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New York New York

Prepared for International Development Work Order No. [illegible]

ENVIRONMENTAL REVIEW
OF
PROPOSED POWER PLANT
AT
ISMAILIA
ARAB REPUBLIC OF EGYPT

AGENCY FOR INTERNATIONAL DEVELOPMENT
WORK ORDER NO. 6, AMENDMENT NO. 2
REQUIREMENTS CONTRACT NO. AID/otr-C-1305

JULY, 1976

SANDERSON & PORTER, INC.
NEW YORK, N.Y.

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ENGINEERS - CONSTRUCTORS - MANAGEMENT CONSULTANTS
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August 10, 1976

Agency for International Development
Department of State
1401 Wilson Blvd., Room 525
Arlington, Virginia 22209

Attention: Mr. Jack Wright, Project Mgr.
ENGR/OPNS/PTC

Gentlemen:

Environmental Services for Electric Utilities
Requirements Contract AID/otr-C-1305
Amendment No. 2 to Work Order No. 6
Environmental Review of Proposed Power
Plant at Ismailia, Arab Republic of Egypt
Final Report
S & P J/O No. 4985-01

In accordance with the instructions contained in Work Order No. 6, Amendment No. 2 of Contract AID/otr-C-1305, enclosed please find twelve copies of the Final Report. This report develops to a greater depth the information contained in the interim report and presents conclusions and recommendations regarding the environmental acceptability of the proposed Ismailia site.

It has been a pleasure to undertake this Environmental Review and we trust this study has been completed to your satisfaction. We will be glad to review this study with you at your convenience and to undertake any future environmental assignments as you may require.

Very truly yours,

SANDERSON & PORTER, INC.

A. H. Ferber

A. H. Ferber
Manager of Consulting Engineering

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SECTION 1.0

INTRODUCTION

The purpose of this report is to present Sanderson & Porter's (S&P) findings, conclusions and recommendations concerning the Environmental Impact associated with the Egyptian Electricity Authority's (EEA) plan of the proposed 300 MW Ismailia Thermal Electric Power Station.

The report has been prepared in compliance with directions received from the Agency for International Development (AID), as described in Amendment No. 2 to Work Order No. 6, Contract No. AID/otr-C-1305, effective date June 11, 1976. The work order encompasses an Environmental Review, very brief in nature, due to the short period of time allotted for the study and will not entirely develop the detail normally associated with Environmental Impact Studies.

The general objectives of the study are to review the effects upon the environment which will result from the construction and operation of the proposed power station whose site was selected by EEA, to analyze and recommend possible remedial measures designed to lessen or alleviate any of such effects, and to provide order-of-magnitude estimates for such remedial measures. This assignment does not include an evaluation of the adequacy of the Ismailia site for the type and size of power station proposed, the adequacy of the cooling water intake and discharge locations and configuration to avoid recirculation nor the suitability of the site with respect to fuel delivery and transmission considerations.

The specific objectives of the study are:

1. To review the effects of air pollution resulting from the burning of Mazout at the Ismailia Thermal Electric Power Station.

2. To review the effects of thermal discharges upon flora, fauna, and recreational facilities at the Great Bitter Lake.

3. To make recommendations for lessening or alleviating pollution problems including order-of-magnitude cost estimates.

It should be emphasized that this study was conducted with certain types of data and information not available to the study team which were requested by S&P in its proposal for the subject work scope dated May 21, 1976 to Mr. Jack Wright, Project Manager, ENGR/OPNS/PTC. The unavailable data and information include:

1) Plot plan

2) Inlet and discharge cooling water locations and configurations

3) Types of flora and fauna in the Great Bitter Lake

4) Bottom contours of the Great Bitter Lake

5) Prevailing currents in the Great Bitter Lake

6) Water quality of the Great Bitter Lake

7) Baseline air quality data

8) Primary fuel choice

9) Transportation mode of fuel

Because of the unavailability of the aforementioned data and information, certain types of environmental impact could not be assessed fully. In such cases, suggestions for future studies are made in Section 2.0, "Conclusions and Recommendations."

To accomplish this work, S&P dispatched a three-man study team to Egypt during the month of June, 1976, to confer with EEA representatives and to perform field inspections of the Ismailia site. The team spent a period of five days in Egypt collecting data and making field inspections.

