EGYPT: EL-AIN SOKHNA 2x650 MWe GAS/OIL THERMAL POWER PROJECT

ESIA EXECUTIVE SUMMARY
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

Project Name: EL-AIN SOKHNA 2x650 MWe GAS/OIL THERMAL POWER PROJECT

Country: Egypt

Project Number: PEG-FAA-014

1. INTRODUCTION

1.1 Engineering Consultants Group (ECG), a private consulting firm (Egypt) was commissioned by the Egyptian Electricity Holding Company (EEHC)/East Delta Electricity production Company (EDEPC) to prepare Environmental and Social Assessment of the El-Ain Al-Sokhna Power Project according to the requirements of the African Development Bank (AfDB) and World Bank (WB). The proposed plant is designated as a Category 1 project under the AfDB rules and a Category C project under the Egyptian environmental regulations and therefore requires a full Environmental Impact Assessment.

1.2 The project involves the construction and operation of this 2x650 MWe, dual fuel power plant. East Delta Electricity Production Company (EDEPC), a company incorporated in Egypt and affiliated to the Egyptian Electricity Holding Company (EEHC) proposes to construct and operate a new thermal power plant at El-Ain Al-Sokhna, which is along the Suez Gulf and about 52km south of the city of Suez on the western coast of the Suez Gulf. The site is within an existing piece of land allocated to previous Egyptian Electricity Authority (EEA) (today EEHC) by the Presidential Decree No. 299 of the year 1999. The overall proposed site area is approximately 275,000 m².

1.3 The proposed power plant will consist of two supercritical thermal steam units, each with a nominal electricity generating capacity of 650 megawatts (MWe), which will be known as El-Ain Al-Sokhna Power Plant. The overall generating capacity of the power plant will be 1300MWe. The power plant is intended to be operational by the end of the year 2012/2013. The power output from the proposed plant will be sold to the Egyptian Electricity Transmission Company (EETC).

1.4 The power plant will utilize natural gas as its primary fuel, delivered to the site via an existing pipeline to be operated by "City Gas", and also have the capability to operate using mazout (heavy fuel oil). The ability to "dual-fuel" the power plant (with natural gas or mazout) will provide security of electricity supply in the event that gas supplies are unavailable for any reason. In addition, a small emergency generator, for the plant safe shut down, operating on sollar oil (light fuel oil) will also be provided on-site to drive key items of equipment within the power plant in the event of a power supply failure, and sollar oil will also be able to be used, if required, to operate the auxiliary boiler during start-up.

1.5 The power plant will incorporate a direct (once through) cooling system using water abstracted from the Suez Gulf. The abstracted water will also be used, following pretreatment demineralization and desalination, to provide process water make-up in the boiler system. Potable water supplies will be drawn from the same existing supply system for the Suez Gulf BOOT power plant.
1.6 The main demand for water is due to the direct cooling system. The use of a direct cooling system maximizes the electrical efficiency of the power plant and, after use, virtually all of the water will be returned to the Gulf of Suez at a slightly elevated temperature compared to the abstraction. No evaporative cooling towers are required, hence there is no opportunity for water drift or the formation of visible plumes of water vapor or ground fogging.

1.7 The site is bordered to the south by the 2 x 341.25 MWe Suez Gulf BOOT power plant on the rest of the land area that was allocated to the Egyptian Electricity Authority (EEA) (today EEHC) by the Government of the Arab Republic of Egypt. EEA have granted exclusive rights of use of that adjacent land to the BOOT project company. The site of the proposed power plant is shown on Figure 1. Also, Figure 2 depicts this location within the context of the Suez Governorate. Figure 3 illustrates a general view of the proposed site land.

2. LEGAL and ADMINISTRATIVE FRAMEWORK

2.1 Government of Egypt Requirements

2.1.1 The Egyptian standards have been drawn from the range of provisions in the following documents:

- Law No. 93 for 1962 regarding the drainage of liquid wastes, particularly sanitary drainage.

2.1.2 Law 4/1994 requires that, for establishments requiring licenses, an environmental impact assessment must be prepared and submitted to the Egyptian Environmental Affairs Agency (EEAA) for review. The environmental impact assessment must be submitted to the EEAA by “the Competent Administrative Authority (CAA) or the licensing authority” for the project in question. For the Power Plant Project, the Competent Administrative Authority is the Suez Governorate.

2.1.3 The Suez Governorate will send the EIA to EEAA for review and provide its opinion within 60 days. Once EEAA has approved the project, a license to proceed can be issued. No additional environmental or social clearances are required other than the approval of EIA to proceed with the project activities. The law requires that any new project should comply with all the relevant articles pertinent to environmental attributes, which could be impacted from project activities.

2.1.4 Egyptian EEAA regulations specify the technical scope or contents of an environmental impact assessment. As a matter of practice, environmental impact assessments for power plant projects typically have a scope and organization similar to World Bank environmental assessments.

2.1.5 In addition to environmental impact assessment requirements, the Government of Egypt has established air pollution and water pollution limits applicable to the Power Plant project. These limits are presented in Table 2, along with the actual air and water pollution levels expected from the Power Plant.
2.2 **African Development Bank Guidelines**

2.2.1 The African Development Bank Policy and Guidelines were used in preparing the ESIA:

- Environmental and Social Impact Assessment Procedures (ESAP) for AfDB’s Public Sector Operations (June 2001).
- Policy on Gender

3. **DESCRIPTION OF THE ENVIRONMENT**

3.1 The Al-Sokhna power plant site is located on the western coast of the Gulf of Suez, part of the Red Sea, approximately 52 km south of Suez City, and 1.6 km east of the Suez/Red Sea Highway, which runs parallel to the Gulf of Suez. The site is within the administrative boundary of the Suez governorate and its Ettaqa District. The site, also, is within the Suez industrial complex, an area being developed for industrial use. The area surrounding the site is locally known as the El-Ain Al-Sokhna area. The general site location is given in Figure 5.1 (A, B & C-Landsat image of the Suez Region).

3.2 The site is located in a developing industrial zone (Suez Gulf Development Corporation and El-Ain Al-Sokhna) and lies 1km south of the Al-Sokhna Port which is currently under operation. The port is being developed to be a major commercial harbour facility. Areas directly to the west and south of the proposed site are being developed with a variety of heavy and light industrial activities.

3.3 Land cover on the site consists primarily of bare sand, with scattered low-growing vegetation. No residences, agricultural activities or other significant land uses are located on the site or in its immediate vicinity and the arid nature of the area provides little opportunity for agricultural production.

3.4 The site is located some 52 km south of Suez City and is delimited by the two coordinates: Latitudes 29° 30' and 30° 00' North and Longitudes 32° 00’ and 32° 30’ East.

