2.4 Emergency Procedures and Accident Response

Instructions on emergency measures necessary to safeguard employees and the wider environment will be prepared as part of the Operations Manual for the power plant.

Accident Response

As part of the preparation of emergency procedures and the plans for accident response arrangements, the NREA will carry out the following

- review industry-specific and Egyptian and World Bank standards and regulations;
- establish general guidelines on potential safety and accident risks;
- prepare job-specific operating instructions where appropriate;
- establish safety and security notices for hazardous materials;
- prepare specific emergency operating instructions;
- provide protective equipment (including clothing, air and ear protection etc.) as required;
- evaluate information and feedback from employees; and
- record and investigate all accidents, injuries and incidents.

Contingency plans and emergency procedures are being developed to cover events due to operational failures, natural causes and acts of third parties. The plans and procedures will cover, as a minimum, the following:

- fire;
- explosion;
- bomb alerts;
- leaks and spills of hazardous materials;
- structure or equipment failures;
- injuries and illnesses;
- risk from natural disasters (wind, sandstorm, earthquake); and
- third-party risks (potential impacts of an accident occurring at another industrial facility which may impact upon the power plant).

Oil Spill Contingency Plan

As Good practice and part of the EAP, NREAIISCC-KPP will prepare an Oil Spill Contingency Plan.

Oil will be delivered to the site by road and stored in:

- two storage tanks for the light fuel oil (oil No. 2 / sollar).

These tanks are surrounded contained within separate retention area which is designed to contain 1 10% of one tank.

The plan will cover the following activities.

- delivery;
- handling;
- spills; and
- cleanup.

The plan will detail procedures, responsibilities, chains of command, information flows, monitoring and documentation.

Risk Related to Thermal Fluid Leakage

There might be some significant leakage of thermal fluid at the connection with the trough. Specification for the fluid to be used or likely to be used are not identified yet. But risk related to thermal fluid leakage at the connection with troughs could be managed through collecting sumps to be installed immediately underneath the connection points with the troughs.

8.3 SCHEDULE FOR PREPARATION AND IMPLEMENTATION OF EHS PLANS

Table 8.1 below provides a proposed time schedule for the preparation and implementation of the Environment, Health and Safety Plans.

Table 8-1

Environment, Health and Safety Proposed Plans

Plan	Responsibility	Schedule for Submission	Schedule for Implementation
Occupational Health and Safety Plan (Construction)	ISCC- Plant Manager	2"d Quarter 2007	3rd Quarter 2007
Occupational Health and Safety Plan (Operation)	ISCC- Plant Manager	3rd Quarter 2009	4th Quarter 2009
Emergency Procedures and Accident Response Plan	ISCC- Plant Manager	3rd Quarter 2007	4th Quarter 2007
Oil Spill Contingency Plan	ISCC- Plant Manager	3rd Quarter 2009	4th Quarter 2009
Chance Finds Procedure	ISCC- Plant Manager	2"d Quarter 2007	3'd Quarter 2007
Monitoring Plan	ISCC- Plant Manager	Already prepared, see Tables 8-2 and 8-3 of EAP	Start of construction

Table 8-2 Provides with construction Impact Mitigation, Monitoring and Management Measures and *Table 8-3*present the same items during operation.

Table 8-2

Construction Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
Air Quality									
Dust emissions caused by construction activities, construction vehicles movements, and transport of friable construction materials.	Implementation of good site practices including: • Appropriate siting and maintenance of stockpiles of friable materials so as to minimize dust blow; • Minimizing drop heights for material transfer activities such as unloading of friable • Construction phase to begin with construction of access roads; • Roads will be kept damp via a water bowser; • Roads will be compacted and graveled if necessary; • Site roads will be maintained in good order; • Regulation of site access; • Sheeting of lorries transporting friable construction materials	Before and during construction	Initiate baseline air quality survey in cooperation and coordination with existing key performance indicators. Measurements and analysis of these pollutants to be made by a trained staff assigned by NREA/ISCC-KPP and submitted to EEAA, WB or any other concerned authority. Annual reporting of summary results (or more if requested) and	Implementation of good site practices shall be the responsibility of contractors and subcontractors under the supervision of NREA with support from EEHC.	NREA with support from EEHC.	Dust levels (TSP, PM10)	Semi annual reporting of summary results (or more if requested) submitted to WB, EEAA.	NREA responsible for management of the air quality monitoring measurements and submission of reports. Basic training of persons employed to operate and maintain the monitoring. NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction	Air quality measurement equipment through NREA or third party (US$ 20K). Management time and reporting for the air quality monitoring (US$ 30K)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	and spoil; • Enforcement of vehicle speed limits <35km/h		submitted to the EEAA, WB or any other concerned authority. Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of NREA.					training on good construction site and management practices.	
Aquatic Environment Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils (see also under "Soils	Management activities will include the following: • No discharge of effluents into the ambient environment unless effluents has been checked and meets all the local requirements; • Development of a site drainage plan which reduces flow velocity and sediments load; • Protection of temporary stockpiles of soil from erosion by using a	During construction	Nile river survey undertaken July 2003 and May 2004 along many profiles fronting the site. Report to be maintained for later monitoring and evaluation during operation. Water quality	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help from EEHC.	NREA with support from EEHC	Fluid effluents within the site. Soil erosion. Surface water runoff. Sewage effluents. Earth, mud and debris	Monthly for water quality issues. Quarterly reporting of summary results	NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction training on good construction site and management practices. .	Management time and costs included in the cost of the Project Management Unit.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
and Hydrology").	reduced slope angle where practical, and sheeting • Maintenance of well kept construction site.		issues (temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals. Monitoring is required to ensure the implementation of management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of NREA with the help of EEHC.	NREA with support from EEHC	depositions on roads.	submitted to EEAA and WB.	These mitigation measures must be a condition of any construction contracts commissioned. NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction training on good construction site and management practices.	Management time and costs included in the cost of the Project Management Unit.
Noise ***Increased noise in the project area as a result of the use of***	Implementation of good site practices including: • Enforcement of vehicle speed limits; • Strict controls of	During construction	Monitoring and supervision by NREA is required to ensure the	Implementation of good site management shall be the responsibility of all contractors	NREA with support from EEHC	Noise complaints register to voice concerns.	NREA will produce a monthly log of any complaints	NREA to ensure all contractors and sub-contractors working on-site	Management time and costs included in the cost of the Project

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
noisy machinery and increased vehicle movements.	vehicle routing; • Diesel engine contraction plant equipment to be fitted with silences; • Limited noisy construction activities at night; • Use of protective hearing equipment for workers.		implementation of good site management practices by all contractors during construction.	under the supervision of NREA with help from EEHC.		Check validity using noise measuring devices.	and action taken and submit to the EEAA and WB. Quarterly reporting of summary results submitted to EEAA and WB.	are aware of EMP and all employees are given a basic introduction training on good construction site and management practices.	Management Unit. Noise measuring through independent third party (US$ 20K)
Flora and Fauna Site Clearance-Vegetation removal and habitat disturbance.	• Good site management practices will be observed to ensure that disturbance of habitats off-site is minimized. • Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads.	During construction	Monitoring and supervision by NREA is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help from EEHC.	NREA with support from EEHC	Good conservation of floral wealth. NREA to check the status of floral species weekly.	Monthly Number of trees conserved or replanted.	NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction training on good construction site and management practices.	Management time and costs included in the cost of the Project Management Unit.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
Soils and Hydrology									
Site clearance excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movements of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • Development of effective site drainage systems; • Restriction of access only to construction site areas; • Monitoring and control of spoil; • Disposal of waste materials unsuitable for reuse on-site, (e.g. for landscaping) at appropriately licensed sites; • Provision of oil interceptors; • Management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • Provision of impermeable bases in	During construction.	Monitoring is required to ensure the implementation of good management practices during construction.	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help from EEHC.	NREA with support from EEHC	Site drainage Access only to construction site areas. Spoils Waste materials. Oily waters. Drainage pathways. Potential spillage in operational areas. Soil sample test. Ground water sample test.	Quarterly reporting of summary results submitted to EEAA and WB.	NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction training on good construction site and management practices.	Management time and costs included in the cost of the Project Management Unit. Site drainage system included in construction.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	operational areas to prevent absorption of spillage.								
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, heavy loads and abnormal loads.	Standard good practice measures will be implemented as follows: • Adherence to abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; • Construction shifts will be staggered; • Scheduling of traffic to avoid peak hours on local roads.	During construction.	Monitoring is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help from EEHC.	NREA with support from EEHC	Increased congestion. Travel time (compared to reasonable daily commute).	Monthly, based on a representative sample	NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are given a basic introduction training on good construction site and management practices.	Management time and costs included in the cost of the Project Management Unit.
Socio-Economic Environment Positive impacts identified.	All activities related to the construction of the new plant will take place within the area belonging to NREA.	During construction.	Record local employment provided by the project	PIU at the site.	NREA with help from EEHC.	Workers satisfaction as measured by staff interviews	NREA will produce a monthly log of any complaints	Responsibility of NREA.	Management time and costs included in the cost of the

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	A local labor force will be employed for the project thus no need for workers colony. Contractors will be responsible for relevant temporary water and toilet facilities.					and complaints submitted.	and action taken and submit to the EEAA and WB.		Project Management Unit.
Archeological Potential chance finds of archeological remains during construction.	The project site does not lie on, or in the immediate vicinity of any known archeological areas of interest. If remains are found, NREA is committed to: • Cease activities and consult Antiquities authority; • Protection in situ if possible; • Excavation of areas where protection not feasible; • Preparation of a Chance Finds Procedure and Method	During construction.	Supervision of construction activities.	Construction contractors. NREA will allocate responsibilities in accordance with the Chance Find Procedures.	NREA with help from EEHC.	Chance Finds	Daily	NREA to ensure that all workers on site are aware of the importance of archeological remains and must report any potential finds immediately. Immediate liaison with Competent Administrative Authority should a potential find be uncovered.	Management time and costs included in the cost of the Project Management Unit. Should chance finds occur, protection and excavation could add significantly to the cost.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision	.			
	Statement.								
Natural Disasters Flash Flooding,	Good engineering design will incorporate the following mitigation measures: • Drainage system designed to direct flood water from main plant areas into a natural drainage basin/wadi or a ground well and direct potentially contaminated waters through the oil interceptor.	During construction.	No monitoring measures are envisaged.	NREA.	NREA with help from EEHC.			NREA to ensure that all workers on site receive training in emergency preparedness and response procedures.	Management time and costs included in the cost of the Project Management Unit. Site drainage system included in construction
Solid Waste Management	Good Practice measures such as the following: • All waste taken off-site will be undertaken through the EPC . NREA will audit disposal procedure; • Segregation of wastes	During construction.	Monitoring is required to ensure the implementation of good management practices during construction.	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help	NREA with help from EEHC	disposal procedure submitted by contractors and approved by NREA.	Quarterly reporting of summary results submitted to EEAA and WB.	NREA to ensure all contractors and sub-contractors working on-site are aware of EMP and all employees are	Management time and costs included in the cost of the Project Management Unit.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	and safe storage; • Recording of consignments for disposal; • Prior agreement of standards for storage, management and disposal with relevant authorities.			from EEHC.				given a basic introduction training on good construction site and management practices.	
Occupational Health & Safety	Good local and international construction practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • Implementation of EHS procedures as a condition of contract all contractors and sub-contractors; • Clear definition of the EHS roles and responsibilities of all construction companies and staff; • Management, supervision, monitoring and record-keeping as set out in	During construction.	Monitoring is required to ensure the implementation of EHS Policies, plans and practices during construction.	Implementation of good site management shall be the responsibility of all contractors under the supervision of NREA with help from EEHC.	NREA with help from EEHC.	Management procedures in place. Workers health and safety as measured by number of incidents.	Daily. Quarterly reporting of summary results submitted to EEAA and WB.	NREA to ensure all contractors and sub-contractors with workers on site have reference to the requirements of the EMP and are aware of the EHS policies and practices. All employees will be given basic induction training on EHS policies and practices. NREA is responsible for ensuring that a	Management time and costs included in the cost of the Project Management Unit plus preparation of the EHS plan (US$ 50K)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	the plant's operational manual; • Pre-construction and operation assessment of the EHS risks and hazards; • Completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • Provision of appropriate training on EHS issues for all workers; • Provision of health and safety information; • Regular inspection, review and recording of EHS performance; and • Maintenance of a high standard of housekeeping at all times.							Fire Safety Plan, which conforms to NFPA 850, is prepared and implemented prior to commissioning of any part of the plant.	