SECTION 2.0

CONCLUSIONS AND RECOMMENDATIONS

2.1 CONCLUSIONS

1. Based on the following recommendations and conclusions derived from the available study data and information, it is believed that by using sound engineering and ecological principles, this project can be made environmentally compatible with the existing environment.

2. Emission rates of pollutants (sulfur dioxide, nitrogen oxides and particulates) from the power station were calculated. The Arab Republic of Egypt has no regulations governing emissions. The calculated rates are in excess of United States Environmental Protection Agency's emission standards.

3. Diffusion analyses of the pollutants from the power station were conducted. The maximum ground level concentration of pollutants based on annual averages occurs at a distance of 2 kilometers south of the site.

4. The Arab Republic of Egypt has no regulations governing air quality. The calculated ground level concentrations of oxides of nitrogen and particulates meet the United States National Ambient Air Quality Standards. The short-term (24-hour) ground level concentration of sulfur dioxide does not meet United States Air Quality Standards.

5. The damages to the materials and vegetation due to the pollutant concentrations resulting from the power station will be minimal.

6. Based on the data available, the effects on aquatic organisms resulting from operation of the proposed facility are not expected to be of sufficient magnitude to produce discernible changes in aquatic populations in the Great Bitter Lake. However, ecological damage will occur in the thermal plume area.

7. Based on an estimated separation distance of 600 meters (exact separation distance is not known at present) between the condenser intake and discharge and also based on a cursory thermal analysis, the potential exists for undesirable recirculation of condenser discharge flow into the condenser intake.

8. Field observations of the proposed site indicate that the potential for adverse environmental impacts exists affecting the Great Bitter Lake and/or the Suez Sweet Water Canal if a major oil spill occurs.

9. The adverse impacts on human activity during construction of the facility are expected to be minimal. The short-term inconveniences of increased noise, dust, smoke from transportation vehicles and traffic will be balanced by the long-term benefits of increased employment and income and the supply of power for industrial, commercial, and residential uses.

10. Construction of the proposed facilities will require acquisition of 75 acres of agricultural land. The agricultural productivity use of this land will be lost.

11. The loss of the shoreline immediate to the site as a recreational area to local inhabitants is not expected to be a significant adverse impact.

12. The terrestrial ecological impact on the general area due to construction activities is not anticipated to be a long-term one. The general area will return to a stable condition soon after the construction of the project.

13. Typical in-plant noise levels resulting from the operation of the proposed generating facility will be approximately 90-100 dBA. Exposure of plant personnel to these sound levels for long duration of time should be controlled.

14. Noise levels, resulting from operation of the proposed generating equipment, are not expected to have any adverse effects upon the inhabitants of existing or proposed residential communities in the immediate vicinity of the plant

2.2 RECOMMENDATIONS

It is recommended that the following actions be taken to minimize the environmental impact from construction and operation of the Ismailia Thermal Electric Power Station.

1. Incorporate the following considerations in the condenser cooling water system design.

   A. Minimum entrainment of planktonic organisms and fish into the condenser inlet. The intake of fish and planktonic organisms is an unavoidable consequence of using sea water for cooling. Proper design features can minimize entrainment.

   B. A proper intake screening system with respect to the organisms considered.

   C. Locate the discharge structure to prevent the condenser discharge thermal plume from impinging upon the lake substrate or shorelines. The purpose of this is to minimize the potential for adverse effects on benthic and intertidal organisms.

2. To ensure environmental compatibility of this project, the following studies, not within the scope of this assignment, should be conducted.

   A. Perform an in-depth biological and oceanographic investigation of the Great Bitter Lake. This baseline data is required for the establishment of proper design criteria and to fully assess the environmental impact of operation of the facility on the Great Bitter Lake.

   B. Prepare an oil spill prevention control and countermeasure plan.

3. Construct concrete dikes isolating the proposed Mazout storage tanks, Mazout day tanks, and solar oil storage tank. The total order-of-magnitude cost estimate for construction of these dikes is $400,000.

4. Further analysis should be performed to determine the appropriate distance and configuration between condenser discharge and intake to minimize recirculation.