3.5 The annual average surface water temperature in the Suez Gulf site area is 23.6°C, with a range of 15.7°C (recorded in February) to 30.4°C (recorded in August). The highest monthly average surface water temperatures are 27.1°C in July and 28.0°C in August.

3.6 The project area lies within the hyper-arid climatic province of Egypt characterized by a mild winter and hot summer. During 2006, the monthly average low temperature ranged between 11.5°C and 26.2°C, and the monthly average high temperature ranged between 18.6°C and 38.3°C. The high temperature exceeded 42°C in some summer days. During 2006, the average yearly temperature was around 23.9°C, and the average yearly humidity was around 52.25%. The air pressure is generally high all through the year; its minimum level occurs in August.
3.7 The annual average wind speed for 2006 was 4.37m/sec. Wind speeds rarely exceeded 10 meters/second. The prevailing wind direction was generally from the North and/or North Northwest for over 60% of the year.

3.8 The land around the Gulf of Suez is generally composed of littoral salt marsh, coastal desert plain and adjoining hills; the project area lies in the coastal desert plains. These plains extend between the littoral salt marsh belt on the seaward side and the coastal range of hills and mountains on the inland side. The coastal plain is characterized by active soil transporting agencies (water and wind). Except for the main drainage channels or deltas of wadis, the coastal plain is mostly devoid of plant and animal life.

3.9 The only vegetation found on the project site is scattered low-growing bushes. Most of the site is bare sand. This type of habitat is not expected to provide adequate food or cover for large animals. The site probably is used by a limited number of invertebrates, reptiles, and birds.

3.10 Bird migration generally occurs during the autumn season. During this season, large numbers of raptors migrate and pass through the northern sector of this coastal plain, including the project site. Other migratory species utilize vegetated areas of the coastal plains.

3.11 The main transport infrastructure linking the Suez South area to the country main ports facilities is principally based on road network. The site is accessible through, at least, three main highways. The Suez/Red Sea highway runs parallel to the Gulf of Suez. The Maadi/El-Ain Al-Sokhna highway crosses the southern part of the area from northwest to southeast. The Wadi Hagul highway runs from Cairo/Suez highway southwards to connect with Maadi/El-Ain Al-Sokhna highway west of Suez Cement Factory.

3.12 The water resources in the project area are mainly: (1) the hallow and deep aquifers in the area; (2) Nile River, at Maadi-Helwan reach; (3) fresh Suez Canal irrigation branch, fed from Manayyef and Ismailia Canal; and desalination of Red Sea water. Rain is generally the main source of groundwater, either for surface sedimentary aquifers (Wadi Bedaa and Wadi Gheweiba) or for structural aquifers deeply seated. It is believed that during the alluvial time, huge quantities of fresh water were kept in the porous beds and in wadi alluvium. Aquifers along the main valleys are recharged every now and then with rainwater. Percolation occurs when rainwater runs along the slopes to the Red Sea. Wadi Bedaa and Wadi Gheweiba have the largest watershed area and rainwater flows.

3.13 The proposed site lies within the administrative boundary of the Suez Governorate. The Governorate of Suez has prepared an Urgent Development Plan (UDP) for land use management and planning (1993) and its update (2007), in which it sets out its policy to control development in the Suez region up to 2000.

4. ANALYSIS OF ALTERNATIVES

4.1 Current Situation (“No Action” Option)

4.1.1 The no action alternative to the proposed El-Ain Al-Sokhna 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 and economic 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

4.2.1 On the basis of security of supply, response to demand and economic advantages, the EEHC has specified that the Al-Sokhna project should be a two gas/oil-fired supercritical steam cycle units of 650 MWe nominal generating capacity each. Other possible options include “importing electricity”, “rehabilitation of existing power plants”, “transmission and distribution investment” and “IPPs”.

4.3 Other alternatives considered:

- **Importing electricity:** Egypt is interconnected to Libya and Jordan and is exporting electricity to both countries. Interconnection to Libya has a capacity of 300 MWe, and that of Jordan has a capacity of 350 MWe, which was increased to 450 MWe in 2006. Libya and Jordan are currently paying 4 US¢/kWh for the Egyptian power supply. As they are net importers, there is currently not much scope for electricity imports to Egypt from the interconnected networks. In addition, the cost of electricity in both countries is much higher than that of Egypt, making it an uncompetitive alternative. There is currently no south border connection to Sudan, although there are ongoing activities in the context of the Nile Basin Initiative (NBI) whereby Egypt could potentially import hydroelectric power starting approximately in 2012, if the price is competitive. However, considering the abundance of natural gas and thus the low cost electricity provision in Egypt, it will be difficult for imported electricity to be competitive.

- **Renewable energy:** Current world market cost of wind based electricity is 5.9-7.38 US¢/kWh, whilst is 2.1 US¢/kWh with current grant financing for wind projects, which is higher than the cost from natural gas thermal plants. Therefore, renewable energy is not competitive unless further subsidies are provided.

- **Rehabilitation of existing power plants:** EEHC has concluded that the rehabilitation option is cost effective in seven of its existing power plants, and these sites have already been or will be rehabilitated. However, these efforts are not enough to cope with the growing demand for electricity.

- **Transmission and distribution investments:** EEHC has developed a transmission and distribution (T&D) development plan and the T&D system is optimized for the current load requirements and generation capacity. To meet the demand growth for the fast track period and medium term expansion, a T&D investment plan has been developed. New electricity generation capacity is required in the network; therefore, strengthening of T&D capacity alone will not replace the need for the generation capacity. Furthermore, T&D losses are at a relatively low level, around 10% on average, and reducing the losses further would not free up the amount of electricity supply required.

- **BOOTs/IPPs:** Three BOOT projects (650 MWe each) have been built in Egypt in late 1990's and early 2000's. The government is encouraging private sector participation in order to attract private investment. However, given the worldwide reduction in investor’s interest in the power sector, private financing for power generation in the near term is still unlikely.
4.4 Consistent with the generation expansion plan, the EEHC has stipulated that the El-Ain Al-Sokhna should be gas/oil-fired supercritical steam units of a net 2x650 MWe generating capacity.

5. **Power Plant Design**

5.1 There are a wide variety of potential designs for the proposed power plant. On the basis of 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:

- the stack has been designed to maximize buoyancy and dispersion of emissions and its height (150 m) exceeds good engineering practice;
- the steam generators will be equipped with low NOx burners, minimizing emissions of NOx which is the key pollutant associated with combustion of natural gas;
- direct cooling water will be used to maximize generating efficiency, minimizing visual impact, noise emissions and the potential for visible vapor plumes or ground fogging. Alternatives such as cooling towers and air cooled condensers (open, whilst using less water, result in lower generating efficiencies and also result in impacts such as vapor plumes, visual and noise impacts). The availability of water is not considered an issue for this project given the use of water from the Suez Gulf;
- cooling water will be supplied from a sustainable water supply, namely the Suez Gulf, and the intake and outfall structures can be constructed and operated without significant impacts.