Table 8-3

Operational Impact Mitigation, Monitoring and Management Measures

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
Air Quality									
Emissions from stack are not expected to exceed standards. Ambient air quality affected by emissions from the power plant.	Mitigation measures have already been included in the design of the plant and, given NREA/ISCC's. Commitment to use Natural Gas for available operating time, no further mitigation measures are proposed. NREA/ISCC will however demonstrate the validity of the conclusions drawn in the EIA report. NREA/ISCC will demonstrate the validity of the conclusions drawn in the EIA report. If ground level concentrations are found to be above local and World Bank standards options for further mitigation will be discussed.	During first three years of operation.	Monitoring of stack emissions for NOx, SO2, particulate matter and carbon monoxide (CO) via test ports installed in the main stacks. Monitoring of NOx, SO2, CO, PM10 and TSP. Monitoring stations in the existing KPP will monitor short-term concentrations in the area predicted to have the highest impacts on humans. ISCC will install analyzer station near or within the site that will	The analyzer stations will be owned and operated by NREA.	NREA with help from EEHC	Stack emissions (PM10, NOx, SOx and CO). Ambient air pollutants concentrations (at least NOx, SO2, CO, PM10 and TSP).	Frequent data acquisition. Quarterly reporting to the World Bank/EEAA. Reports are to be available to any of the concerning authorities (World Bank, EEAA).	Records must be kept and summary data (including any deviations from Egyptian and World Bank standards) will be submitted to the Government and World Bank on annual basis (or more frequently if required). Annual reporting by NREA/ISCC to Government and World Bank (or more frequently if required) highlighting key features and comparing results with air quality	Automatic stack monitors (included in project cost). Management time for compilation of reports and performance monitoring included in cost of PIU.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
			include a continuous monitoring of meteorological conditions (temperature, wind speed, direction, etc).					standards and prediction in EIA report.	
Aquatic Environment Discharge of process, cooling blowdown and sanitary waters.	The design of the intake structures has already incorporated measures to reduce impacts Wastewaters including drainage from treatments plant, HRSG area equipment drainage, cooling towers blow down and sample cooler will be treated first in a common effluent tank before off-site disposal through discharge by gravity , to a natural drainage basin/wadi or a ground well. Effluent treatment plant will receive wastes from combustion turbine area floor drain, ST lube oil	Lifetime of the plant.	Prepare regular water quality monitoring program including: Quality of all water prior to discharge (monitoring of all discharged water for temperatures and pH, monitoring of process water for COD, TSS, oil & grease and residual chlorine and monitoring of heavy metals and other pollutants).	NREA with help from EEHC.	NREA with help from EEHC.	Basic parameters as per Law 48/1982 and Law 93/1962.	Frequent monitoring of water quality. Frequent monitoring of heavy metals and other pollutants. 3-monthly monitoring of plume. Annual monitoring of benthic environment (over 1 year period).	Records will be kept and compared on regular basis against Egyptian and World Bank standards and impacts predicted in the EIA. Summary reports (with any exceptions identified) will be submitted to the Government and the World Bank annually (or more	Management time is included in the cost of the PIU. Design features included in the project costs. Water Quality measurement equipment (included in operation costs)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	centrifuge, tank farm area, ST area floor washing and transformer area drain and process them into an oil/water separator where wastewaters are channeled to the common effluent tank for treatment before discharge to a natural drainage basin/wadi or a ground well. GTG wash water will be collected in an individual sump and discharged with a portable pump to a tanker for off-site disposal via special contractor part of EPC contractor scope. Wasters contaminated by chemical wastes will be channeled from neutralization pit and combustion turbine compressor wash effluent to the common effluent tank for treatment before off-site disposal. Sanitary wastes will be collected via plant sewage and sewerage lines in a local sanitary treatment		Monthly monitoring of fish catches on intake screens including species, numbers and size (over a 1 year period).				Monthly monitoring of fish catches on intake screens (over 1 year period). Reports are to be available to any of the concerning authorities (World Bank, EEAA).	frequently if required). NREA/ISCC to ensure that all employees are given basic induction training on the requirements of the EIA, good site management practices and H&S procedures. The PIU will ensure implementation of procedures	

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	plant where the treated water will be re-used in the plant plantation irrigation program while the dirt will be collected for off-site disposal by sanitary road tankers of a licensed contractor. Solar field will be provided with emergency strategy for immediate response to any accidental spillage. Operational leakages or droplets of thermal oil to allow collection and control as required. Water spillage from mirror washing and cleaning will be monitored and controlled. Bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system. Oil and chemical storage tanks will have secondary containment structures that will hold 110% of the								

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	contents of the largest storage tank. Areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump; equipped with a manually operated valve. Transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Storm-water runoff from equipment slabs that may be subject to oil contamination exposure will be collected and channeled through an oil/water separator prior to discharge into the discharge pathway. In addition, good site management practices including the following will be implemented: • Neutralization, oil separation, flocculation and filtration of any								

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	contaminated water before discharge; • No disposal of solid wastes into the discharge structure; • Regular maintenance of site drainage system to ensure efficient operation; and • All discharges will comply with local Egyptian and World Bank guidelines. NREA/ISCC will demonstrate the validity of the conclusions drawn in the EIA report. If pollutant concentrations in the discharge or impacts to surrounding environment are found to be above local and World Bank standards or unacceptable, options for further mitigation will be discussed.								
Noise	Specific design mitigation measures to minimize noise impacts include: • Gas turbines; • Steam turbine generators are	During first year of operation.	Given that no sensitive receptors are located in the immediate vicinity of the plant, no	NREA with help from EEHC.	NREA with help from EEHC.	Power plant compliance with EIA.	Annual reporting of summary results submitted to EEAA and	Should any complaints be received regarding noise, these will be logged and	Management time is included in the cost of the PIU.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	equipped with appropriate sound protecting enclosures; • Air compressors are equipped with silencers; • Noisy outdoor equipment are designed to a noise limit of 85dB (A) at 1m. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The plant will operate in accordance with internationally accepted health and safety measures.		monitoring is envisaged.				WB.	NREA will investigate problem. NREA/ISCC to ensure that all employees are given basic induction training on the requirements of the EIA, good site management practices and H&S procedures. NREA will ensure implementation of procedure	Design features included in the project costs. US$ 5 K over 5 years for third party measurements
Flora and Fauna Disturbance to habitats are a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: • Restrict personnel and vehicle movements to access roads and within boundaries of site only; and • Control of noise during operation.	Lifetime of the plant.	No monitoring is envisaged.	NREA with help from EEHC.	NREA with help from EEHC	Good plantation.	Annually.	NREA/ISCC to ensure that all employees are given basic induction training on the requirements of the EIA, good site management practices and	Management time is included in the cost of the PIU.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
								H&S procedures. NREA will ensure implementation of procedures.	
Visual Impact Visual image of power plant from surrounding areas	The visual effect of the power plant will be improved through: • Creation of landscaped boundary along the fence of the power plant.	Lifetime of the plant	No monitoring is envisaged.	NREA with help from EEHC.	NREA with help from EEHC	Improved visual image.		Management of landscaped areas to maximize visual image and habitat creation. NREA/ISCC to contract a suitable firm to manage landscaped areas.	Management time is included in the cost of the PIU. Landscaping US$ 150K in addition to US$ 10K annually for maintenance
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as described under Aquatic Environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be	Lifetime of the plant	NREA will monitor application of the EIA and good site management practices and take corrective action	NREA with help from EEHC.	NREA with help from EEHC	Quality of bunds and drainage systems. Efficient operation.	Quarterly reporting of summary results submitted to EEAA and WB.	NREA/ISCC will implement a Spills Response Plan and all employees will receive corresponding	Management time is included in the cost of the PIU.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	undertaken to ensure containment and efficient operation.		if required.					training.	
Solid Waste	Good practice measures undertaken during the construction phase will be continued into the operation phase, disposal via special contractor part of O&M contractor scope..	Lifetime of the plant	Monitoring is required to ensure the implementation of management practices during operations.	NREA with help from EEHC	NREA with help from EEHC	Management contracts in place.	Quarterly reporting of summary results submitted to EEAA and WB.	NREA/ISCC to ensure all employees are given basic induction training on good training on good operation and site management practices.	Management time is included in the cost of the PIU. Management contract US$ 20K annually
Occupational Health and Safety, Risks and Hazards	Standard international practice on EHS issues shall be employed on site. In addition, the following measures will be undertaken: • Provision of training in use of protection equipment and chemical handling. • Use of protective equipment. • Clear marking of work site hazards and training in recognition of hazard symbols. • Installation of vapor detection equipment	Lifetime of the plant	Regular on site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management.	NREA with help from EEHC	NREA with help from EEHC	Management procedures in place Workers health and safety measured by incidents, injuries and illnesses.	Monthly reporting of summary results submitted to EEAA and WB.	NREA/ISCC to ensure that all employees are given basic induction training on H&S policies and procedures, Emergency Preparedness and Response Plan and a Spills Response Plan. NREA/ISCC is responsible for ensuring that the site emergency response plan in	Management time is included in the cost of the PIU.

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and frequency of reporting/ monitoring	Management and Training	Cost (US$)
				Implementation	Supervision				
	and control systems. • Development of site emergency response plans.							complete and implemented prior to commissioning any part of the power plant.	

8.4 BASELINE MONITORING OF THE PRE-CONSTRUCTION NVIRONMENT

8.4.1 Baseline Air Quality Survey Using Air Quality Monitoring System

Objectives

Monitoring of air quality parameters such as NO_2 and SO_2 offers an appropriate method of obtaining hourly, daily, monthly and annual mean pollutant concentrations over a wide spatial area. A continuous monitoring program continued over an extended period, enables measured I hr, 24 hr and annual mean pollutant concentrations to be compared with relevant Egyptian and World Bank guidelines as well as regulations of involved lending agencies. It provides a baseline against which to evaluate short-term impacts measured using continuous NO_2 , SO_2, CO and TSP analyzers.

The main objective of the proposed air quality monitoring program is to determine the effect of effluent emissions from the Kuraymat Station. Prior to the commencement of a monitoring program, the number and location of monitors that are required to provide adequate aerial coverage need to be determined. Consideration should be given to the effects of existing sources, nearby terrain, meteorological conditions, and the pollutant to be monitored as well as their associated averaging times.

Natural gas will be used as the primary fuel. And for the siting study, the normal gas-fired scenario was analyzed.

Methodology

Based on the U.S. Environmental Protection Agency guidance (EPA, 1987), air dispersion modeling should first be performed to determine the general locations(s) of maximum air pollutant concentrations from the proposed source.

To determine the magnitude and locations of maximum background air quality impacts, the EPA-approved Industrial Source Complex (ISC-Prime) atmospheric dispersion model was used for the study. The ISC-Prime mode was also used for a stack height determination analysis conducted for the Kuraymat Project (see Section 6.2).

In addition, as indicated in Section 5.4, there were five existing background air quality monitors located within the Kuraymat plant area. These five monitors have collected sufficient ambient records to form a good base of representative background data (National Research Center, 2004).

In general, air quality monitors should be placed at (a) the expected area of the maximum concentration from the new source, and (b) the maximum combined impact area (s).

Generally, two to three sites would be sufficient for most situations in multi-source areas. In areas where there are no significant existing sources, one or two sites would be sufficient.

For convenience, the maximum impact locations derived in Section 6.2 are presented by the polar coordinate and the conventional x-y coordinate. Both coordinates use the same origin as shown in *Figure 8-1.*

Only 1-hour and 24-hour maximum impact areas were considered in the design of the monitoring network.

The majority of the 24-hour maximum combined impact areas due to the operation of both Kuraymat power plants (existing thermal power plant including its proposed extension and the proposed ISCC-KPP) occurred at SWW direction to the plant at distances between 2400 m and 2500 m. The highest impact area is at SWW direction about 2450 m from the origin of the modeling grid network (i.e. the power house of the proposed ISCC-KPP).

Therefore, a monitoring station is required at this high combined impact area in order to collect the maximum 24-hour impact. The maximum 1-hour impact levels are very similar among the same years of meteorological data considered. The majority of the maximum impact areas occurred far from the site boundary to the south west of the plant at a distance of about 2580 m from the origin of the modeling grid network. The results further indicated that the maximum combined impact area for each of the five years considered all occurred at the same location. Subsequently, another monitoring station is required at this area to collect the hourly maximum impact. The suggested monitoring locations are presented in *Figure 8-1.* Areas, instead of the precise points, are suggested because in some cases, it is simply not practical to place monitors at the indicated modeled locations. However, it is recommended that an air quality monitoring system composed of 2 monitoring stations will be utilized. The monitoring station equipped with meteorological monitoring system will be located within the designated site, the other station will be located on the other designated area.

These monitoring stations and the corresponding monitoring program will be the responsibility of the existing Kuraymat thermal power plant and their company, i.e. the UEEPC, provided that the power plant is already operating an ambient air quality monitoring system composed of three monitoring shelters, fully equipped to monitor NO_x, SO, and PM_{M0} short-term and long-term concentrations on a continuous basis. One of the analyzer stations includes a continuous monitor of meteorological conditions (temperature, wind speed, wind direction, 60 and mixing heights).

However, NREA/ISCC-KPP may undertake ambient air quality measurements using third party (e.g. Ain Shams University or the Air Pollution Preclusion Unit of the National Research Center) in the area predicted to have the highest impacts resulting from the only ISCC-KPP (on the SE direction to the power house at a distance between 430 m and 520 m), for once a year during the first 3-years of normal operation.

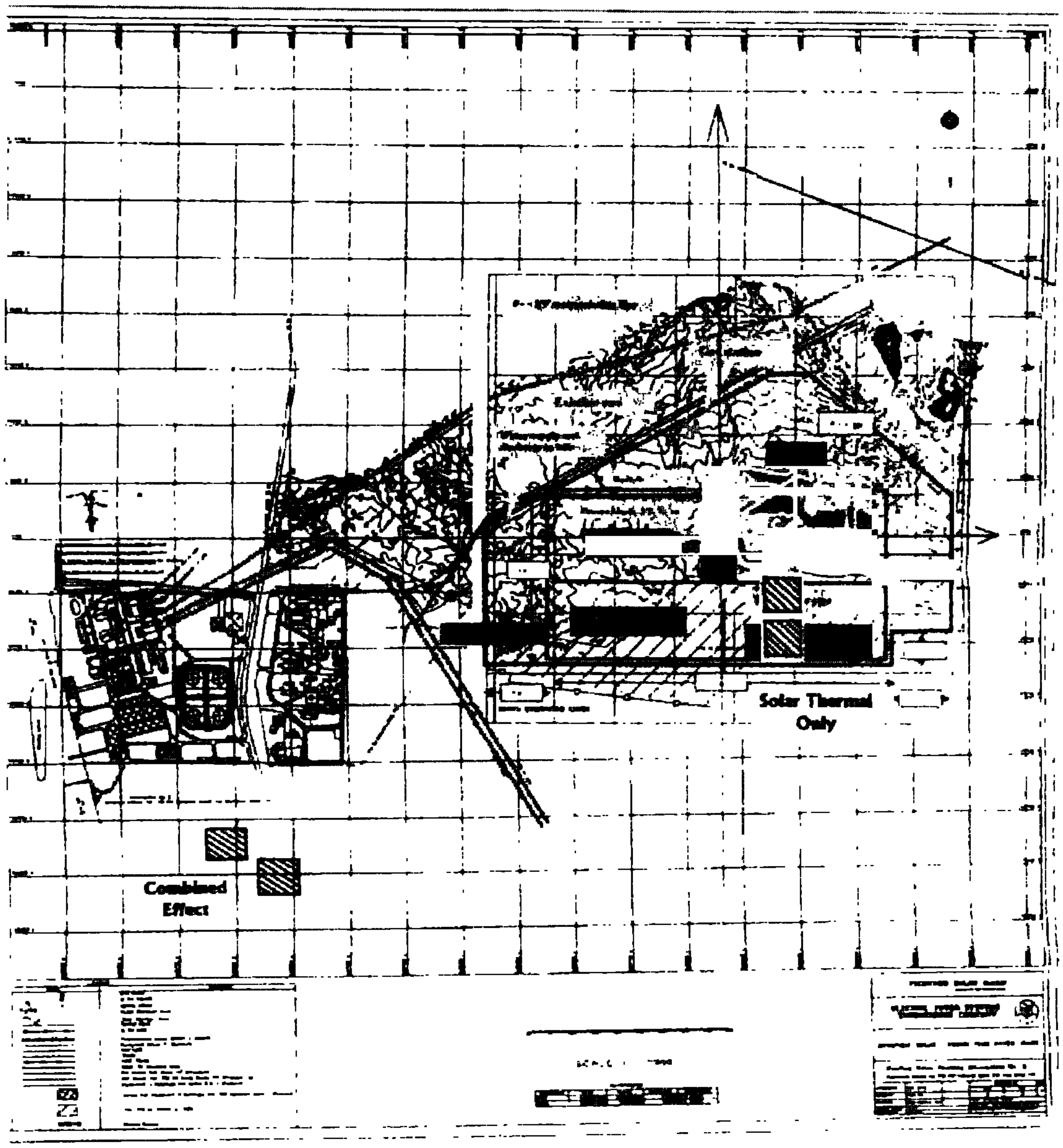
Also, NREA will initiate baseline air quality survey before, and during, construction of the plant in cooperation and coordination with existing KPP and the UEEPC using their existing operational monitoring system.