5. Proper design should be incorporated to minimize the condenser discharge thermal plume area.

6. The stack height should not be less than about 45 meters (150 feet), to aid the dispersion of pollutants.

7. Since no baseline air quality data now exists for the site area, monitoring of ambient air quality at the site prior to the design and construction of the power station should be instituted.

8. No raw sewerage should be discharged to the Great Bitter Lake, nor to the Suez Sweet Water Canal.

SECTION 3.0

OVERALL PROJECT DESCRIPTION

The EEA proposes to construct and operate a 300 MW Thermal Electric Power Station, at a site generally referred to as Ismailia. The site is approximately 28 kilometers south of the city of Ismailia (30°N, 32° 17'E) on the northwestern shore of the Great Bitter Lake. The power generated by the plant will be tied into the national grid. It is expected that the bulk of the power will be consumed along the Canal Zone and will be used to improve rural and urban living conditions as well as assist continuing industrial expansion for the planned city of the 10th of Ramadan.

SECTION 4.0

PROPOSED POWER GENERATING FACILITIES

4.1 SITE

The site upon which the project is to be located is shown in Fig. 4.1. This site is a rectangular plot of land (600 meters x 500 meters) having an eastern boundary parallel to the Ismailia-Suez Highway. The nearest town is Abu Soltan, about 1 kilometer west of the proposed facility. The site is near to planned transmission lines and has access to highway and railroad communications.

4.2 EQUIPMENT

The proposed facilities comprising the power generating complex will be as follows:

- Two 150 MW units having dual fuel capabilities using Mazout and/or natural gas.

- Two auxiliary package type steam generating units and associated equipment to be used for heating the fuel oil storage tanks and for the steam tracing of oil piping and as an auxiliary supply for the steam air heaters.

- Fuel oil storage tanks, day service tanks, and fuel handling facilities.

- Office, toilet facilities, and housing as appropriate, for plant personnel.