5.2 **Alternative Sites**

5.2.1 The EEHC designated the proposed El-Ain Al-Sokhna site for power plant construction from a group of three alternative sites, namely: Safaga, Sharm el-Sheikh and El-Ain Al-Sokhna. The site area was allocated to the Egyptian Electricity Authority (EEA) (today, EEHC) by the Government of Egypt (Presidential Decree no. 299 of the year 1999, issued on 21 September 1999) and EEHC has given rights of use of the site to EDEPC. In selecting the required site, consideration was given to the following criteria:

5.2.2 **Economic Factors:** capital costs; operation and maintenance costs; requirement for natural gas; requirement for cooling water; demand loads for electricity; and requirements for electricity transmission lines and sub-stations.

5.2.3 **Non-economic Factors:** potential environmental impacts; and site development.

Potential environmental impacts have been examined for all sites. Screening level assessment during feasibility study indicated that the level of environmental impact will be relatively constant for all three sites.

5.2.4 Following negotiations with the concerned authorities, the planned location of El-Ain Al-Sokhna 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.

5.2.5 In addition, the power plant will be constructed and operated on a land originally dedicated for power generation activity, thus it will not include any land take. Also, the power plant site will bring socio-economic benefits to the wider Suez Region, through employment opportunities, supply contracts and the effects of project expenditure within the local economy.

6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Introduction

6.1.1 A thorough assessment of the impacts of the proposed plant has been carried out based on information provided by EEHC, EDEPC and their sub-consultants. A combination of quantitative and qualitative assessment techniques, ranging from computer and/or physical 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 Government of the Arab Republic of Egypt, AfDB and the World Bank, whichever is the more stringent.

6.1.2 The following items are examined in the corresponding sub-sections of the ESIA Study Report:
- 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.

6.1.3 Table 1 presents environmental, health and safety issues relating to construction and operation of El-Ain Al-Sokhna power project.

6.1.4 For each of these items, a concise description and evaluation of the significance of potential impacts of the project is presented in the ESIA study report. Where modeling has been undertaken, a description of the model as well as corresponding maps summarizing the results of the assessment are provided in the main report.

6.1.5 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.

6.1.6 Table 2 provides with 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 conclusions of the assessment are that (with suitable mitigation
measures described in *Tables 4, 5, 6 and 7 in the main report*) the project is in compliance with the environmental requirements of both the Government of Egypt and the World Bank with respect to stack emissions of the new power plant, ambient air quality, discharge quality and noise. The following discussion highlights some of the key considerations and results of the assessment.

6.2 **Air Quality**

*Construction Dust*

6.2.1 Construction activities will result in locally high levels of dust. This may affect nearest receptors or sensitive environments which lie in the immediate boundaries of the power plant. Existing concentrations of airborne dust are already high in this industrial 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 and Background Air Quality*

6.2.2 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 heavy fuel oil will result in emissions of particulate matter and SO2 along with trace amounts of other pollutants. Emissions from the plant will meet Egyptian and World Bank Guidelines.

6.2.3 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.

6.2.4 The assessment indicates that the highest concentrations for each of the averaging periods under consideration (hourly, daily, annual) are found to the north-north-west, north-west, and south-south-west of the site, respectively. This is because the winds are exposed to the atmospheric prevailing conditions, although they are overwhelmingly from the north and northwest for most of the time. Maximum annual concentration of NOx emissions in the ambient atmosphere due to operation of both of the Al-Sokhna power plant and the Suez Gulf BOOT power plant will not exceed 44.8 µg/m³ (highest annual maximum is 44.8 µg/m³ at the location [-141.5m, -658.8m]) and the maximum daily reaches 130 µg/m³ at a distance of 271.2 m north-west the origin point intermediating the stacks. Also, Maximum “One-hour Average” concentration of NOx emissions in the ambient atmosphere reaches 322.1µg/m³ at the location [-141.5m, 461.2m] (see Figure 5). An air quality monitoring system composed of 2 or 3 monitoring stations will be utilized. The monitoring station equipped with meteorological monitoring system will be located near to, or within, the power plant site, the other one or two stations will be located one down wind within the designated area of maximum predicted pollutant concentration and the other (if any) upwind.

6.3 **Aquatic Environment**

6.3.1 Cooling water and process water for power plant operation will be drawn from the Suez Gulf via an intake structure. The quantity of the cooling water that will be returned back to the Suez Gulf is about 46 m³/sec. Process water that will be abstracted from the Suez Gulf is about 0.07% of this quantity. Potable water will be supplied to the power plant via Suez potable water system. Cooling water will be returned to the Suez Gulf via a discharge structure whilst waste process water will be disposed of after treatment via discharge system, which includes two pathways: plantation irrigation network and Circulating Water Discharge
System (CWDS). Sanitary waste water will be disposed of -after treatment- via plantation irrigation network. No ground water or other surface water will be used during power plant construction and operation. The Contractors will be responsible for relevant water/toilet facilities during construction and the need to provide appropriate services will be specified in their contracts. The key potential impacts of the power plant on the aquatic environment will therefore be impacts to the aquatic flora and fauna during power plant construction and operation.

6.3.2 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 very limited fishing activity occurs in the vicinity of the project.

6.3.3 During construction of the power plant dredging and construction of the intake and discharge structures could lead to potential impacts on bathymetry, water quality and removal of, or disturbance to, aquatic habitats, flora and fauna. Given that the area of impact will be highly localized, 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.

6.3.4 Power plant operation will result in a heated plume of waste cooling water being discharged into the Suez Gulf. Process water will be disposed of to the discharge system (identified above). All discharges of process water will be treated prior to discharge to ensure that the Egyptian, AfDB and World Bank waste water quality guidelines are met. Treatment includes neutralization, oil separation, flocculation and filtration.

6.3.5 The returned cooling water will be released at a temperature of no more than 9.6°C at the point of discharge. Thermal modeling of the discharge plume shows that, at full load operation, the point at which the plume has decreased in temperature to 5°C above ambient, lies at approximately 100 m from the point of discharge. The mixing zone has been defined to be 150 m from the point of discharge.

6.3.6 The temperature of the returned cooling water at the point of discharge conforms to the Egyptian Standard, and the discharge as modeled satisfies the World Bank standard of a maximum increase of 3°C above ambient at the edge of the mixing zone (100 m from the point of discharge). In addition, the area affected by the highest temperature increases and therefore where aquatic ecology is likely to be most affected, is localized and the aquatic habitats in this area have been found to already be relatively impoverished. Outside this area, more marginal increases in the Suez Gulf water temperature are likely to create new or improved habitats for flora and fauna.