Reporting

Reports will be prepared by NREA/ISCC-KPP on an annually basis, and be prepared as monitoring concentration summaries.

Table 8-2

Construction Impact Mitigation, Monitoring and Management Measures



8.4.2 Aquatic Environment

A field survey was undertaken by Hydraulics Research Institute representatives and by National Research Center staff of the Kuraymat Nile segment area at the power station site. The results of this survey shall be retained as a baseline comparison for Nile River monitoring during power plant operation. This will be done in cooperation and coordination with existing KPP and UEEPC.

In addition, site management practices and site drainage systems will be continuously monitored by the site Assistant Plant Manager to ensure that no pollutants reach the aquatic resources.

8.4.3 Archaeology and Cultural Heritage

Throughout construction, activities will be closely supervised by personnel trained to recognize potential archaeological finds. Should a potential find be uncovered, the mitigation measures described in Section 7.2.8 will be employed.

8.5 MONITORING OF IMPACTS DURING POWER PLANT OPERATION 8.5.1 Stack Emissions

Stack emissions will be monitored continuously during plant operation at a representative point in the stack. Operational monitoring of stack emissions shall comprise monitoring the levels of:

- Oxides of Nitrogen;
- Sulfur Dioxide; and
- Carbon Monoxide.

The automatic monitoring system used will be linked to an alarm to warn when emission limits (as stated in Section 2) for each pollutant are being approached.

Concentrations will be recorded as hourly rolling averages and reports on stack emissions monitoring will compare recorded emissions against predicted levels and Egyptian and IFC guidelines (as given in Section 2). Reports will be submitted to the EEAA, the WB and any other concerned authority on an annual basis (or as required).

8.5.2 Ambient Air Quality - Validation of Modeling Predictions Using Continuous NOx, SO2 and TSP/PM10 Analyzer

Objectives

The use of a continuous NOx, S02, CO and TSP/PM_{10} analyzer allows for baseline air quality monitoring on a continuous basis. The provision of two continuous monitors will provide the basis for "validating" the predictions made in the EIA. The monitors will also include a weather station providing data on air temperature, wind speed, wind direction and mixing heights on a continuous basis. This will be the responsibility of the existing KPP and UEEPC as stated before.

8.5.3 Aquatic Environment

Monitoring of impacts of the power plant on the aquatic environment will include monitoring of the quality of the discharge water, Nile bank and benthic sediments, ambient water quality and the impact on aquatic flora and fauna. The survey techniques and areas will be comparable to the survey undertaken by both of the Hydraulics Research Institute and the National Research Center during 2003 and 2004. The survey will include the area affected by the intake process and structures.

The operational monitoring of cooling towers and effluent discharge will include the parameters summarized in *Table* 8-4 below.

Monitoring data will be analyzed and reviewed at regular intervals and compared with Egyptian and World Bank guidelines (as given in Section 2). Records of monitoring results will be kept in a suitable format and will be reported (in summary format with any exceptions identified) to the responsible government authorities and the WB or any other concerned authority as required. As a result, the NREA, in discussion with the EEAA and the WB or any other concerned authority, will review the need to implement any additional mitigation features, such as provision of further water treatment facilities on site and also on the need to continue monitoring.

8.5.4 Waste Monitoring

Wastes generated on site and collected for disposal by skilled firms will be referenced, weighed and recorded. Environmental audits will be undertaken which will assess the quality and suitability of on- and off-site waste management procedures.

Table 8-4
Monitoring of the Aquatic Environment During Operation

Issue	Parameter	Method	Frequency of
Water Quality	Temperature & pH of all discharged water COD, TSS, oil & grease, residual chlorine of effluent Heavy metals & other pollutants of effluent	Continuous automatic monitor of discharges Sample taken from water in discharge system and submitted for lab. Analysis As above	Continuous Daily Monthly
Ambient Water Quality	Temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals & other pollutants	Grab sampling and analysis within the area predicted to be affected by the discharge.	3-monthly
Flora & Fauna [W]	Benthic flora & fauna	Transect sampling (following same method as in baseline monitoring) within a 200m radius of the intake point	Annual
Entrainment [(2)]	Fish entrainment on screens	Removal and analysis of any debris caught in intake screens	Weekly

Notes:

To be undertaken for the first 3 years of plant operation. To be undertaken for the first year of plant operation.
Abbreviations:

COD: Chemical Oxygen Demand BOD: Biological Oxygen Demand TOC: Total Organic Carbon

DO: Dissolved Oxygen

TSS: Total Suspended Solids

9. CONSULTATION AND DISCLOSURE

9.1 INTRODUCTION AND GENERAL APPROACH

In order to ensure that the views and interests of all project stakeholders are taken into accounts, a Public Consultation and Disclosure Plan (PCDP) was prepared in accordance with IFC requirements as part of the Environmental Impact Assessment process. This also included Public Consultation that has been carried out according to the EEAA guidelines which require coordination with other government agencies involved in the EIA, obtaining views of local people and affected groups. This consultation has been also undertaken as part of the Environmental Impact Assessment process.

This section summarizes the activities which were undertaken as part of phase I consulation. It, also, summarizes Phase II consultation, namely the Disclosure of the draft final EIA Report, which comprises the activities that will be undertaken as a complementary procedure. It, also, highlights the activities which may be undertaken, under this condition, during the construction and operation of the Kuraymat ISCC power plant.

9.1.1 Public Consultation Regulations and Requirements

In accordance with World Bank/ IFC requirements, namely the Bank's Operational Directive (OD) 4.01 Environmental Assessment and other key documents, affected groups and NGOs must be consulted as part of the environmental assessment of projects. The primary purpose of this provision is to protect the interests of affected communities. Therefore, the EIA process should include consultation and disclosure of information to key stakeholders involved in and/or affected by the Kuraymat ISCC power plant project.

The objectives of consultation and disclosure are to ensure that all stakeholders and interested parties, are fully informed of the proposed project, have the opportunity to voice their concerns and that any issues resulting from this process are addressed in the EIA and incorporated into the design and implementation of the project.

Egyptian Law number 4 of 1994, which addresses the environment, does not stipulate or refer directly to public consultation within the EIA process. However, its importance may be inferred from the inclusion of representatives of environmental non-governmental organizations on the Board of Directors of the EEAA. Furthermore, the EEAA's "Guidelines for the Basis and Procedures of Environmental Impact Assessment (EEA) – Sector Guidelines" suggest discussions with local stakeholders and interested parties during scoping and preparation of the EIA.

9.2 CONSULTATION METHODOLOGY

The adopted methodology for the public consultation comprises three elements, namely:

- discussions with local stakeholders and interested parties during preparation of the environmental documents for local permitting requirements;

- discussions with local stakeholders during scoping and preparation of this EIA-Report;

- the organization of a Public Meeting in the Giza Governorate; and

- on-going consultation through an "open-door" policy during construction and operation of the power plant.

As far as public disclosure is concerned, major initiatives to inform the public and interested parties about the Kuraymat ISCC Power Project include the following:

- distribution of a leaflet describing the context of the power plant, the technology employed and the impact on the environment;

- press advertisements describing the project and inviting interested parties to attend the public meeting and review the Draft Final EIA Report available at a number of locations;

- distribution of an invitation and copy of the Non Technical Summary; and

- disclosure of the Draft Final EIA Report locally and the Non-Technical Summary via the financing lending agents Infoshops.

The full methodology for consultation and disclosure will be presented in the project's PCDP. The purpose of the Plan is to establish the process by which NREA will consult and involve stakeholders in the planning, development, construction and operation of the power plant.

9.2.1 Stakeholders

During the EIA process, stakeholders for the project have been identified and include the following :

- Local Council and District Authorities;
- Government Regulatory Agencies;
- local business and commercial interests;
- local people including Fellah population representatives;

Table 9-1

Primary Stakeholder Organizations

Organization
• Giza Governorate
• Kuraymat Local Authority (Kuraymat Zone)
• New and Renewable Energy Authority (NREA), Ministry of Electricity & Energy
• Egyptian Electricity Holding Company (EEHC), Ministry of Electricity & Energy
• Egyptian Electricity Transmission Company (EETC), Egyptian Electricity Holding Company (EEHC), Ministry of Electricity & Energy
• Local Electricity Authority (Upper Egypt Electricity Production Company "UEEPC")
• Egyptian Environmental Affairs Agency (EEAA)
• Hydraulics Research Institute (HRI), National Water Research Center, Ministry of Irrigation and Water Resources
• Kuraymat population representatives
• Egypt National Institute of Transport, Ministry of Transport
• The General Authority for Roads, Bridges and Land Transport, Ministry of Transport
• Giza Transport Department
• Egyptian General Petroleum Corporation (EGPC), Ministry of Petroleum
• Egyptian Natural Gas Holding Company (EGAS), Ministry of Petroleum
• Egyptian National Gas Company (GASCO), Egyptian Natural Gas Holding Company (EGAS), Ministry of Petroleum
• Supreme Council of Antiquities
• Egyptian General Authority for Shore Protection
• National Research Center, State Ministry of Scientific Research and Technology
• General Authority for Fish Resources Development, Ministry of Agriculture
• Research Institute for Ground Water (RIGW), Water Research Center, Ministry of Irrigation and Water Resources
• National Authority for Remote Sensing and Space Sciences
• Noise and Vibration Department, Ain Shams University - Faculty of Engineering

9.2.2 Management and Participation

Public consultation and disclosure was managed and undertaken by E&E with participation from NREA. Phase II of the consultation and disclosure process, which includes local disclosure of the Draft Final EIA-Report and a public meeting, will also be undertaken in close collaboration with the local authorihes, namely the Giza Governorate. Concerned stakeholders including farm owners, local industry, economic representatives and local people, have been, and will continue to be, requested to actively participate in this process.

It is not anticipated that any further notification will be required, for example, the posting of notices locally.

9.3 PHASE 1 CONSULTATION

9.3.1 Undertaken Consultation

During the preparation of an EIA-Report for local permitting requirements, consultations were undertaken with a variety of organizations to assist them in the identification of environmental and social concerns and the overall development of the project. These stakeholders included the Egyptian Electricity Holding Company (EEHC), Upper Egypt Electricity Production Company (UEEPC), Existing KPP, Egyptian Environmental Affairs Agency (EEAA), the Giza Governorate and the District Council of Atfieh (Kuraymat zone), the Supreme Council of Antiquities, Egyptian General Authority for Shore Protection, Hydraulics Research Institute and local population leaders.

The different steps of this process comprised the following:

- Several mini-meetings were undertaken with the mini-groups contacted during project preparation and completion of environmental documentation for preparing the EIA study-Report.
- An extensive description of the project was presented to individuals of each group at the beginning of each meeting. This presentation included positive and negative aspects of the project, neutrally introduced with no bias.
- Several visits have been conducted to concerned groups in their premises or locations. The majority of these visits, particularly to the governmental agencies and research institutions, were prepared for in advance, and rest of visits were undertaken without advance dating or preparation, such as those undertaken to local population and farm owners.
- Research groups were contacted and accompanied with during site reconnaissance, where extensive discussions and deliberations were made.

The purpose of these consultations was primarily to provide information regarding the project, identify published and non-published sources of relevant data and information relating to the site and surrounding area, obtain views on the scope of the project, and open channels for ongoing discussions.

The key environmental issues raised during this consultation process are summarized in *Table 9-2* and these issues were subsequently taken into account in the preparation of EIA documentation both for local permitting requirements and this EIA report.

The environmental documentation for local permitting purposes, will be presented to the Giza Governorate (the Competent Administrative Authority (CAA) and the EEAA.

Table 9-2

Key Environmental Issues Associated with the Development of the Proposed Power Plant Identified During Consultation

Subject	Description of the Key Issue
Air Quality	• Level of stack emissions from the power plant and the resulting compliance with air quality standards during normal operation and emergency periods, i.e. if the gas supply is interrupted. • Potential for cumulative air quality impacts due to the simultaneous operation of the existing thermal power station and the proposed power plant. • Potential vulnearability of agricultural activities (damage of plants and crops) due to NOx emissions and consequent ground level pollution concentrations.
Aquatic Ecology	• Vulnerability of ground basins or wells from liquid effluents and the cooling towers discharge.
Noise	• Levels of noise which will be experienced at local receptors.
Traffic	• Traffic generation, especially during construction, and the potential for congestion on local roads. • The potential effect on traffic due to ground fogging produced by the cooling towers vapour plume.
Socio-economic	• Employment. • Demand for Local Service. • Compensation for loss of agricultural land.

9.3.2 Consultation during the EIA process

A Scoping Consultation for this EIA undertaken by E&E and NREA, took place during the period September 2003 – May 2004, during which mini-meetings were held with government and municipal agencies, research institutions and commercial entities. The key objectives of this consultation were to identify primary and secondary stakeholders, ensure that they had received sufficient information about the project during earlier E&E and NREA Consultation activities and to identify their immediate concerns. The issues raised during the scoping consultation are summarized in *Table 9-3* below.