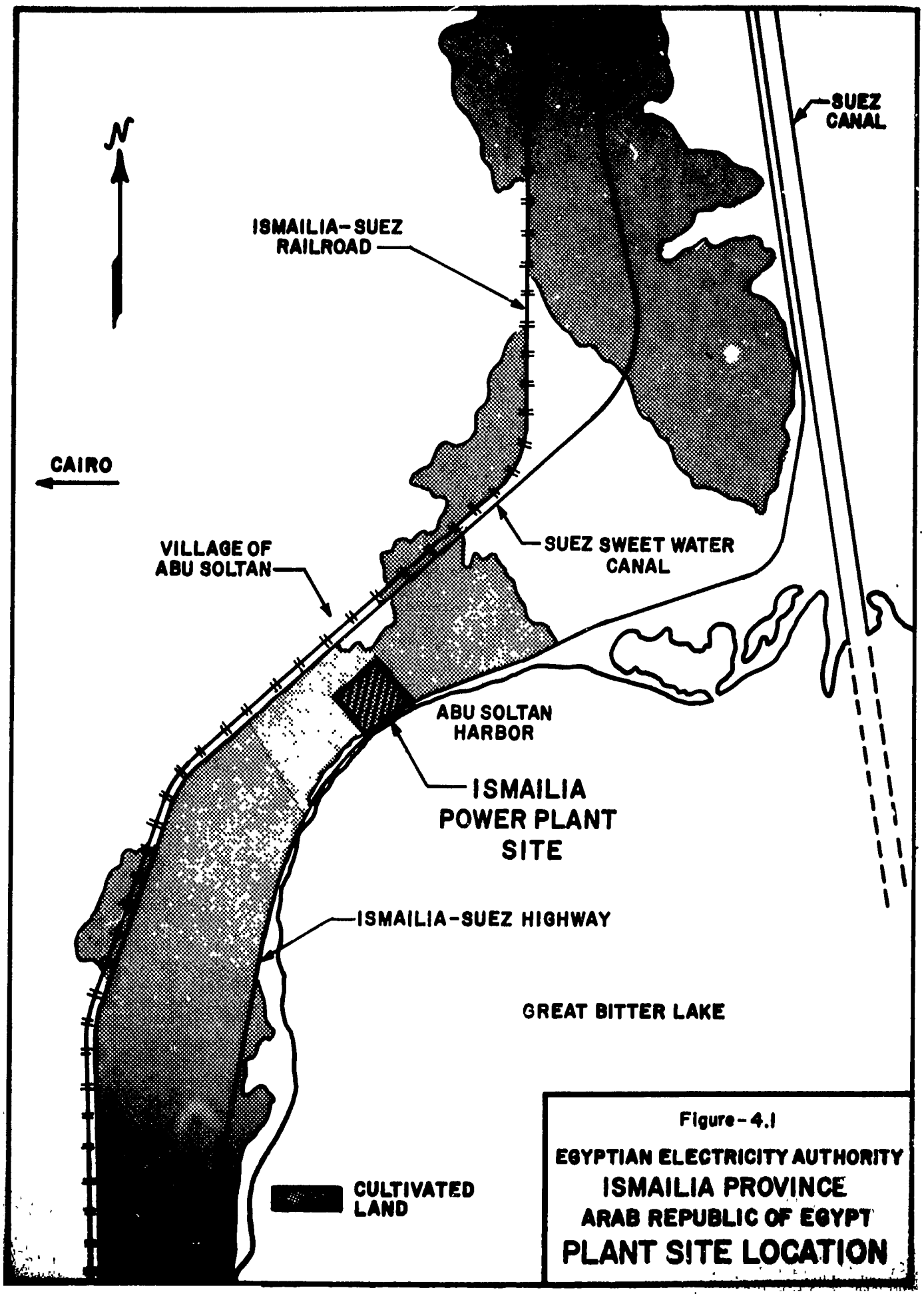


Figure-4.1

EGYPTIAN ELECTRICITY AUTHORITY

ISMAILIA PROVINCE

ARAB REPUBLIC OF EGYPT

PLANT SITE LOCATION

SECTION 5.0

PROPOSED UTILITY SERVICES

It is proposed that the general utility services such as fuel, water, sewerage and power be provided by EEA in the general area of the site to accommodate not only the power station needs but also the needs of the construction and operation personnel and their families.

5.1 FUEL

The station's main fuel burners will be designed for dual-firing of Mazout and /or natural gas. The allocation of fuel mix has not yet been determined. If natural gas is available, it will be supplied by pipeline from the Abu El Gharadig gas field about 320 kilometers west of Cairo on the southeastern extremity of the Quattara Depression. Mazout will be transported to the Ismailia site from the Egyptian Petroleum Corporation refinery at Suez either by a pipeline, railway, or barge. The exact method of transport has not yet been determined. If barge transportation is used, a new fuel transfer pier has to be constructed at the Great Bitter Lake. Mazout will be unloaded to an underground 500 tons capacity tank from which it may be transferred to the four main 10,000 tons capacity concrete storage tanks or to the four 1000 tons capacity concrete day service tanks.

No. 2 fuel oil (solar oil) will be used as prime fuel to fire the auxiliary steam generating units, ignition fuel for the main burner start-up and pilot fuel for auxiliary boiler start-up. The oil will be delivered to the 100 tons capacity steel tank and the small auxiliary boiler pilot tank.

5.2 WATER

Cooling water for the power station will be withdrawn from the Great Bitter Lake and discharged into it. The exact locations of

the intake and discharge points have not yet been identified. Water for human services and other in-plant uses will be withdrawn from the Suez Sweet Water Canal which runs parallel to the western boundary of the site. The water will be chemically and physically treated in a water treatment plant.

5.3 SEWERAGE

At the present time no definite plans for the type of sewerage treatment facilities to be installed at the site have been specified.

5.4 POWER

Black start will be provided through power transformers connected to the transmission grid. Power during construction will be provided through an auxiliary internal combustion engine driven generator or a gas turbine.

SECTION 6.0

NATURE OF SURROUNDING ENVIRONMENT

In order to assess the environmental impact of the proposed facility, it is first necessary to appraise the existing environment. The following sections describe the land, water, and air resources in the vicinity of the proposed facility and will serve as the basis for predicting the effects of the proposed facility on the environment.