6.3.7 Physical bathymetry, Al-Sokhna Shoreline access, fishing and navigation are not predicted to be significantly affected by the presence of the intake and discharge structures.

6.4 Noise Impacts

6.4.1 The construction of the Al-Sokhna power plant is expected to generate a maximum noise level of 59 dB(A) during the day at the fence of the power plant and 57 dB(A) at night.
These worst-case construction noise levels are both within Egyptian and World Bank\(^{(1)}\) guidelines, and for most of the construction periods, the noise levels will be lower than these values. There are no residential receptors within 1000 m of the plant.

6.4.2 Construction traffic on local roads will also generate additional noise, however noise levels on local roads predicted for peak construction activity (during 2010-2012) 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.

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

6.5 Flora and Fauna

6.5.1 No areas protected for their conservation value are located on, or in the vicinity of, the project area. The proposed site itself and the surrounding land is poorly vegetated with much of the area having been dominated by sands and sabkha. Given that the 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.

6.6 Land Use, Landscape and Visual Impacts

6.6.1 The land use at the project site is industrial land. There is no loss of this land to the power plant development, as this land is dedicated for a power generation activity since 1999, therefore there is not significant land use impacts due to the Al-Sokhna power project.

6.6.2 The surrounding land use is generally industrial. As the land is highly industrialized with almost no vegetation, all existing views will be insignificantly influenced by the power plant and given the surrounding industrial context, particularly the existing Suez Gulf power plant and industrial facilities of Al-Sokhna port, the visual intrusion of the power plant will be minimal.

6.6.3 Visual impacts of the power plant from the residential (tourist) areas to the north and south are also not expected to be significant given the long distance of their locations from the site and orientation of the facilities. The potential landscape and visual impacts of the project are therefore expected to be minor and not significant.

6.7 Soils, Geology and Hydrology

6.7.1 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, preliminary land surface investigations confirmed the site as being uncontaminated. However, soil sample testing is recommended for further geotechnical investigation.

6.8 Traffic

6.8.1 The assessment of traffic and transport covers the changes in traffic conditions in terms of delay and congestion during construction and operation.
6.8.2 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.

6.9 Socio-economics and Socio-cultural effects

6.9.1 It is anticipated that the power plant will provide a net positive socio-economic impact through the provision affordable electricity to the larger population to meet the electricity needs of households, manufacturers, agribusinesses, touristic establishments, schools, hospitals, and others, thereby contributing to the enhancement of the quality of life and living standards of the population at large. This will be particularly valuable for the Ain Sokhna region itself, with its expanding tourism and resort areas, the developing industrial zone as it seeks to attract additional investors, and the Sokhna port which is being developed to become a major commercial harbour facility.

6.9.2 The power plant will be located in Suez governorate, considered one of the most developed governorates in Egypt, ranking second by government, with real GDP per capita of PPP$ 5790.9 in 2006; a combined literacy rate of 81.4%; life expectancy of 71.9 years (2006); and access to piped water and sanitation for 99.3% and 89.2% of households respectively and access to electricity to 99.3% of households.

6.9.3 The labor force in Suez governorate, approximately 30.6% of the population, is primarily concentrated in the services sector (73.5%), followed by the industrial sector (25%) with very few working in agriculture 1.4%. Almost a quarter of the labor force are employed by the government and the public sector. Therefore it is expected that staff for Ain Sokhna power plant will be locally recruited, primarily from the Suez governorate.

6.9.4 The Ain Sokhna power plant will provide direct and indirect employment opportunities, during the construction phase as well as the operation phase. During construction, temporary employment will be availed to consultants, contractors, engineers, laborers, handymen and others skilled workers. Indirect jobs, mostly from the informal sector, will also be created as a result of the needs of those on the plant, such as transportation, food, etc. During operation, it is anticipated that EDEPC staff will be relocated to the plant, in addition to new hires. It is expected that employment opportunities will also be availed to women, in line with EEHC’s equal opportunity measures implemented. The use of local labor from the neighbouring Suez area (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.

6.9.5 In the Suez governorate working women constitute 19.33% of the labor force, a percentage slightly below the country-wide percentage 22.97%. However a substantially important portion of women, 73.8%, hold professional and technical jobs, by far exceeding the country-wide percentage of 33.5%. As such, it is anticipated that the Ain Sokhna power plant provide employment opportunities to women from the Suez governorate in administration, management and other similar positions. This would be consistent with the EEHC equal opportunity measures in employment are implemented.

6.9.6 There are few indigenous people in the area, and the project is not anticipated to negatively affect them. On the contrary, they may be well positioned to start up micro-

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initiatives to meet the anticipated daily catering demands of the construction workers, such as provision of food, coffee and tea, tents for shelters, and so forth.

6.9.7 Transmission lines will need to be extended to connect with existing transmission lines from neighboring power plants. Some land appropriation and/or resettlement of minor population may be associated with this extension. Mitigation mechanisms should be put in place to address these potential challenges. As the Bank is not financing the transmission lines, they are considered to be associated facilities. The Bank will ensure that the ESIA and RAP are carried out for the transmission lines according to the Bank standards.

6.9.8 In addition to the area specifically designated for the plant, there are large empty spaces next to the power plant site. All activities related to the construction of the new plant will therefore take place within the area belonging to the EDEPC, i.e. there will be no off-site activities or associated land acquisition during construction.

6.9.9 As indicated in the main document, scientific research has shown that certain species of the fish grow considerably faster in warmer water. Therefore, it is anticipated that the rejected water from the plant, slightly warmer than the sea water, may be beneficial to the aquatic life.

6.9.10 The effects on the fisheries of warmer water returned to the Suez Gulf from similar power plants along the sea coasts are well known. Experience from about 10 other power plants located on the shorelines of both of the Mediterranean and Red seas that have operated in Egypt for a number of years indicates that the overall impacts on fisheries of slightly warmer water actually are positive, and consultations with the fishermen indicate that the catches in these areas have increased rather than decreased. Since this is part-time, small-scale fisheries no statistics are available, but after many years the warmer water around the various points of discharge, is clearly perceived by the fishermen to have positive effects.

6.9.11 In line with this recognition, discussions have already been initiated between the EEHC and the General Authority for Fishery Development with a view to jointly take advantage of this, e.g. establishing a fry collection station near the edge of the mixing zone.

6.10 Archaeology, Historic and Cultural Heritage

6.10.1 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.

6.10.2 EDEPC 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 Supreme Council for Antiquities.

6.11 Natural Disaster Risks

6.11.1 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.