Table 9-3

Key Issues Raised During EIA Scoping

Key issue discussed	Comments
Overall Project	All parties consulted expressed their overall approval for the project. Local Stakeholders commented that the power plant will be central to securing power supply for the industrial and commercial activities in the area, provided that many industrial activities will be established due to designating Kuraymat as an industrial investment zone, and will benefit the local economy through labor opportunities.
Social and Economic Impact	Local stakeholders and council leaders considered the social and economic impact of the plant to be wholly positive. They also very much appreciated compensation rules for loss of land if any agricultural activities need to be stopped for the sake of the project infrastructure. They considered that the existence of solar field with reflective mirrors will create an attractive area for tourism within the Kuraymat area.
Wastewater Discharge and the Aquatic Environment	All local stakeholders expressed concern about the quality of discharge water from the power plant to a drainage basin/wadi or well. It was however acknowledged that there are no significant aquatic ecosystems in the immediate vicinity around the power plant. The suggestion was made that treated wastewater could be used for irrigation of landscaped areas.
Air Quality	There was concern over compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area. There, also, was concern about the potential damage to vegetation in the immediate south of the power plant resulting from emissions of pollutants from power plant operation.
Environmental Compliance	An underlying concern expressed by all local stakeholders was compliance with environmental regulations. Assurances from NREA are sought to the effect that NREA will guarantee implementation of the environmental compliance measures which are stated in the Environmental Action Plan.
Other Discharges	There was concern over other discharges of the power plant, particularly water vapour dissipated from cooling towers into the atmosphere and the potential impact of ground fogging on transportation along the Cairo/Beni-sueif road.

9.3.3 Conclusions from Phase I Consultation

The main results of Phase I consultation were to successfully raise the level of local awareness about the plant, to identify the immediate local concerns and to seek stakeholder involvement in the implementation of the project.

The three issues of key concern to the stakeholders consulted were the impact of the plant on pollutant loads in the Kuraymat zone, compliance with environmental standards particularly with regard to air and wastewater discharge quality and the potential economic impacts on the local community. These concerns have been addressed within the EIA process and measures to ensure compliance are incorporated into the Environmental Action Plan (EAP). The EAP will be implemented by NREA/ISCC-KPP as a condition of compliance with the EEAA regulations and of financing from the WB.

9.4 PHASE II CONSULTATION AND DISCLOSURE

Phase II of the public consultation and disclosure process includes the disclosure of information about the project (leaflet, advertisement, invitation including a copy of the Non Technical Summary and public access to the Draft Final EIA Report) and organization of a public meeting.

The leaflet, describing the project, technical features, possible benefits, common concerns and other related information, will be sent to all stakeholders identified for this project together with invitations to the Public Meeting. The leaflets will also be made available for collection in the Governorate's Environmental Management Unit and to all people who come to review the Draft Final EIA report.

The Draft Final EIA report, together with the Non-Technical Summary in Arabic, will be disclosed locally for 60 days at the offices of the NREA's Environmental Affairs department.

In order to make people aware of the disclosure of the Draft Final EIA Report, an advertisement will be placed in the national newspaper Al Ahram in Arabic and English. The advertisement will also draw readers attention to the date and venue of the proposed public meeting.

Finally, a public meeting will be held in the Governorate of Giza. The aim of the meeting will be to present and explain the results of the Draft Final EIA Report to local stakeholders, to provide them with the opportunity to raise any further or additional concerns and to ensure that all issues are taken into account in the Final EIA Report and corresponding EAP.

The results of this Phase II Consultation and Disclosure activities will be reported separately and annexed to the Final EIA Report.

9.5 ONGOING FACILITY FOR PUBLIC CONSULTATION AND DISCLOSURE

The World Bank/IFC and other international and regional lending agents also require that the consultation process is ongoing during the construction and operation phases of the project. To this effect, NREA/ISCC-KPP has stated its commitment to maintaining long term and mutually beneficial open dialogue with local authorities, industrial and commercial interests and local people, through its Safety and Environment Officer during construction and Assistant Plant Manager during operation. A key role of this post consultation will be to ensure that local stakeholders have an opportunity to raise questions, comments or concerns and that all issues raised are answered promptly and accurately.

Disclosure of information will also continue throughout project construction and operation. The primary emphasis here will be to assure stakeholders that the environmental mitigation, monitoring and management practices established in the EIA and its EAP are being implemented and the environmental standards and guidelines dictated by the Egyptian government and the World Bank/IFC are being met through a comprehensive monitoring and reporting process. NREA/ISCC-KPP is required under Egyptian law, to maintain an Environment Register of written records with respect to environmental impacts from the power plant. In addition, an annual report containing technical data relating to the monitoring program will be prepared by the NREA/ISCC-KPP and submitted to the EEAA, and the WB.

ANNEXES

Annex A

RECORD OF CONSULTATION

RECORDS OF CONSULTATIONS

The following Table provides a record of meetings undertaken during project preparation and completion of environmental documentation for preparing the EIA study report and local permitting.

Organization	Name	Date
New and Renewable Energy Authority (NREA)		
• Executive Chairman	- Eng. Hosni El-Kholi	9 Nov. 2003 4 Jan. 2004 30 March 2004 7 June 2004
• Deputy Executive Chairman	- Eng. Laila Salah	9 Nov. 2003 15 March 2004
• Technical Consultant	- Eng. Salah Ed-Desouki	9 Nov. 2003 4 Jan. 2004
• Managing Director, • Studies, Research & Testing Sector	- Eng. Amina Ez-Zalabani	24 Feb. 2004 13 April 2004 16 May 2004
• General Director, Thermal Systems and Energy Conservation	- Eng. Mohamed Sobhi	13 April 2004 16 May 2004
• General Director, Planning and Follow-up	- Eng. Buthaina Rashed	13 April 2004 16 May 2004
• Director, Solar Energy Studies		30 Dec. 2003
	- Eng. Reda Abdel-Azim	19 Nov. 2003
	- Eng. Khaled Fikry	28 Feb. 2004
	- Eng. Mohamed Gamal	28 Feb. 2004
	- Eng. Ayman Fayek	28 Feb. 2004
	- Eng. Emil Shafik	28 May 2004
	- Eng. Tarek Abdel-Aati	
Egyptian Electricity Holding Company (EEHC)		
• Chairman	- Dr. Mohamed M. Awad	24 Jan. 2004
• Executive Board Member, Planning, Studies and Engineering	- Dr. Kamel Yassin	22 March 2004
• Sector Chief, Projects	- Eng. Adel Afifi	287 March 2004
• Sector Chief, Network Studies	- Eng. Ahmed Kamel Hegazi	15 May 2004
• Sector Chief, Operation & Dispatching	- Eng. Mohamed Es-Sayed	6 Dec. 2004 22 March 2004
• General Director, Power Plant Studies	- Eng. Murad Badie	15 May 2004 6 Dec. 2004

Upper Egypt Electricity Production Company (UEEPC)		
• Chairman • Head of Power Plants Sectors	- Eng. Ahmed Diab - Eng. Mohamed Omar	15 April 2004 15 April 2004
Middle Egypt Electricity Distribution Company (MEEDC)		
• Chairman	- Eng. Abdel Maksoud Ibrahim Ahmed	15 April 2004
Kuraymat Thermal Power Plant (KPP)		
• Chief Eng., Power Plant Sector • Chief Eng., Project Sector • General Director, Maintenance • Chief Engineer, Operations • General Director, Chemical Lab	- Eng. Lyon Labib - Eng. Goda Hassan Mohamed - Eng Mahmoud Attia Moustafa - Eng. Ibrahim Zarei Mahmoud - Eng. Mohamed Abdel-Hamid	12 Nov. 2004 12 Nov. 2004 15 April 2004 5 May 2004 12 Nov. 2004 5 May 2004 5 May 2004
Egyptian Environmental Affairs Agency (EEAA)		
Environmental Management Sector	Eng. Ahmed Mosutafa	16 Jan. 2004
Giza Governorate		
• Secretary General • Head of Central Department for Economic Affairs • General Director, Information Center • General Director, Environmental Health & Safety • General Director, Mines & Industrial Activities • Geologist • Geologist	- Mr. Ahmed Allam - Ms. Hposnyyah Ahmed Abdel-Rahim - Ms. Soaad Al-Guwaila - Mr. Mohamed Mehanni - Mr. Adli Ahmed El-Maltı - Eng. Ali Awad Ali - Mr. Gebril Ahmed Hefni -	12 Dec. 2004 16 April 2004 16 April 2004 16 April 2004 5 May 2004 5 May 2004 5 May 2004
Kuraymat District		
• Head of Local Council, Markaz and town of Atfieh • Omda of Kuraymat Village • Deputy Head of Markaz and town of Atfieh • Deputy Head of Atfieh Police Center • Omda of Soul Village	- Mr. Salah Ismail Khalil - Mr. Abdel-Tawab Ismail - Mr. Shaaban Abdel-Hamid Al-Kadi - Officer Mohamed Gab-Allah - M. Mohamed Abdel-Azim Gheith	12 Nov. 2004 12 Nov. 2004 5 May 2004 12 Nov. 2004 5 May 2004
Egyptian General Authority for Shore Protection		
• Managing Director of Planning & Implementation • Director of Studies & Research	- Eng. Ausama A. A. Abu-Zeid - Eng. Hanaa Rasmi	7 March 2004 7 March 2004

Organization	Name	Date
Egyptian General Petroleum Corporation (EGPC)		
• Head of Planning Section	- Eng. Abdel Rahim Salah	23 May 2004
Egyptian Natural Gas Holding Company (EGAS)		
• Chairman • Deputy Chairman	- Eng. Mohamed Ibrahim Tawila - Eng. Ismail Karara	13 Feb. 2004 13 Feb. 2004
Egyptian National Gas Company(GASCO)		
• Chairman • Deputy Chairman for Commercial Affairs • Deputy Chairman for Networks • General Director for Marketing • General Director for Gas Contracts and Agreements	- Eng. Hani Soliman - Eng. Gamal Amer - Eng. Sayed Talat - Eng. Zainab Gamal Ahmed - Eng. Mahmoud Tawfik	11 Dec. 2004 11 Dec. 2004 11 Dec. 2004 11 Dec. 2004 11 Dec. 2004
General Organization for Physical Planning		
• Deputy Chairman • Chief of Studies Sector	- Eng. Shawki Shaaban - Eng. Ali Mohamed Moussa	24 Jan. 2004 24 Jan. 2004
Giza Roads and Transport Department		
• Director	- Eng. Mohamed Abdel-Aziz	10 Feb. 2004
Supreme Council of Antiquities		
• Secretary General • Permanent Committee for Antiquities	- Prof. Dr. GabAllah Ali GabAlla - Mr. Magdi Sayed Abu El-Elaa	25 Dec. 2004 25 Dec. 2004
Hydraulics Research Institute		
• Director • Deputy Director • Senior Hydraulics Expert	- Prof. Dr. M. T. K. Gaweesh - Eng. Ibrahim El-Desouky - Eng. M. I. Roushdy	19 Feb. 2004 14 March 2004 19 May 2004 19 May 2004
Research Institute for Groundwater (SIGW)		
• Director	- Prof. Dr. Ahmed Rashaad Khater	26 May 2004
National Authority for Remote Sensing and Space Sciences		
• Ex-Chairman • Head of Division of Environmental Studies & Land Use • Division of Environmental Studies & Land Use • Head of Division of Geology	- Prof.Dr. Mohamed Adel Yehia - Prof. Dr. Hassan A. El-Etr - Prof. Dr. Fikey Ibrahim Khalaf - Prof. Dr. Omar Hassan Sherif	5 Feb. 2004 5 Feb. 2004 2 March 2004 28 May 2004

Organization	Name	Date
General Authority for Fish Resources Development		
• Chairman	- Dr. Sirage Eddin Abdel-Hafiez	24 Dec. 2004
• Head of Central Department of Fish Resources	- Dr.Al-Sayed Tawfik Moustafa	24 Dec. 2004
• Senior Aqua-culture Specialist	- Dr. Magdi Abbas Saleh	24 Dec. 2004
The Egyptian Geological Survey and Mining Authority		
• Chairman	- Dr. Ahmed Hamdi Sweilam	28 Feb. 2004
• Head of Central Department of Projects	- Dr. Khairat Soliman	28 Feb. 2004
National Research Institute of Astronomy and Geophysics (NRIAG)		
• Chairman	- Dr. Ali Abdel-Azim Toailab	16 Jan. 2004
• Associate Professor	- Dr. Salah El-Hadidi Ali	16 Jan. 2004
	- Dr. Ahmed Badawi	16 Jan. 2004
	- Dr. Ahmed Gomaa	16 Jan. 2004
• Senior Researcher	- Dr. Kamal A. Atiyya	16 Jan. 2004
• Senior Researcher	- Dr. Kamal Abdel-Rahman	16 Jan. 2004
Egypt National Institute of Transport (ENIT)		
• Director	- Prof. Dr. Ali Zein El-Abedine Salem Haikal	7 October 2003
• Senior Transport Expert	- Dr. M. Mahmoud	7 October 2003
National Research Center		
• Air Protection from Pollution Unit	- Prof.Dr.Kamal Tamer Hindy	8 March 2004
	- Prof.Dr.Aliyah Abdel-Shakour	8 March 2004
	- Chem. Yasser Hassan Ibrahim	8 March 2004
	- Eng. Adel Hassan Amer	8 March 2004
• Water Quality Unit	- Prof.Dr. Ahmed Sayed Morsy	15 May 2004
	- Prof.Dr. Mohamed Anwar El-Dib	15 May 2004
	- Prof.Dr. Mohamed M.Al-Abdi	15 May 2004
	- Prof.Dr. Osama Ahmed Ali	22 May 2004
	- Prof.Dr. Mohamed Ismail Badawi	22 May 2004
	- Dr. Mohamed Bakr M.Ibrahim	22 May 2004
Ain Shams University, Faculty of Engineering		
• Noise and Vibration Engineering	- Prof. Dr. Mansour M. El-Bardisi	15 June 2004
Institute of Environemntal Studies and Research, Ain-Shams University		
• Ecological Studies Department	- Dr. Aly Nasser Hassan	23 Feb. 2004

Organization	Name	Date
Kuraymat Local Population		
• Member of People's Council for Atfieh	- Mr. Mohamed Abdel-Alim Gheith	9 Jan. 2004
• Member of Local Governorate Council for El-Burumbul	- Mr. Hussin Yahyya Mohamed	9 Jan. 2004
• Member of Local Governorate Council for Atfieh	- Ms. Salwa Gaad El-Hakk	9 Jan. 2004
• Head of People's Council of El-Burumbul	- Mr. Magdi Zeree Mahmoud	9 Jan. 2004
• Kuraymat Village Representatives	- El-Hagg. Ahmed Hassan El-Morsi	5 May 2004
	- El-Hagg. Ahmed Abdel-Motaal	5 May 2004
	- El-Hagg. Shaaban Khalil	5 May 2004
	- Farmer. Ahmed Moawad	5 May 2004
	- Farmer. Mahfouz El-Gamal	5 May 2004
	- Farmer. Abu Gabal Al-Awadi	5 May 2004
	- Farmer. Gindi Mahfouz	5 May 2004
	- Farmer. Awadien El-Eyyouti	5 May 2004

Annex B

PRELIMINARY ARCHAEOLOGICAL ASSESSMENT FOR THE KURAYMAT PROJECT

Preliminary Archaeological Assessment for the El-Kureimat, Egypt Feasibility Study

by
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and
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Submitted to:
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Office
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Archaeology
Boston University

February 1991

Office of Public Archaeology Report of Investigations No. 94

PRELIMINARY ARCHAEOLOGICAL ASSESSMENT FOR THE EL-KUREIMAT, EGYPT FEASIBILITY STUDY

1.1 GENERAL

The project area for the proposed facilities is located near the village of El-Kureimat, on the east bank of the Nile River. The site locus is approximately 95 km south of Cairo and 30 km north of Beni-Suef.