6.11.2 Furthermore the power plant will be designed to conform to the Uniform Building Code Zone 2 seismic criteria, according to US regulations for earthquake. These design criteria are therefore considered sufficient to withstand the level of seismic activity experienced in the area.
6.11.3 The risks of flooding during power plant construction and operation were also examined. However, site drainage will be constructed to minimize any risks of contaminated water reaching the surroundings and to properly drain the site, no significant flood risk impacts are anticipated.

6.12 Major Accident Hazards

6.12.1 Given the wider land surrounding the Al-Sokhna 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.

6.13 Solid and Hazardous Waste Management

6.13.1 The management of wastes during construction and operation of the power plant will include mitigation measures to collect and store waste on-site, record all consignments of solid 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 according to the rules set by Law 4/1994 and the Governorate of Suez.

6.13.2 Private sector contractor will be assigned via general bidding process and the contract will include detailed environmental procedures, according to Law 4/1994 and Governorate of Suez regulations, for disposing debris materials. The contract covers all fees required.

6.13.3 During construction and operation, all wastes including debris waste, general waste, packaging waste, commercial wastes, raw-water pre-treatment sludge, tank sludge and interceptor sludge will be disposed of by licensed waste contractors according to the rules set by Law 4/1994 and the Governorate of Suez.

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

6.14 Occupational Health and Safety

6.14.1 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.

6.15 Associated Infrastructure

6.15.1 Connections to existing gas and electrical facilities will be the responsibility of "City Gas", EETC and the EDEPC respectively. In regard to the gas connection with the gas reducing station of the site and oil pipeline to the oil tanks on the site no environmental or social impacts are anticipated.

6.15.2 EEHC has already submitted a request to City Gas for their needs for the new plant which will necessitate a bigger diameter pipeline, or an additional pipeline, which will follow the same existing pipeline.

6.15.3 The electricity generated by the proposed power plant will be exported via the 500 and 220 kV electricity transmission system. The power plant will be connected to the 500 kV switchyard via step-up transformers.
6.15.4 The electricity generated by the proposed El-Ain Al-Sokhna power plant will be exported by the EETC electricity network, via two transmission systems, double circuit 220 kV and 500 kV lines. The first will be connected to the unified network upward direction towards Suez city with approximately 40 km length, while the second will be extended to the west direction, approximately 90 km until it meets the 500 kV transmission line connecting El-Kureimat and El-Tebbin 500 kV substations. Construction and operation of this infrastructure will be the responsibility of the EETC. No routes have as yet been defined.

6.15.5 Although land take or resettlement will most probably be not associated to the power interconnecting lines (because the areas in question are largely uninhabited public land), a Resettlement Policy Framework (RPF) is prepared separately as part of this ESIA in order to handle any potential future changes and to satisfy the requirement of AfDB and World Bank.

6.15.6 EETC and EDEPC will submit Screening Form B to the EEAA concerning this interconnection. No significant impacts are anticipated.

6.16 Global Impacts

6.16.1 Natural gas has been selected as the main fuel for the power plant. Compared to other fossil fuel generating technologies, gas fired steam generators have a relatively low emissions of carbon dioxide (CO₂), moderate emission levels of nitrogen oxides (NOₓ) and the lowest emission levels (almost traces) of sulfur dioxide (SO₂) and particulates.

6.16.2 The greenhouse effect is caused by the build-up of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and chlorofluorocarbons (CFCs) in the atmosphere. Water vapor and ozone (O₃) can also act as greenhouse gases. For power generation processes, CO₂ is the key emission of concern, as methane and CFCs are not emitted by power plants and none of the other greenhouse gases are emitted in sufficient quantities from power generation to be considered important in terms of the greenhouse effect.

6.16.3 The efficiency of the proposed steam power plant is 45% with natural gas, with associated CO₂ emissions of 0.55kg/kWh. This compares with the efficiency of a typical CCGT power plant of 53-54%.

6.16.4 Emissions of carbon dioxide are estimated to be up to 3,500 kilotonnes per year (expressed as CO₂). This assumes that the plant operates for the whole year and consumes around 120 tonnes of gas per hour. The emissions of CO₂ from fuel burning in Egypt amounted to around 220,620 kilotonnes in 2004/2005 (Ref: EEAA: Second National Communication, not published yet). Fuel combustion will account for most of Egypt’s CO₂ emissions from all sources. Hence, the power plant as proposed will emit up to around 1.59% of the total Egyptian CO₂ emissions in 2004/2005. This is an upper estimate as the plant will not operate 100% of the year or at full load 100% of the time.

6.16.5 Natural gas, which is the main fuel to be used in the Al-Sokhna plant, contains very low concentrations of sulfur or particulate matter, therefore the potential for emissions of SO₂ and particulates from the electricity generating process is also very low. Fuel oil however, leads to greater emissions of SO₂ and particulates, due to the relatively high sulfur content of these fuels and the generation of ash during their combustion.

6.16.6 Natural gas fuel also has the significant benefit of being able to be delivered by an existing pipeline (even though it may be enlarged in capacity).
7. THE ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Enhancement and Mitigation Plan

7.1.1 The Environmental and Social Management Plant (ESMP) includes mitigation measures, design of monitoring programs where appropriate, and specification of management measures (including institutional responsibility and training requirements).

7.1.2 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 the ESIA report for both the construction and operational phases of the power plant. The mitigation measures discussed in this section are summarized in the following three Tables, 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.

7.1.3 All the mitigation, monitoring and management measures proposed below and in Section 8 of the ESIA report (the Environmental and Social Management Plan (ESMP)), will be adopted by the Project Company 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.

7.1.4 Mitigation measures introduced into the design and construction phase of the power plant will be carried forward into the operational phase by the EDEPC Company. Many of the mitigation measures, as described in Sections 4 and 6 of the ESIA 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 burners, noise silencers and water discharge controls are for example integral to the design of the power plant.

7.1.5 The key features of the ESMP relate to air quality, aquatic discharge and implementation of good site management practice. The ESMP is summarized in Tables 4, 5, 6 and 7 of the main report which relate to construction and operational phases respectively. Table 3 summarizes the cost of ESMP, which will be required to be included in the project financial plan.

7.1.6 Table 4 shows that the total implementation cost of the Environmental and Social Management Plan is about US$ 1.848 million, which amounts to about 0.083% of the total project cost.

7.2 MONITORING PROGRAM

Stack Emissions

7.2.1 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; Carbon Monoxide; and Total Suspended Particles and PM10.