The project area consists of two principal facilities—the power plant and its colony (Figure 1). Two physiographic zones occupy this area: a floodplain adjacent to the Nile, and a rocky desert plateau east of the floodplain. The site of the power plant is 750 meters wide and has an average length of 1150 meters; in all the site encompasses more than 860,000 square meters. The site of the community facilities, or colony, is located near the northeast corner of the power plant area; the colony area will measure 670 x 670 meters, or approximately 450,000 square meters.

1.2 METHODOLOGY

The goals of the preliminary archaeological assessment are 1) to identify recorded archaeological sites within the project area and its vicinity; and 2) to assess the potential archaeological sensitivity of the project area.

Research for the project consisted of a review of the published literature to identify archaeological sites in the region. In addition, archaeologists who are familiar with recent archaeological work in the area were consulted for information about archaeological sites that may not appear in the literature. At present, recorded site distributions suggest a relative paucity of sites on the east side of the Nile in comparison to the west side; for this reason, the research concentrated on identifying archaeological site distributions on the east side of the Nile.

An archaeological field reconnaissance of the project area was not conducted at this stage of the project.

1.3 ARCHAEOLOGICAL SITE DISTRIBUTIONS

The literature review identified recorded archaeological sites in the vicinity of the project area. The discussion is divided into three areas: 1) archaeological sites near El-Kureimat; 2) archaeological sites on the east bank of the Nile; and 3) archaeological sites on the west bank of the Nile.

1.3.1 Archaeological Sites Near El-Kureimat

Although there are hundreds of recorded archaeological sites on the west bank of the Nile opposite El-Kureimat and in the Fayum region, the east bank of the Nile in this region is one of the many areas in Egypt that has not been systematically examined for archaeological remains. The east bank in Lower Egypt has a much narrower floodplain than the west bank, so farming villages are more concentrated on the west bank and in the irrigated lowlands of the Fayum. This would not always have been the case, however, as the Nile has shifted its course eastward over the past 4000 years. Therefore it is likely that prior to ca. 2000 B. C.—including the Neolithic period, ca. 5000–4000 B. C.—early farming communities may have been located along the low desert of the east bank, just as they are found in abundance in the Fayum.

1.3.2 Archaeological Sites on the East Bank

South of Cairo, on the east bank, early farming villages have been excavated at Maadi and El-Omari, 3 km NE of Helwan (Debono 1948; Rizkana and Seeher 1989), which were discovered as a result of urban development earlier in this century, and it seems likely that similar sites may be found farther south. The settlements at Maadi and El-Omari date to the fourth millennium B. C. (during the Predynastic period). Prehistoric cemeteries were found in association with these settlements. Archaeological evidence at Maadi suggests a center which had the earliest known trading connections with southern Palestine, and Maadi may have been a very early center of copper production (Hayes 1965). At Tura, 2 km south of Maadi, over 500 burials from the First Dynasty, at the dawn of pharaonic history, have also been excavated (Junker 1912). About 28 km north of El-Kureimat, at El-Saff, a prehistoric cemetery, which is also related to the Maadi culture, was excavated in 1935 (Habachi and Kaiser 1985).

While it is possible that there would be evidence of Neolithic sites on the east bank in the vicinity of El-Kureimat, pharaonic period sites on this side of the river have not been reported, with the exception of isolated small finds. At Atfih, about 6 km north of El-Kureimat, a town is known from pharaonic times that probably was the location of a temple dedicated to the goddess Hathor (Baines and Malek 1988: 212). During the Ptolemaic period (i.e., after the Greek conquest of Egypt by Alexander the Great, ca. 332–30 B. C.), Atfih was known as Aphroditopolis. Sir Flinders Petrie reported a finely painted Ptolemaic tomb at Atfih, measuring 15 x 12 ft with a vaulted roof (Petrie and MacKay 1915: 38). The pavement of this tomb was made of limestone blocks taken from an earlier monument of Ramesses II. A second Ptolemaic tomb at Atfih was reported by Bertha Porter and Rosalind Moss (1960: 76). In this tomb were paintings from the "Book of the Dead" and an astronomical ceiling. About 75 km south of El-Kureimat also on the east bank is another Ptolemaic site (Ancyropolis) at El Hiba investigated by Robert Wenke in the early 1980s (Robert Wenke, personal communication).

A few kilometers south of El-Kureimat is the beginning of a desert track to the Red Sea which has been in use for at least 1500 years and probably much longer. This track leads to the Monastery of St. Anthony in the eastern Red Sea Hills. St. Anthony founded the monastic movement, and this monastery has been an important center for the Coptic faith after Egypt accepted Christianity in the 4th century A. D.

In summary, early farming sites (Neolithic and Predynastic) are recorded on the east bank of the Nile south of Cairo, and there are also isolated finds dating to pharaonic times. The remains of a Greco-Roman period town and cemetery are located just to the north of El-Kureimat at Atfih (Porter and Moss 1960: 75–76).

1.3.3 Archaeological Sites on the West Bank

The Fayum region, south and east of Lake Moeris, and along the west bank of the Nile in this region, is one of the richest archaeological areas in Egypt. Fossil remains of the earliest known species of ape (Aegyptopithecus zeuxis, ca. 32,000,000 years old) have been found in the Fayum (Tattersall, Delson, and Couvering 1988: 485), and the earliest known farming communities in Egypt are located around the shorelines of the lake (Caton-Thompson and Gardner 1934). An important Predynastic cemetery was excavated at Gerza, about 5 km downstream from Atfih (Petrie, Wainwright, and MacKay 1912). From this cemetery is derived the term "Gerzean," which refers to the middle Predynastic period (ca. 3600–3300 B. C.) when complex society can first be attested in Egypt; this period was followed by the emergence of the early Egyptian state and civilization. Another large Predynastic cemetery was also excavated at Abusir el Meleq, SW of Gerza (Möllers and Scharff 1969). In 1911–1912 Petrie excavated a large cemetery dating to the First Dynasty at Tarkhan, northeast of Gerza (Petrie 1914).

Meydum is the site of the earliest true pyramid; it was built at the beginning of the Fourth Dynasty (ca. 2575–2465 B. C.), but was never finished because it collapsed during construction (Mendelssohn 1986: 88). Several important early Fourth Dynasty tombs have been excavated at Meydum, from which come the painted statues of Prince Rahotep and his wife Nofret, and the painting of "Geese from Meydum," now in the Cairo Museum (Smith 1986: 83, 88).

During the Middle Kingdom (ca. 2000–1785 B. C.) hundreds of acres of land in the Fayum were reclaimed for irrigation (Butzer 1976: 36–37). The Middle Kingdom capital was at a site known from texts as Herakleopolis (not discovered archaeologically), and the royal pyramid tombs were built at Hawara, El Lahun, and El Lisht. At El Lahun are the remains of a Middle Kingdom town built to house construction workers and supervisors of the royal pyramids and their families (Petrie 1891). Numerous papyrus texts have been found in this town including a census list, and literary, medical, and veterinary texts.

The town of Ihnasya is covered with ruins dating mainly to the New Kingdom (ca.1551–1070 B. C.), and there are a number of important tombs from the Eighteenth and Nineteenth Dynasties (Kees 1977: 218). During the Ramesside period (later New Kingdom) a large garrison was located there. Medinet Gurob, north of Ihnasya, was the site of the royal harîm in the New Kingdom, and a finely carved ebony head of

Queen Tiye, mother of Akhenaten and grandmother of Tutankhamen, comes from there (now in the Berlin Museum). Tuthmosis III built at stone temple at Medinet Gurob, but much of this town was disassembled during the reign of Ramesses II in order to built his new capital in the eastern Nile Delta (Kees 1977: 227).

During the Ptolemaic period and the Roman occupation of Egypt, the Fayum was once again a region of dense occupation, mainly due to its great agricultural productivity, which declined after the third century A. D. Well-known mummy portraits painted realistically on wooden panels have been found on burials of the Roman period at Hawara (Petrie 1911). Large Greco-Roman towns in the Fayum were located at Crocodilopolis (the modern El Fayum also known as Arsinoë, once covering an area of 558 acres), Philadelphia, Narmouthis, and Qasr Qarun (Kees 1977: 229). In a cemetery at Tebtunis, 15 km SE of El Fayum, papyrus texts were found on mummified crocodiles, and many late papyrus texts dealing with religion and medicine have been found within the temple precincts at Tebtunis (Baedeker n.d.: 187).

1.4 SUMMARY

Because of major geographical differences, the Fayum and the west bank of the Nile in the region of El-Kureimat have much more extensive archaeological evidence than the east bank, where El-Kureimat is located. Lake Moeris provided water for extensive irrigation projects in the Fayum, and to the east of this a very wide strip of land is cultivable between the Bar Yusef canal and the Nile. In contrast, the east bank has a very narrow floodplain with the limestone formation of the low desert beginning less than 1 km east of the Nile in some places.

While the west bank has a rich and well-documented archaeological history, with sites spanning all periods of Egyptian prehistory and history (and even paleontological specimens dating back millions of years), the east bank is poorly represented in the archaeological record. Sites from the Neolithic and Greco-Roman periods have been found on the east side in the vicinity of the project area, although pharaonic sites seem to be only rarely reported there. An important track leading to the Red Sea also begins a few kilometers south of the project area; this track is at least 1500 years old. No sites have been reported within the El-Kureimat project area.

1.5 RECOMMENDATIONS

Despite a wealth of archaeological sites in the region, our present understanding of the distribution of sites in the vicinity of El-Kureimat indicates that the east bank of the Nile, with its narrow strip of floodplain, was less intensively occupied than the west bank. Archaeological sites have been found here, however, and the project area is considered to have a moderate sensitivity for containing archaeological sites. The limited information available suggests that sites of the Neolithic and post-pharonic periods are more likely to be found in the project area than pharaonic sites.

Although the preliminary assessment indicates a moderate archaeological sensitivity for the project area, only a systematic archaeological survey can identify whether or not sites exist there. In this region of Egypt, archaeological sites can generally be detected on the basis of evidence on the ground surface. For this reason, it is recommended that an archaeological field reconnaissance of the project area be made to determine if archaeological sites are present in the project area. The field inspection should include the proposed site of both the power plant and the colony.

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Annex C

COOLING SYSTEM ALTERNATIVES

EL KUREIMAT SOLAR POWER PLANT COOLING SYSTEM ALTERNATIVE

TABLE OF CONTENTS

1. INTRODUCTION

PGESCo was directed to study different alternatives for supplying cooling water to the proposed Kureimat Integrated Solar Combined Cycle Power Plant.

Contacts with the Ministry of Water Resources and Irrigation led to providing information about the water levels and discharges in the River at the existing Kureimat Power Plant site in addition to carrying out preliminary geophysical investigation on the ground water availability at the site of the solar plant.

This report presents the cooling systems options that were considered for the projects; technical specifications; cost estimate for installation of each option; cost estimate for the operation of each option; and the required studies for each alternative.

The report aims at presenting and analyzing the different methods for cooling the proposed Solar Power Plant in order to facilitate the process of selecting which alternative to sponsor for detailed studies and engineering

2. ALTERNATIVES FOR COOLING SYSTEM

Two main options are available in order to cool the Integrated Combined Cycle Solar Power Plant, namely once through and closed cycle cooling systems.

The Project comprises two gas turbines of about 40 MW each, two heat recovery steam generator (HRSG), one steam turbine of about 70 MW, one parabolic trough solar field capable to generate about 200 GWh/a (thermal) of solar heat plus all associated balance of plant equipment.

The cooling options considered are once through cooling system and closed cooling system with cooling tower.