7.2.2 The automatic monitoring system used will be linked in the controlling room to an alarm system to warn when emission limits for each pollutant are being approached.
7.2.3 Concentrations will be recorded as hourly rolling averages and reports on stack emissions monitoring will compare recorded emissions against predicted levels and Egyptian and WB and AfDB guidelines. Reports will be submitted to the EEAA, the WB, AfDB and any other concerned authority on an annual basis (or as required).

**Ambient Air Quality**

7.2.4 The use of a continuous NOx, SO2, CO and TSP analyzer allows for baseline air quality monitoring on a continuous basis. The provision of two continuous monitors (or three: one at the site, one upwind and the third downwind) will provide the basis for “validating” the predictions made in the ESIA. The monitors will also include a weather station providing data on air temperature, wind speed, wind direction and mixing heights on a continuous basis. These monitors shall, also, be connected electronically, if possible, to the EEAA ambient monitoring system.

7.2.5 The construction and operational monitoring of air quality around the Al-Sokhna power project will include the parameters summarized in Table 9 in the main report.

**Aquatic Environment**

7.2.6 Monitoring of impacts of the power plant on the aquatic environment will include monitoring of the quality of the discharge water, Suez Gulf shoreline 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 May-June 2008. The survey will include the area affected by the thermal plume (i.e. 100-150 m from the discharge point).

7.2.7 Monitoring data will be analyzed and reviewed at regular intervals and compared with Egyptian, AfDB and World Bank guidelines. 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, the WB and AfDB or any other concerned authority as required. As a result, the project company, in discussion with the EEAA, EEHC, the WB and the AfDB 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.

**Waste Monitoring**

7.2.8 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.

8. **PUBLIC CONSULTATION AND DISCLOSURE**

8.1 In order to ensure that the views and interests of all project stakeholders are taken into accounts, public consultation 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 undertaken as part of the Environmental Impact Assessment process.

8.2 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.
8.3 The adopted methodology for the public consultation, which conforms with the WB & AfDB requirements, comprises four elements, namely:

**Phase I**
- discussions with local stakeholders and interested parties during preparation of the environmental documents for local permitting requirements;
- discussions with local stakeholders during the scoping meeting organized in the Suez Governorate, and preparation of this ESIA-Report;

**Phase II**
- the organization of a Public Meeting in the Suez Governorate, and
- on-going consultation through an “open-door” policy during construction and operation of the power plant.

8.4 As far as public disclosure is concerned, major initiatives to inform the public and interested parties about the Al-Sokhna Power project include the following:
- press advertisement describing the project and inviting interested parties to attend the public meeting and review the Draft Final ESIA Report;
- distribution of an invitation and Arabic copy of the Non Technical Summary describing the context of the power plant, the technology employed, the impact on the environment, the mitigation measures and the ESMP; and
- disclosure of the Draft Final ESIA Report locally and the Executive Summary, including ESMP via the AfDB Infoshop.

8.5 The full methodology for consultation and disclosure is presented in the project’s Public Consultation and Disclosure Activities (PCDA), given in Annex D of the main report. The purpose of the activities is to establish the process by which EDEPC/SPP will consult and involve stakeholders in the planning, development, construction and operation of the power plant.

8.6 During the preparation of an ESIA-Report for local permitting requirements, ECG, EEHC and EDEPC undertook consultations 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), East Delta Electricity Production Company (EDEPC), Egyptian Environmental Affairs Agency (EEAA), the Suez Governorate and the District Council of Ettaqa Zone, Egyptian General Authority for Shore Protection, Hydraulics Research Institute and local population leaders.

8.7 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.

8.8 A scoping session for this ESIA undertaken by ECG in collaboration with the EEHC and EDEPC, took place on Wednesday, 2 June 2008 during which a wide selection of personnel from different orientations contributed actively to its activities.

8.9 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 ECG/EEHC/EDEPC consultation activities and to identify their immediate concerns.
8.10 In addition to the scoping meeting, several mini-meetings were held with some particular affected stakeholders for taking their viewpoints into consideration.

8.11 Mini-meetings were held with fishermen on the Suez area, Regional Branch of the Egyptian Environmental Affairs Agency (EEAA), Suez Governorate officials, Local People's Council's leaders, General Authority for Fish Resources Development and some active NGOs in Suez zone, namely the Environment Protection Society, El-Kheir Society, Specific Federation of Civil Societies in Suez and Association of Tourism Investors in Suez.

8.12 The key environmental issues raised during this consultation process are summarized in Table 3 and these issues were subsequently taken into account in the preparation of ESIA documentation both for local permitting requirements and this ESIA report.

8.13 The main results of Phase 1 consultation was 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.

8.14 Phase II of the public consultation and disclosure process included the disclosure of information about the project (advertisement, invitation including a copy of the Non-Technical Summary, in Arabic, and public access to the Draft Final ESIA Report) and organization of a public meeting.

8.15 A public meeting will be held in the Suez Governorate on Wednesday, 6th August 2008. The aim of the meeting is to present and explain the results of the Draft Final ESIA 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 ESIA Report and corresponding ESMP.

8.16 The key environmental issues that will be raised during this public consultation meeting will be summarized also in Table 3.

**Ongoing Consultation and Disclosure**

8.17 Sokhna Power Plant's (SPP’s) 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 ESMP. 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.

8.18 The process and results of the public consultation activities held to date are documented in the EISA, Chapter 9 and Annexes A, B, C and D.

8.19 All issues have been taken into account and addressed in the ESIA through assessment and the inclusion of mitigation, management and monitoring requirements which are detailed within the ESMP.
9. RESPONSIBILITIES AND INSTITUTIONAL ARRANGEMENTS

9.1 Environmental Management Organization

During Design and Construction

9.1.1 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.

9.1.2 During construction, EDEPC/SPP will ensure that all contracts with Contractors and sub-contractors stipulate all construction management measures (as given in this ESMP), 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 ESMP and all environmental permits.

During Power Plant Operation

9.1.3 During operation, direct responsibility for environmental compliance and the implementation of the mitigation, management and monitoring measures will continue to be with the Assistant Plant Manager. This position will report directly to the Chairman/General Manager of EDEPC/SPP.

9.1.4 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.

9.1.5 In his 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.

9.1.6 Chemicals used during plant operation are process-related. Hazardous chemicals to be used include chlorine (5500 kg/hr), sulfuric acid (7000 kg/day infrequency once per day). Handling, storage and application of these chemicals will be used under strict regulations of handling hazardous materials stipulated by Law 4/1994.

9.1.7 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, EDEPC/SPP, through the Assistant Plant Manager, will immediately inform the EEAA and disclose the procedures being taken to rectify non-conformity.

9.1.8 Results of environmental monitoring as described above, shall be recorded and submitted to the EEAA, EEHC and to any other party (i.e. WB, AfDB etc.) as required. The EEAA, WB and AfDB are entitled to audit the project company in order to ensure conformity with environmental standards and requirements.
9.1.9 In addition, the project company 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 ensuring that these records are maintained up to date and are available on site.