The cooling requirements and main configuration for each case are listed as follow:

Once Through Cooling System-Option I:

- The Condenser Heat Duty =128.96×10^6 J/s
- Circulating Water Flow Rate =6.2 m^3/s
- Temperature Rise across the Condenser =5 °C
- G.R.P. Pipeline

Once Through Cooling System-Option II:

- The Condenser Heat Duty =128.96×10^6 J/s

Once Through Cooling System-Option II:

- The Condenser Heat Duty	$=128.96 \times 10^6$	J/s
- Circulating Water Flow Rate	=6.2	m^3/s
- Temperature Rise across the Condenser	=5	°C
- Pre-Stressed Pipeline		

Once Through Cooling System-Option III:

- The Condenser Heat Duty	$=128.96 \times 10^6$	J/s
- Circulating Water Flow Rate	=3.9	m^3/s
- Temperature Rise across the Condenser	=8	°C
- GRP Pipeline		

Once Through Cooling System-Option IV:

- The Condenser Heat Duty	$=128.96 \times 10^6$	J/s
- Circulating Water Flow Rate	=3.9	m^3/s
- Temperature Rise across the Condenser	=8	°C
- Pre-Stressed Pipeline		

Closed Cycle Cooling System-Option V:

- Cooling Tower Heat Duty	$=129.3 \times 10^6$	J/sec
- Circulating Water Flow Rate	=3.1	m^3/s
- Temperature Rise across the Condenser	=10	°C
- Make up Flow Rate	=0.048	m^3/s
- Blow Down Flow Rate	=0.01	m^3/s
- Make up and Blow Down from the Ground Water Reservoir		

Closed Cycle Cooling System-Option VI:

- Cooling Tower Heat Duty	$=129.3 \times 10^6$	J/sec
- Circulating Water Flow Rate	=3.1	m^3/s
- Temperature Rise across the Condenser	=10	°C
- Make up Flow Rate	=0.048	m^3/s
- Blow Down Flow Rate	=0.01	m^3/s
- Make up and Blow Down from and to the River Nile		

The following section presents the technical characteristics of each alternative and its advantages and disadvantages.

2.1 Once Through Cooling System

The intake and discharge structures are constructed to the River Nile East Shoreline. The position of the intake structure will be to the southern most boundary of the Kureimat Power Plant.

The intake structure will be equipped with pumping station to lift water for about 60 m to overcome head losses and elevation difference between

- The pumping station will be equipped with an anti water hammer devise to overcome any transient induced pressures, which might affect the safety of the cooling system.

A pipeline will deliver water to the condenser from the pumping station.

Two options of the pipeline material were considered; namely G. R. P. and Pre-stressed R. C. pipe.

2.1.a Option I

The water will flow through 1.8m I.D. pressurized G. R. P. pipes from the pumping station location and by the southern boundary of the Kureimat Power Plant, then crosses the Road under a bridge. The pipeline will extend northward toward the existing colony of the Kureimat Power Plant, then toward the potential location of the condenser.

The length of the cooling water delivery pipeline is about 3500m, depending on the exact location of the condenser.

The warm water will flow out of the condenser and guided to the discharge structure through a discharge pipeline of 1.4m inner diameter G. R. P. pipeline, which has a total length of 3300m depending on the exact location of the condenser and the discharge structure.

The discharge structure will be downstream of the proposed combined cycle project, i.e. downstream of the existing units discharge structure.

The attached drawing represents the layout of the proposed once through cooling system.

In order to estimate the total require pump head; the head losses have to be evaluated.

The head lost due to friction in the 3500m-delivery pipeline could be evaluated from the following equation:

$$H_f = \frac{fLQ^2}{2gDA^2} \quad (1)$$

In which:
H_f is the head lost due to pipe wall friction
f is the Darcy-Weissbach friction factor
L is the length of the pipeline
Q is the cooling water flow rate

g is the gravitational acceleration
D is the I.D. of the pipeline
A is the cross sectional area of the pipeline

Based of a cooling water flow rate of 6.2m3/s and a pipeline length of 3.5km with an internal diameter of 1.8m, the head lost due to friction in this reach will be 12.6m.

Secondary losses due to intake structure characteristics, elbows, and fittings are estimated to be about 2.4m.
Head difference between the condenser and the intake water level in the River Nile is about 45m.

The required pumping head is then 60m

The warm water, which is discharged from the condenser, has a head difference of about 45m over the water level in the River.

In order to overcome the high difference in altitude between the condenser discharge level and River water level, the pipe wall friction will be exploited by contracting the inner diameter of the discharge pipe. The contraction will increase the flow velocity and consequently the friction head lost.
The selected discharge pipe diameter is then 1.4m
The head lost in the discharge segment could be calculated from equation (1).

The value of the head lost is then 35.6m. The secondary losses in the discharge reach will be about 1.4m. The total head lost in the discharge pipe reach is then 37m.
A water box will be installed in the pipe reach mid point in order to over come the remaining 8m head difference and to maintain pressurized pipe flow in the system.

The power consumed during the pumping procedure could be estimated from equation (2)

$$P_{Once\_Through\_Cooling\_System} = \frac{\rho g Q H_{total\_headlost}}{\eta} \qquad (2)$$

In which:

P is the consumed power
ρ is the water density
Q is cooling system flow rate

, H is the total head lost
η is the overall efficiency
D is the I.D. of the pipeline
A is the cross sectional area of the pipeline

From above, it becomes clear that the pumping pressure required for the once through system will be approximately 4.9 MW.

2.1.b Option II

The only different between this option and the previous one (Option I) is that the pipeline material used to convey the cooling water is selected to be Pre-Stressed pipes instead of the G.R.P., which was used in the previous option.

2.1.c Option III

In option III, the discharge is limited to $3.9m^3/s$. The water will flow through 1.4m I.D, G.R.P. pressurized pipes from the pumping station location toward the potential location of the condenser.

The warm water will flow out of the condenser and guided to the discharge structure through a discharge pipeline of 1.1m I.D, G.R.P. pressurized pipes.

In order to estimate the total require pump head; the head losses have to be evaluated.

The head lost due to friction in the 3500m-delivery pipeline could be evaluated from equation (1)
Based on a cooling water flow rate of $3.9m^3/s$ and a pipeline length of 3.5km with an internal diameter of 1.4m, the head lost due to friction in this reach will be 12.6m.

Secondary losses due to intake structure characteristics, elbows, and fittings are estimated to be about 2.4m.
Head difference between the condenser and the intake water level in the River Nile is about 45m.

The required pumping head is then 60m

The warm water, which is discharged from the condenser, has a head difference of about 45m over the water level in the River.

The selected discharge pipe diameter is then 1.1m
The head lost in the discharge segment could be also calculated from equation (1).

The value of the head lost is then 37m. The secondary losses in the discharge reach will be about 1.4m. The total head lost in the discharge pipe reach is then 38.4m.
A water box will be installed in the pipe reach mid point in order to over come the remaining 7m head difference and to maintain pressurized pipe flow in the system

The power consumed during the pumping procedure could be estimated from equation (2). The consumed power is then 2.3 MW.

2.1.d Option IV

The only different between this option and the previous one (Option III) is that the pipeline material used to convey the cooling water is selected to be Pre-Stressed pipes instead of the G.R.P., which was used in the previous option.

Figure 1 represents the historical record of the water levels in the plant location.

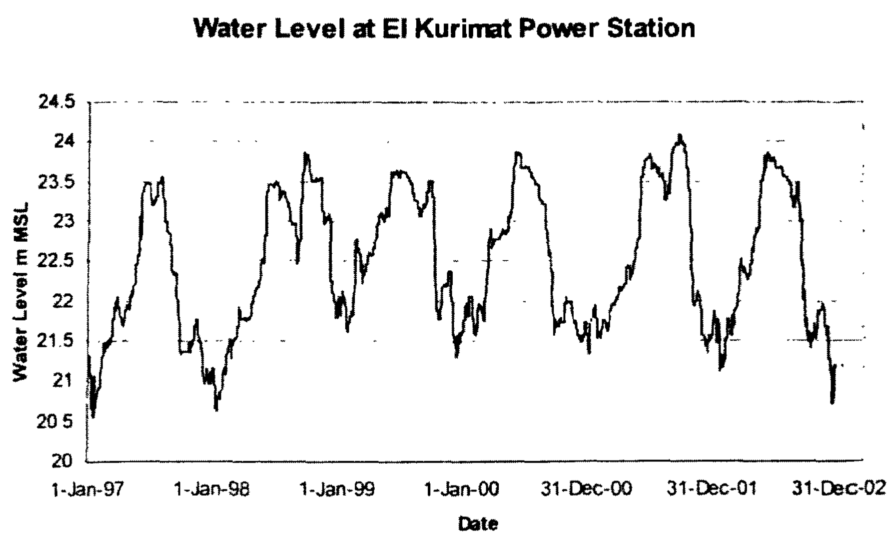

Figure 1 River Nile Water Level at the Plant Location

2.2 Closed Cycle Cooling Tower System

The cooling tower is operated based on the closed circuit cooling process. The cooling water is pumped from the cooling basin to the condenser via a pumping station. Warm water is collected from the outlet of the condenser and guided to the cooling tower were it is cooled down by means of an air ventilator. After the cooling water excess temperature is transferred to the ambient air, the water is dripping again to the basin of the cooling tower. The cooling tower is filled with water once, and then a making up pump is providing continuous flow to compensate for the water volume lost during the ventilation process.

The make up water is coming from either a deep well if the ground water reservoir will assure the sustainability of providing the required make up water flow or from the River Nile. The blow down water will be discharged back to the ground water reservoir or to a nearby drain.

2.2.a Option V

The make up water will be pumped from a ground water reservoir and the blow down water will be discharged to a well.

The design conditions of the cooling tower are as follow:

- Circulating water flow of	3.1	m^3/s.
- Make up flow of	0.04	m^3/s.
- Blow down flow of	0.001	m^3/s.
- Ambient air temperature of	20	°C.
- Cooling tower range of	10	°C.
- Wet bulb temperature of	13	°C.
- Warm water temperature to the cooling tower	27	°C.
- Cold water temperature out of the cooling tower	17	°C.
- Blow down water temperature of	17	°C.
- Total fan motor power of	0.77	MW.
- The cycle of concentration is	5	(-).
- Number of cells is	4	(-).
- Cells arrangement is	Train.	
- Tower overall dimensions (LxWxH)	To be provided later	
- Basin inside dimensions (LxWxH)	To be provided later	
- Fan diameter	To be provided later	
- Fan stack height is	To be provided later	

- Structure material is — Structure material concrete with internals of Fiberglass.

The power consumed in the operation of the cooling tower process is calculated from the following equation:

$$P_{Cooling-Tower-Circulation} = \frac{\rho g Q H_{condenser}}{\eta} \quad (3)$$

From equation 3, the power consumed in the circulating process is about 0.85MW.
The consumed power for make up and blow down will be about 0.1MW, as could be calculate in the same way as in equation (3).
The consumed power for fan motor operation will be 0.77MW.
The overall power consumption in the process of the cooling tower operation will be 0.85 + 0.1+ 0.77 MW or 1.72 MW.

2.2.b Option VI

The make up water will be pumped from the intake structure of the combined cycle project and pumped through a G. R. P. pipeline to the cooling tower.
The blow down water will be guided to a near by drain estimated to be about 5km away from the cooling tower. Blow down water will flow through a 100mm G. R. P. pipeline to the drain.
The consumed power for make up from the River Nile is about 0.034 MW, as could be calculate in the same way as in equation (3).
The consumed power for blow down to the drain is about 0.00015 MW, as could be calculate in the same way as in equation (3).
The overall consumed power on option II is then 1.65 MW.

3. Cost Analysis

3.1 Installation costs

Table 1 to 4 present the installation costs for the once through cooling system, as based on the available information of Nubaria project.
Table 5 and 6 present the installation costs for the closed cycle cooling system-Option I as based on the available database.

Table 1 Installation Cost Estimates of the Once Through Cooling System-Option I

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
$Q=6.2m^3/s$, $\Delta t=5^\circ C$	1.8m I.D. GRP Pipes	3500	(m) length	4500	15,750,000.00
	1.4m I.D. GRP Pipes	3200	(m) length	3200	10,240,000.00
	Intake and Discharge Structure	1	Lump Sum	4,200,000.00	4,200,000.00
	Pumping Station Civil Work	1	Lump Sum	5,200,000.00	5,200,000.00
	Pumping Station Mechanical Equipment	2x50% Pumps (Capacity 3.1 m^3/s at Head 60m) and Screens	Lump Sum	12,500,000.00	12,500,000.00
					47,890,000.00

Table 2 Installation Cost Estimates of the Once Through Cooling System-Option II

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
$Q=6.2m^3/s$, $\Delta t=5^\circ C$	1.8m I.D. Pre-Stressed Pipes	3500	(m) length	9000	31,500,000.00
	1.4m I.D. Pre-Stressed Pipes	3200	(m) length	7500	24,000,000.00
	Intake and Discharge Structure	1	Lump Sum	4,200,000.00	4,200,000.00
	Pumping Station Civil Work	1	Lump Sum	5,200,000.00	5,200,000.00
	Pumping Station Mechanical Equipment	2x50% Pumps (Capacity 3.1 m^3/s at Head 60m) and Screens	Lump Sum	12,500,000.00	12,500,000.00
					77,400,000.00

Table 3 Installation Cost Estimates of the Once Through Cooling System-Option III

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
$Q=3.9m^3/s$, $\Delta t=8°C$	1.4m I.D. G.R.P. Pipes	3500	(m) length	3200.00	11,200,000.00
	1.1m I.D. G.R.P. Pipes	3200	(m) length	2200 00	7,040,000.00
	Intake and Discharge Structure	1	Lump Sum	2,800,000.00	2,800,000.00
	Pumping Station Civil Work	1	Lump Sum	3,500,000.00	3,500,000 00
	Pumping Station Mechanical Equipment	2x50% Pumps (Capacity 1.9 m^3/s at Head 60m) and Screens	Lump Sum	11,000,000.00	11,000,000.00
					35,540,000.00

Table 4 Installation Cost Estimates of the Once Through Cooling System-Option IV

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
$Q=3.9m^3/s$, $\Delta t=8°C$	1.4m I.D. Pre-Stressed Pipes	3500	(m) length	7500.00	26,250,000.00
	1.1m I.D. Pre-Stressed Pipes	3200	(m) length	5000.00	16,000,000.00
	Intake and Discharge Structure	1	Lump Sum	2,800,000.00	2,800,000.00
	Pumping Station Civil Work	1	Lump Sum	3,500,000.00	3,500,000.00
	Pumping Station Mechanical Equipment	2x50% Pumps (Capacity 1.9 m^3/s at Head 60m) and Screens	Lump Sum	11,000,000.00	11,000,000.00
					59,550,000.00

Table 5 Installation Cost Estimates of the Cooling Tower-Option V

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
Cooling Tower	4 Cells	1	Lump Sum	5,000,000.00	5,000,000.00
	Pumping Station Civil Work	1	Lump Sum	4,000,000.00	4,000,000.00
	Circulating Pumps Capacity 1.55m^3/s-Head 20m)	3x50%	Item	1,700,000.00	5,100,000.00
	Make up Pumps Capacity 0.05m^3/s-Head 150m)	2x100%	Item	450,000 00	900,000.00
	Deep Well (150 m deep-150mm diameter)	2x100%	Item	350,000 00	700,000.00
	Blow Down Pumps Capacity 0.01m^3/s-Head 15m)	2x100%	Item	35,000.00	70,000.00
					15,770,000.00

Table 6 Installation Cost Estimates of the Cooling Tower-Option VI

Option	Description	Item		Unit Price L.E.	Total Cost L.E.
		Quantity	Unit		
Cooling Tower	4 Cells	1	Lump Sum	5,000,000.00	5,000,000.00
	Pumping Station Civil Work	1	Lump Sum	4,000,000.00	4,000,000.00
	Circulating Pumps Capacity 1.55m^3/s-Head 20m)	3x50%	Item	1,700,000.00	5,100,000.00
	Make up Pumps Capacity 0.05m^3/s-Head 60m)	2x100%	Item	450,000 00	900,000.00
	0.2m I.D. GRP Pipes	3500	(m) length	500.00	1,750.000.00
	Blow Down Pumps Capacity 0.01m^3/s-Head 15m)	2x100%	Item	35,000 00	70,000.00
	0.1m I.D. GRP Pipes	5000	(m) length	300.00	1,500.000.00
					18,320,000.00

3.2 Running costs

The estimated cost of a KWhr is estimated to be 0.1535L.E., while the cost of a cubic meter that is used for industrial purposes is 0.15L.E.
Table 7 indicates the running cost for each case of the installation.

Table 3 Running Cost Estimates

<table>
<tr><th rowspan="2">Option</th><th colspan="2">Consumption</th><th colspan="2">Unit Price
L.E.</th><th colspan="3">Total Cost
L.E.</th></tr>
<tr><th>Water
m^3/year</th><th>Electricity
KWhr/year</th><th>m^3
Water</th><th>KWhr
Electricity</th><th colspan="2">Water/year</th><th>Electric energy/year</th></tr>
<tr><td rowspan="2">Once Through Cooling System Option I and II</td><td rowspan="2">-</td><td rowspan="2">$43x10^6$</td><td rowspan="2">-</td><td rowspan="2">0.15</td><td colspan="2">-</td><td>$6.44x10^6$</td></tr>
<tr><td colspan="3">$6.44x10^6$</td></tr>
<tr><td rowspan="2">Once Through Cooling System Option III and IV</td><td rowspan="2">-</td><td rowspan="2">$26.8x10^6$</td><td rowspan="2">-</td><td rowspan="2">0.15</td><td colspan="2">-</td><td>$4x10^6$</td></tr>
<tr><td colspan="3">$4x10^6$</td></tr>
<tr><td rowspan="2">Cooling Tower Option V</td><td rowspan="2">$1.26x10^6$</td><td rowspan="2">$15.07x10^6$</td><td rowspan="2">0.15</td><td rowspan="2">0.15</td><td colspan="2">$0.19x10^6$</td><td>$2.25x10^6$</td></tr>
<tr><td colspan="3">$2.45x10^6$</td></tr>
<tr><td rowspan="2">Cooling Tower Option VI</td><td>Fresh Water from River Nile
$1.26x10^6$</td><td rowspan="2">$14.45x10^6$</td><td rowspan="2">0.15</td><td rowspan="2">0.15</td><td>$0.19x10^6$</td><td>$0.005x10^6$</td><td>$2.2x10^6$</td></tr>
<tr><td>Blow down water to drain
$0.03x10^6$</td><td colspan="3">$2.4x10^6$.</td></tr>
</table>

When adding the installation costs to the running cost and neglecting the rate of inflation for a simple comparison, figure 3 could be plotted.

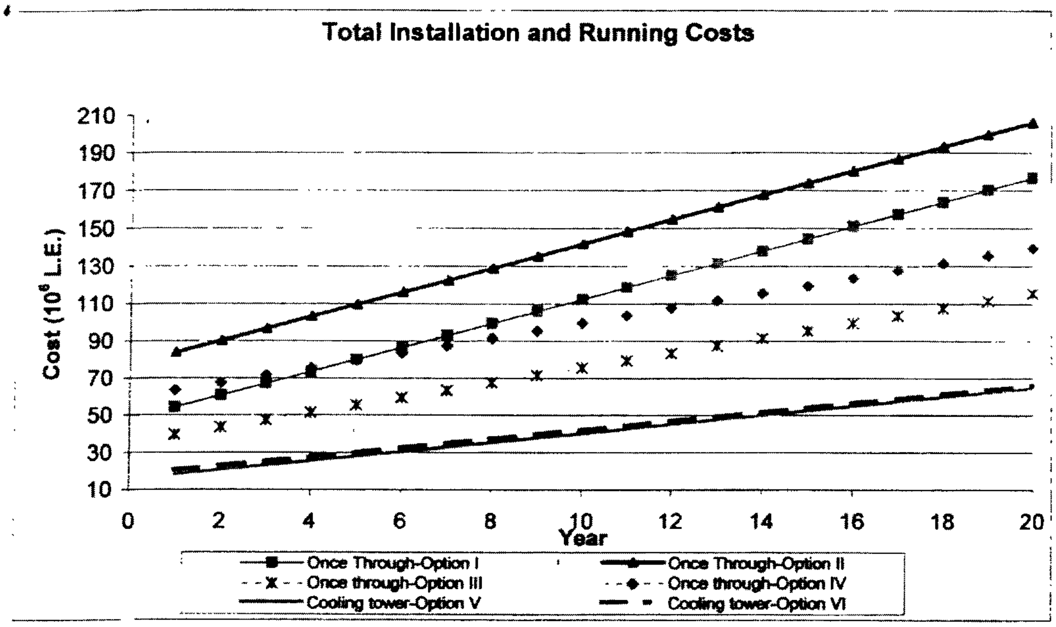

Figure 3 Total Costs

4. CONCLUSION

The design and cost analysis of the Cooling Tower-Option V was based on the assumption that groundwater is available all year long at a level of 150m below the condenser bottom level.
A detailed hydrological study is required to confirm the assumption.

From the demonstrated analysis it could be seen that the cooling tower-Option V would have the least installation and running costs.

When adding the running cost to the installation cost the once through cooling system it could be seen that the installation and operation of the cooling tower is by far cheaper than the once through cooling system to the River Nile.

5. RECOMMENDATIONS

It is recommended to contact the irrigation authorities to initiate a detailed hydrological study about the ground water reservoir and validate the assumptions that were adopted in Cooling Tower-Option V in the study. A comprehensive geophysical, geological, hydrogeological, and hydrochemical studies should be carried out to delineate the available water-bearing formations and their average depths.

It is recommended to select the Cooling Tower-Option V as a cooling system for the Kureimat Solar Power Plant.
If the hydrological study indicates that the ground water availability is not sustained or the quality is not suitable, then Option VI should be adopted.

It is recommended to contact the general consultant to discuss the outcomes of the study with him and confirm all the assumptions and data that were used in the current study.

Detailed engineering and designs should follow the study.

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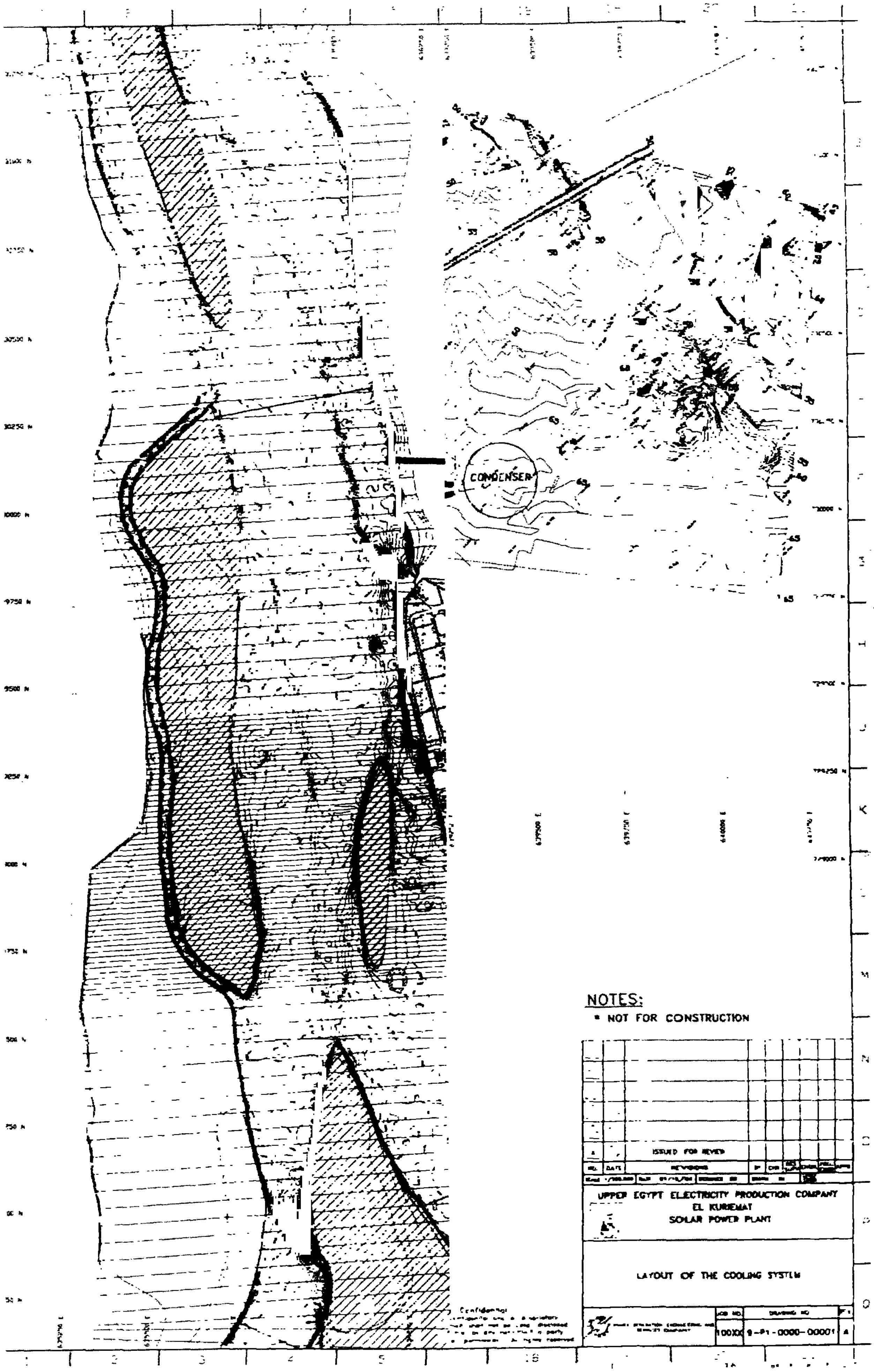
CONDENSER
NOTES:
* NOT FOR CONSTRUCTION
ISSUED FOR REVIEW
UPPER EGYPT ELECTRICITY PRODUCTION COMPANY
EL KURIEMAT
SOLAR POWER PLANT
LAYOUT OF THE COOLING SYSTEM
100XX 9-P1-0000-00001 A

Annex D

KURAYMAT PROJECT
LAND ACQUISITION

بسم الله الرحمن الرحيم

جمهورية مصر العربية
وزارة الزراعـــة
الوزيـــر

وارد رقم
٨٧٠
١٤ / ٦ / ٢٠٠٠

مكتب السيد/ وزير الزراعة
صادر ٤٤٢٩
ملف رقم ٢٧٧٤
التاريخ ٧ / ٦ / ٢٠٠٠

الاخ الدكتور مهندس/ على فهمى الصعيدى

وزير الكهرباء والطاقـــه

تحيه طيبه وبعد ،،،،

بالاشاره الى كتاب سيادتكم رقم ٣٩٩ بتاريخ ٢٨/٥/٢٠٠٠ بشأن الطلب المقدم من هيئة تنميةواستخدام الطاقه الجديده والمتجدده لتخصيص مساحة ٦٦٠ فدان بناحية الكريمات الجيزه بغرض اقامة المحطه الشمسيه الحراريه لتوليد الكهرباء .

نحيط سيادتكم علما بانه لامانع لدى الوزاره من استغلال مساحة ٦٦٠ فدان محل طلب هيئة تنمية واستخدام الطاقه الجديده والمتجدده لاقامة المحطه الشمسيه الحراريه لتوليد الكهرباء بناحية الكريمات ـ جيزه مع التزام الهيئه الطالبه التنسيق مع باقى الجهات المعنيه الاخرى وعدم استغلال المساحه فى غير الغرض المخصصه من اجلـــه .

وانتهز تلك الفرصه لابعث لكم باطيب تمنياتى بدوام التوفيق .

مع خالص تحياتى ،،،

نائب رئيس الوزراء

ووزير الزراعه واستصلاح الاراضـــى

" دكتور/ يوسف والـى "

١٠ / ٩ / ٢٠٠٠

للعرض على السيد المهندس
الرئيس التنفيذى لهيئة الطاقة الجديدة والمتجددة
مع تأكيد الاهتمام
٦/١٠

أستاذنا السيد المهندس صلاح ... ـ ...
السيد المهندس أمينة ... ـ المدير ...
٦/١١

محافظة الجيزه

الادارة العامه للأملاك

============

السيد المهندس / رئيس الادارة المركزية للملكيه و التصرف بالهيئه العامه لمشروعات التعمير و التنمية الزراعيه

تحية طيبه ... وبعد ..

بالاشاره الى كتاب سيادتكم رقم ٥٢٦ في ٢٢/١/٢٠٠٠ بخصوص الطلب المقدم من هيئة تنمية و أستخدام الطاقة الجديده و المتجدده ..

تحيط سيادتكم علما بأن المساحه موضوع الطلب والتي تم عمل معاينة لها من قبل الاداره العامه للأملاك بالمحافظه تقع خارج المنطقة الصناعيه بالكريمات ..