9.2 Environmental Training

9.2.1 The Project Company 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.

9.2.2 Training will include: induction training on appointment; specialist training (as required for their prescribed job role); and refresher training as required.

9.2.3 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.

9.2.4 In addition to this environmental training for all staff employed at the plant, special environmental training will be given to the staff employed for the EMU. They will receive training in the following: day-to-day monitoring activities; monitoring the stack emissions; collection and analysis of air quality data; monitoring the water effluents; collection and analysis of water quality information; use of monitoring equipment, operation and maintenance; industrial hygiene; occupational health and safety; and emergency and contingency procedures.

9.3 Occupational Health and Safety

9.3.1 EDEPC/SPP 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, AfDB and World Bank guidelines. 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.

9.3.2 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.

9.3.3 The training will include induction courses when staff is 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.

9.3.4 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.

9.3.5 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.
9.4 Emergency Procedures and Accident Response

9.4.1 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

9.4.2 As part of the preparation of emergency procedures and the plans for accident response arrangements, the project company 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.

9.4.3 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, earthquakes); 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

9.4.4 As Good practice and part of the ESMP, EDEPC/SPP will prepare an Oil Spill Contingency Plan. Heavy fuel oil will be delivered to the site by road and stored in: two 45,000 m³ tanks for the mazout oil (oil no. 6).

9.4.5 Light fuel oil will be delivered to the site by road and stored in: one 2,000 m³ tank for the light fuel oil (oil no. 2 / sollar). These tanks are surrounded contained within separate retention area which is designed to contain 110% 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. Table 4 in the main report presents institutional arrangements for El-Ain Al-Sokhna power project.

10. IMPLEMENTATION SCHEDULE AND REPORTING

10.1 Environmental and social management and monitoring activities will be implemented (according to the ESMP), following the same project schedule, as all activities are mainstreamed in the project design. Achievements/problems will be reported in the project quarterly progress reports and should be timely addressed by the project management and the Bank.

11. CONCLUSIONS

11.1 The Project Company proposes to develop a new thermal power plant of total capacity 2x650 MWe at the area reserved for the Al-Sokhna Power Plant on land owned by
the EDEPC Company. The site is an Industrial Setting and does not contain significant residential environmental sensitivity of importance.

11.2 The key environmental issues associated with the power plant are as follows:
- Emission of oxides of nitrogen to the air;
- Generation and disposal of liquid effluents including cooling water; and
- Emission of noise.

11.3 The Environmental and Social Impact Assessment has evaluated the potential environmental impacts during construction and operation of the proposed power plant. In particular, the potential impacts of the flue gas emissions to the air, generation and disposal of liquid effluents including cooling water; and the emissions of noise have been assessed using sophisticated modeling techniques, which include consideration of the ambient background environment and the characteristics of the releases or emissions, and predicts the potential impacts which may occur.

11.4 The assessment indicates that no significant environmental impacts will occur as a result of the construction or operation of the power plant and, when taken together, the overall environmental and social impact will not be significant.
Figure 1

Location of Proposed El-Ain Al-Sokhna Power Plant
Figure 2

Location of the Proposed Site within the Context of the Suez Governorate
Figure 3

General View for the Proposed Site Land
Figure 4

Layout of the Proposed Power Plant
Figure 5

El-Ain Al-Sokhna Air Quality Monitoring Locations
### Table 1

*Environmental, Health and Safety Issues Relating to Construction and Operation of El-Ain Al-Sokhna Power Project*

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Potential Impacts During Construction</th>
<th>Potential Impacts During Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Quality</strong></td>
<td>Dust from construction activities.  Traffic-related air quality impacts.</td>
<td>Impacts of emissions from stacks on ambient air quality.  Traffic-related air quality impacts.  Global warming potential.</td>
</tr>
<tr>
<td><strong>Noise and Vibration</strong></td>
<td>Noise from construction activities.</td>
<td>Noise from power plant operations on surrounding land uses.</td>
</tr>
<tr>
<td><strong>Soils, Geology and Hydrogeology</strong></td>
<td>Effects on soils and geological features.  Soil contamination.  Effects on groundwater.</td>
<td>Soil contamination.  Effect on groundwater.</td>
</tr>
<tr>
<td><strong>Flora and Fauna</strong></td>
<td>Loss of habitat or species due to landtake.  Disturbance or damage to adjacent habitat of species.</td>
<td>Disturbance or damage to adjacent habitat.  Effects of structures on bird migration routes.</td>
</tr>
<tr>
<td><strong>Major Accident Hazards</strong></td>
<td>Risk to third-party hazardous industry.</td>
<td>Risk to third-party hazardous industry.  Risk to power plant of third-party hazardous industry.</td>
</tr>
<tr>
<td><strong>Natural Disaster Risk</strong></td>
<td>Seismic risk.  Flood risk.</td>
<td>Seismic risk.  Flood risk.</td>
</tr>
<tr>
<td><strong>Solid Waste Management</strong></td>
<td>Contamination of soils and water.  Hazards to workers health.  Accident risks.</td>
<td>Contamination of soils and water.  Hazards to workers health.  Accident risks.</td>
</tr>
</tbody>
</table>
Table 2

Environmental Impacts and Environmental Guidelines

<table>
<thead>
<tr>
<th>Impact Area</th>
<th>Predicted Max. Concentration from Al-Sokhna Power Plant</th>
<th>Existing Ambient Air Quality (Effect of All Surrounding Industries)</th>
<th>Cumulative Air Quality Impact of both the Al-Sokhna &amp; Suez Gulf Power Plants and Surrounding Industries</th>
<th>Egyptian Standard</th>
<th>World Bank Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx ***</td>
<td>( \leq 300 \text{ mg m}^{-3} )</td>
<td>360 \text{ mg m}^{-3}</td>
<td>320 \text{ mg m}^{-3}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO(_2)</td>
<td>( \leq 300 \text{ mg m}^{-3} )</td>
<td>2,500 \text{ mg m}^{-3}</td>
<td>2,000 \text{ mg m}^{-3}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSP – General (all sizes)</td>
<td>( \leq 50 \text{ mg m}^{-3} )</td>
<td>260 \text{ mg m}^{-3}</td>
<td>50 \text{ mg m}^{-3}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stack emissions (100% load) when firing Natural Gas:

| NOx \*\*\* | \( \leq 300 \text{ mg m}^{-3} \) | 360 \text{ mg m}^{-3} | 320 \text{ mg m}^{-3} |
| SO\(_2\)     | \( \leq 2,000 \text{ mg m}^{-3} \) | 2,500 \text{ mg m}^{-3} | 2,000 \text{ mg m}^{-3} |
| TSP – General (all sizes) | \( \leq 50 \text{ mg m}^{-3} \) | 260 \text{ mg m}^{-3} | 50 \text{ mg m}^{-3} |