برجاء التفضل بالعلم والاحاطه واتخاذ اللازم

وتفضلوا بقبول وافر التقدير ،،

مدير ادارة المساحه

م / محمد مصطفى كامل

مدير عام ادارة الأملاك

م / سعاد عباس الططاوى

تحريرا في ٢٦/١/٢٠٠٠م

وزارة الدفـــــــاع
هيئة عمليات القوات المسلحة
القيد: د/ ٣٠٤/١/٧/٤٦٧ ؟
التاريخ: ٢٦/٦/٢٠٠٠

موافقة رقم (٨ ــ ١ ــ /٢٠٠٠)

السيد/ حامد عماره قاسم - رئيس القطاع المشرف على مكتب السيد/وزير الكهرباء والطاقه

تحيـة طيبـة ... وبعـد،

إيماءا لكتابكم رقم ١٧٧٨ بتاريخ ٢٢/٢/٢٠٠٠ بشأن طلب الموافقه على تخصيص مساحة (٦٦٠)ف (فقـط ستمائه وستون فدان) بناحية الكريمات - الجيزه لهيئة تنمية واستخدام الطاقه الجديده والمتجدده بغرض إقامة المحطه الشمسيه الحراريه لتوليد الكهرباء.

نفيدكم بالموافقة عـلى إقامـة المشروع المشار إلـيه بعاليه الموضـح باللون الأخضر عـلى الخريطة المعتمـدة المرفقـة مقياس رسم ١ : ٥٠٠٠٠ وبالشروط الآتية:

١-الالتزام بالموقع والمساحة الموضحة باللون الأخضر على الخريطة المعتمدة المرفقة.
٢-الالتزام بالقرار الوزاري رقم ٣٦٧ لسنة ٨٦ وملحقاته.
٣-البعد عن طيان الطريق طبقا لقوانين الطرق.
٤-استغـلال المساحة الموافـق عليها فى إقامة المشروع عاليه مع عدم زيـادة ارتفـاع المبـانى والمنشـآت عـن (١٥)م (فقط خمسة عشر متر) من منسوب سطح الأرض الموافق عليها.
٥-التنسيق مع قيادة قوات الدفاع الجوى قبل بدء العمل لتحديد حدود المساحة الموافق عليها.
٦-التنسيق مع قيادة المنطقة المركزية العسكرية قبل وأثناء العمل لتحديد حدود المساحة الموافق على اسـتغلالها علـى الطبيعة ولتأمين الكابلات والمنشآت العسكرية بالمنطقة.
٧-التنسيق مع إدارة الإشارة قبل بدء العمل لتأمين الكوابل العسكرية بالمنطقة.
٨-التنسيق مع إدارة المياه قبل بدء العمل لتأمين خطوط المياه العسكرية بالمنطقة.
٩-عدم مسئولية القوات المسلحة عن بحث موقف التخصيصات الصادرة من أجهزة الدولة وتعديلاتها حيث تعبر الموافقة عن وجهة نظر القوات المسلحة فى استغلال الأرض فقط وتقع مسئولية إجراءات التخصيص أو إلغاؤه أو تعديله على أجهزة الدولة المختصة بذلك.
١٠-حق القوات المسلحة فى إيقاف العمل أو إلغاء الموافقة فى حالة المخالفة لأحد شروط الموافقة.
١١-لا تعتبر هذه الموافقة تصريحاً بالاستغلال ولكنها وجهة نظر القوات المسلحة ويلزم الحصول على موافقة الـــوزارات والهيئات المعنية قبل التنفيذ.

مع وافـــر التحية،،،

التوقيع/
لواء أ.ح/ بكـــر الرشيـــدى
رئيس هيئة عمليات القوات المسلحة

للعرض على السيد المهندس
الرئيس التنفيذى لهيئة الطاقة الجديدة والمتجددة
مع فائق الاحترام

الإدارة المركزية للمناجم والمحاجر
الإدارة العامة للترخيص والتفتيش
١٠٩ شارع القصر العيني - من ميدان التحرير - القاهرة
تليفون : ٣٥٤٥٥٩٨ - فاكس : ٣٥٥١٦٢٣
ص.ب : ١١٥١٢ مجمع التحرير

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مرفق صوره خطاب المعاينه .

السيد المهندس/ رئيس الاداره المركزيه للملكيه والتصرف .
الهيئه العامه لمشروعات التعمير والتنميه الزراعيه .
تحيه طيبه ... وبعد

بالاشاره الى كتابكم رقم ١٧٠٧ بتاريخ ٢٠/٢/٢٠٠٠ بخصوص معاينـه الارض المخصصه لهيئه تنمية واستخدام الطاقه الجديده والمتجدده بناحيـه الكريمات ومساحتها ستمائه وستون فدان والموضحه على الخريطه المرفقـه بكتابكم سالف الذكر .

نتشرف بالاحاطه بأن اداره محاجر الجيزه قامت بالمعاينه الفنيـه الظاهريه على الطبيعه لقطعه الارض بتاريخ ٢٠/٤/٢٠٠٠ (مرفق صوره خطاب المعاينه) وأفادتنا بالأتى :-

١ - الارض تقع على طريق الكريمات / بنى سويف عند ك ٩٠ تقريبا .
٢ - الارض فى مجملها مستويه ومسطحه وهى عباره عن طبقات من الرمال المختلطه بالاكاسيد والحجر الغير صالح للاستغلال .
٣ - يمكن الاستغناء عن مساحه الارض .

وعلية لا مانع من الاستغناء عن اجمالى مساحه الارض . والسير فى الاجراءات القانونيه واذا ظهرت بها أى مواد محجريه مستقبلا يطبق بشأنها القانون ٨٦ لسنه ١٩٥٦ الخاص بالمناجم والمحاجر والترخيص بها كمحاجر من قبـل محافظه الجيـزه .

وتفضلوا بقبول فائق الاحترام ...

مدير عام الاداره
العامه للترخيص والتفتيش
للمناجم والمحاجر

[توقيع] ١٤/٦/٢٠٠٠

تحريرا فى : ١٤/٦/٢٠٠٠ .
اشرف .

[ختم: الهيئة العامة لمشروعات التعمير والتنمية الزراعية ... المرفقات : ...]

[ختم: ١٧/٦/...]

بسم الله الرحمن الرحيم

محافظة الجيزة

السيد المهندس/ مدير عام الاداره العامه للمناجم والمحاجر
٣ ش صلاح سالم ٠ القاهـــره

تحيــه طيبــه ٠٠ وبعــــــد ،،

ايماءا الى كتاب سيادتكم رقم ٣٨٦ فى ٢٠٠٠/٢/٢٩ ٠٠ بشأن معاينه قطعه الارض ومساحتها ـــ ـــ ٦٦٠ س ط ف باسم/ هيئه تنميه واستخدام الطاقه الجديـــده والمتجدده بناحيه الكريمات ٠٠

قامت فى يوم الاثنين الموافق ٢٠٠٠/٣/٢٠ قامت لجنه مشكله من :

١ـ جيولوجى / جبريل احمد حفنى   ٢ـ جيولوجى / على عواد على

بعمل المعاينه اللازمه وطلبت عمل الجسات اللازمه فى الموقع التى حددتها اللجنــه داخل مساحه الارض ٠٠ وفى يوم الخميس الموافق ٢٠٠٠/٤/٢٠ قامت اللجنـــــه باستكمال اعمالها وقد تبين الاتى :ـ

أولا : الارض مساحتها حوالى ـــ ـــ ٦٦٠ س ط ف تقريبا وتقع على طريق الكريمات/بنى سويف عند الكيلو ٩٠ تقريبا بمدخل حوالى ٣٠٠م على الطريق بعرض حوالى ٢كم تقريبا وبطول حوالى ٣كم للداخل تقريبا ٠٠

ثانيا : الارض فى مجموعها مستويه ومسطحه وهى عباره عن طبقات من الرمال المختلطه بالاكاسيد والحجر الغير صالح للاستغلال ٠٠

ثالثا : تبين وجود علامات ارشاديه باسم/ هيئه الطاقه على حدود الارض وجزء منها منزرع والباقى صالح للزراعه ٠٠

رابعا : يمكن الاستغناء عن تلك المساحه مع حق الاحتفاظ بحق المحافظه فيما قد يظهر بها من مواد محجريه مستقبلا ٠

وتفضلوا بقبول فائق الاحـــــترام ،،،

جيولوجى /   جيولوجى /

مديــــر اداره المحاجــــر

تحريرا فى : ٢٠٠٠/٥/٢٠

جمهورية مصر العربية

بسم الله الرحمن الرحيم

الأمانة العامة لوزارة الدفاع

١٨١٥٢

رقم القيد : ١٤/٨٤/١١٥٤

التاريخ : ١١ / ٦ / ٢٠٠٠

(٢)

السيد المهندس / حامد عماره قاسم

رئيس القطاع المشرف على مكتب السيد وزير الكهرباء والطاقه

تحية طيبة ... وبعد ،،

بالاشاره الى كتاب السيد وزير الكهرباء والطاقه رقم ١/٤٠٠ بتاريخ ٢٠٠٠/٥/٢٨ بشأن طلب الموافقه على تخصيص مساحه (٦٦٠) فدان بناحيه الكريمات – الجيزه لهيئه تنميه وإستخدام الطاقه الجديده والمتجدده بغرض إقامه المحطه الشمسيه الحراريه لتوليد الكهرباء .

يرجى التفضل بالاحاطه بأن وزاره الدفاع توافق من وجهه النظر العسكريه على استغلال المساحه المذكوره لصالح اقامه المحطه بارتفاع لا يتجاوز (١٥ متر) وطبقاً لقواعد الاستغلال التى ستصدرها هيئه عمليات القوات المسلحه .

وتفضلوا بقبول فائق الإحترام ،،،

لواء أح / محسن محمود السلاوي

أمين عام وزارة الدفـــــاع

وزارة الثقافة

مكتب الوزير

وزارة الثقافة
سكرتارية مكتب الوزير
الرقم الصادر : ٤٢٥٧
التاريخ : ٢٠٠٠/٦/٢٩
المرفقات : ١

وارد رقم
٩٨٤
٢٠٠٠/٧/١

السيد الأستاذ / المشرف على مكتب

الأستاذ الدكتور وزير الكهرباء والطاقة

تحية طيبة وبعد ..

بالإشارة إلى كتاب الأستاذ الدكتور وزير الكهرباء والطاقة رقم ١/٤٠١ بتاريخ ٢٠٠٠/٥/٢٨ للسيد الأستاذ وزير الثقافة بشأن موافقة مجلس الوزراء بجلسته بتاريخ ١٩٩٨/١٠/٩ على تنفيذ مشروع توليد الكهرباء من الطاقة الشمسية الحرارية ، والذي يشير فيه إلى أنه وقع الاختيار لموقع صحراوي بمنطقة الكريمات جنوب الجيزة وطلب موافقة المجلس الأعلى للآثار على الموقع المقترح لإقامة المشروع .

أتشرف بالإحاطة أن السيد الأستاذ الدكتور أمين عام المجلس الأعلى للآثار أفاد بأن قطاع الآثار المصرية سبق وأن وافق على المشروع وأرسلت الأوراق إلى منطقة آثار الجيزة رقم ١٠١ في ٢٠٠٠/٥/١٦ (مرفق صورة) .

للتفضل بالإحاطة والتوجيه بالتنسيق في هذا الشأن مع منطقة آثار الجيزة .

ومع خالص إعزازي وتقديري ..

تفضلوا بقبول وافر الاحترام ،

رئيس قطاع
مكتب وزير الثقافة

فاروق عبد السلام

يونيو ٢٠٠٠

Far 6 / A

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٢ شارع شجرة الدر ــ الزمالك (ت : ٣٤١٥٥٦٨/٣٤١٥٤٩٥/٣٤٠٦٤٦٩) (فاكس ٣٤٠٣٩٤٧) (الرقم البريدى ١١٢١١)

وزارة الثقافة

مكتب الوزيـر

السيد الأستاذ / المشرف على مكتب

الأستاذ الدكتور وزير الكهرباء والطاقة

تحية طيبة وبعد ..

بالإشارة إلى كتاب الأستاذ الدكتور وزير الكهرباء والطاقة رقم ١/٤٠١ بتاريخ ٢٠٠٠/٥/٢٨ للسيد الأستاذ وزير الثقافة بشأن موافقة مجلس الوزراء بجلسته بتاريخ ١٩٩٨/١٠/٩ على تنفيذ مشروع توليد الكهرباء من الطاقة الشمسية الحرارية ، والذي يشير فيه إلى أنه وقع الاختيار لموقع صحراوي بمنطقة الكريمات جنوب الجيزة وطلب موافقة المجلس الأعلى للآثار على الموقع المقترح لإقامة المشروع .

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للتفضل بالإحاطة والتوجيه بالتنسيق في هذا الشأن مع منطقة آثار الجيزة .

ومع خالص إعزازي وتقديـرى ..

تفضلوا بقبول وافر الاحتـرام ،

رئيس قطاع
مكتب وزير الثقافـة

فاروق عبد السلام

يونيو ٢٠٠٠

Far6 / A

وزارة الثقافة
المجلس الأعلى للآثار
مكتب الأمين العام

السيد الأستاذ/ فاروق عبد السلام
رئيس قطاع مكتب وزير الثقافة

تحيه طيبه وبعد ..

إيماءً إلى خطاب سيادتكم رقم ٣٤٤٩ بتاريخ ٢٠٠٠/٥/٣٠ المرفق به صورة كتاب السيد أ.د. / وزير الكهرباء والطاقة بشأن موافقة مجلس الوزراء فى جلسة بتاريخ ١٩٩٨/١٠/٩ على تنفيذ مشروع توليد الكهرباء من الطاقة الشمسية الحرارية ، والذى يشير فيه إلى أنه وقع الأختيار لموقع صحراوى بمنطقة الكريمات جنوب الجيزة – وطلب موافقة المجلس الأعلى للآثار على الموقع المقترح لإقامة المشروع .

أتشرف بالإحاطة طبقاً لما ورد من قطاع الآثار المصرية بأنه قد سبق الموافقة على المشروع من قبل القطاع وأرسلت الأوراق إلى منطقة آثار الجيزه رقم ١٠١ فى ٢٠٠٠/٥/١٦ .

رجاء التفضل بالعلم ،

مع خالص تقديرى ..

وتفضلوا بقبول فائق الإحترام ..

الأمين العام
للمجلس الأعلى للآثار
أ.د. جاب الله على جاب الله

هناء «خ.م١٢»

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