Stack emissions (100% load) when firing Heavy Fuel Oil (<2% of total annual operating time):

| NOx – oil firing | \( \leq 300 \text{ mg m}^{-3} \) | 360 \text{ mg m}^{-3} | 320 \text{ mg m}^{-3} |
| SO\(_2\) – oil firing | \( \leq 2,000 \text{ mg m}^{-3} \) | 2,500 \text{ mg m}^{-3} | 2,000 \text{ mg m}^{-3} |
| TSP – General (all sizes) | \( \leq 50 \text{ mg m}^{-3} \) | 260 \text{ mg m}^{-3} | 50 \text{ mg m}^{-3} |

Ground Level Concentration (when firing Natural Gas):

| NOx – 1 hour | 266.5 \text{ µg m}^{-3} | 12.69 \text{ µg m}^{-3} | 334.79 \text{ µg m}^{-3} | 400 \text{ µg m}^{-3} |
| NOx – 24 hours | 7.44 \text{ µg m}^{-3} | 137.48 \text{ µg m}^{-3} | 190 \text{ µg m}^{-3} | 150 \text{ µg m}^{-3} |
| NOx – 1 year | 38.8 \text{ µg m}^{-3} | 1.02 \text{ µg m}^{-3} | 45.82 \text{ µg m}^{-3} | 100 \text{ µg m}^{-3} |
| SO\(_2\) – 1 hour | 12.42 \text{ µg m}^{-3} | 12.42 \text{ µg m}^{-3} | 350 \text{ µg m}^{-3} | |
| SO\(_2\) – 24 hours | 3.73 \text{ µg m}^{-3} | 3.73 \text{ µg m}^{-3} | 150 \text{ µg m}^{-3} | 150 \text{ µg m}^{-3} |
| SO\(_2\) – 1 year | 0.99 \text{ µg m}^{-3} | 0.99 \text{ µg m}^{-3} | 60 \text{ µg m}^{-3} | 80 \text{ µg m}^{-3} |
| PM\(_{10}\) – 24 hours | 462 \text{ µg m}^{-3} | 462 \text{ µg m}^{-3} | 150 \text{ µg m}^{-3} | 150 \text{ µg m}^{-3} |
| PM\(_{10}\) – 1 year | 62.64 \text{ µg m}^{-3} | 62.64 \text{ µg m}^{-3} | 70 \text{ µg m}^{-3} | 50 \text{ µg m}^{-3} |

Liquid Effluent:

| pH | 6-9 | 6-9 | 6-9 |
| BOD | <30 mg/l | < 60 mg/l | - |
| Chromium | - | 1 mg/l | 0.5 mg/l |
| Copper | <0.5 mg/l | 1.5 mg/l | 0.5 mg/l |
| Iron | <1 mg/l | 1.5 mg/l | 1.0 mg/l |
| Zinc | <1 mg/l | 3 mg/l | 1.0 mg/l |
| Oil and grease | <5 mg/l | 15 mg/l | 10 mg/l |
| Total Suspended Solids (TSS) | <30 mg/l | 60 mg/l | 50 mg/l |
| Residual Chlorine (total) | <0.2 mg/l | - | 0.2 mg/l |
| Temperature Increase (°C) | \( \leq 9.6 \)°C at the point of discharge and \( \leq 3 \)°C within 300 m. | (max. absolute temp 10°C at the point of discharge above ambient) Mixing zone up to 3°C. | 3°C at edge of mixing zone.

Noise (6):

| Daytime (max.) | Max. <55.1 dB(A) | 70 dB(A) | 70 dB(A) |
| Nighttime (max.) | Max. <55 dB(A) | 60 dB(A) | 70 dB(A) |

(1) Egyptian standards for NOx are expressed in terms of NO2.
(2) Ambient air quality monitoring results measured by the NRC air quality monitoring equipment in Al-Sokhna area during May 2008.
(3) The PM\(_{10}\) concentrations resulting from the power plant itself only is traces.
(4) “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 mg/l 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).
(5) Where this zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance.
(6) There are no sensitive receptors for noise within 150m 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.
## Table 3

**Key Issues Raised During ESIA Scoping Meeting**

<table>
<thead>
<tr>
<th>Key issue discussed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Project</td>
<td>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 and will benefit the local economy through labor opportunities.</td>
</tr>
<tr>
<td>Social and Economic Impact</td>
<td>Local stakeholders and council leaders considered the social and economic impact of the plant to be wholly positive.</td>
</tr>
<tr>
<td>Waste water discharge and the aquatic environment</td>
<td>All local stakeholders expressed concern about the quality and quantity of water in the Suez Gulf Al-Sokhna segment and the quality of water which will be discharged from the power plant. It was however acknowledged that there are no significant aquatic ecosystems close to the power plant. The suggestion was made that treated sanitary wastewater could be used for irrigation of landscaped areas and treated industrial wastewater would be directed to the circulating water discharge system.</td>
</tr>
</tbody>
</table>
| Air Quality                                              | There was big concern over the following issues:  
  - compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area;  
  - accumulated effects of the relatively degraded air quality in the Ettaqa atmosphere and the impact of the power project;  
  - back-up heavy fuel oil is prohibited in residential areas, but El-Ain Al-Sokhna, as identified in several physical planning schemes for Suez Region, belongs to an industrial setting. |
| Ecology of the Site                                       | There was significant attention to keeping a landscape area inside the power plant fence.                                                                                                                   |
| Shoreline & Seabed Morphology                            | Some parties expressed their fears of causing damaging effects due to sedimentation and erosion processes associated with cooling water abstraction and discharge.                                                |
| Environmental Compliance                                 | An underlying concern expressed by all local stakeholders was compliance with environmental regulations. Assurances from EDEPC are sought to the effect that EDEPC will guarantee implementation of the environmental compliance measures which will be stated in the Environmental and Social Management Plan. |
Table 4

*Summary of Implementation Cost of the ESMP*

<table>
<thead>
<tr>
<th>No.</th>
<th>Phase of Implementation</th>
<th>Cost in US$ (1000)</th>
<th></th>
<th></th>
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<tr>
<td></td>
<td></td>
<td>Measures</td>
<td>Monitoring</td>
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<tr>
<td>1</td>
<td>Construction Phase</td>
<td>120</td>
<td>1638</td>
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<tr>
<td>2</td>
<td>Operation Phase</td>
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<tr>
<td></td>
<td>Sub. Total</td>
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<td>1658</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1848</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>