6.1 LAND USE

The site is in a rural, sparsely populated area with no industrial development in the immediate vicinity. The nearest population center is approximately 1 kilometer west of the proposed site and has an estimated population of 250 inhabitants. There are no dwellings on the proposed site. However, there are scattered dwellings adjacent to the southern boundary.

The general area terrain may be characterized as undulating and sandy. The land adjacent to the coastline of the Great Bitter Lake, where the proposed facility is to be located, is presently being used for small scale agriculture. The area is probably sparsely inhabited with fauna, as a result of cultivation.

No historical or archaeological sites are readily known to exist in the power station area.

6.2 WATER RESOURCES

The eastern boundary of the proposed facility is parallel to the Great Bitter Lake. This lake is part of the Suez Canal System and its location with respect to the canal is shown on Fig. 6.1.

The Suez Canal is a sea level type canal, which connects the Mediterranean Sea with the Bay of Suez. The canal has a length of 142 kilometers, of this distance, 107 kilometers is actual canal

and the remainder consists of dredged channels through Lake Timsah and the Bitter Lakes [1].

From November to April, the general direction of the currents between Port Said and Great Bitter Lake is northward; from June to October the current sets southward.

The currents caused by the tidal rise and fall in the Suez Bay are felt from the southern entrance of the Canal to the Little Bitter Lake, where they expand and dissipate. The Great Bitter Lake [2] acts as a damping reservoir for any wave action entering the lake from the Suez Bay in the south and the Mediterranean Sea in the north. Fluctuations in the water level of the lake are negligible, reaching a maximum value of 25 centimeters along the shores of the lake. Prevailing current velocities range from 0.1 meters/sec along the shore of the lake to 0.6 meters/sec in the dredged portions of the canal. The direction of the currents through the lake is dependent upon tidal effects and the bottom contours of the lake. The Great Bitter Lake has depths ranging from 5.5 meters to a maximum depth of 13 meters in the dredged portion of the channel. The lake is 20.5 kilometers long and 11.5 kilometers wide, with a total volume of 1.4 cubic kilometers. The average reported salinity is 44 parts per thousand. The water temperature varies from 15-20°C in the winter months (December and January) to a maximum of 42° in the summer (July and August).

Because no pertinent surveys have been performed concerning the Great Bitter Lake, the study team was not able to obtain proper data regarding the biological and hydrological conditions. Only very general assumptions concerning aquatic communities or current patterns in the Great Bitter Lake can be made. The lake has been reported to support a local fishing industry. Data concerning the type of species netted and the size of the catch are also not available.

The shoreline adjacent to the site is presently being used by local inhabitants as a swimming area.

6.3 AIR RESOURCES

The climatological data [2] for the area are shown on Table 6.1. The average maximum air temperature at the site is 21.2°C. The

prevailing wind direction at the site varies from northwest to northeast. During the month of December, January, February, and March, the prevailing wind direction is southwest and varies from 12 kilometers/hr to 18 kilometers/hr. Tables 6.2 and 6.3 present the percentage frequency of wind speed and direction at Abu Sueir, Egypt, the station nearest to the site for which wind data are available.

Diffusion climatology of the site was obtained by Turners [3] method for determining thermal stability using hourly surface meteorological data. Because on site meteorological data of statistical significance were not available, Cairo, Egypt hourly surface meteorological data were used to determine the stability class distributions. Table 6.4 presents the stability class distribution for Cairo, Egypt.

The joint relative frequencies of stability class and wind direction at Cairo, Egypt for the period January 1965 to December 1974 are shown on Table 6.5. This analysis was used to predict the ambient air quality in Section 7.1.

6.4 REFERENCES

1. U. S. Defence Mapping Agency, Hydrographic Center, "Sailing Directions for the Red Sea and Gulf of Adan", 1965.

2. Information provided by Egyptian Electricity Authority (EEA) Personnel June, 1976.

3. Turner D. B., "Relationships Between 24-Hour Mean Air Quality Measurements and Meteorological Factors in Nashville, Tennessee". Appendix A: Stability Classification using hourly airport observations, Journal of the Air Pollution Control Association, Vol. 11, No. 10, 1961.

TABLE 6.1

CLIMATOLOGICAL DATA FOR

ABU SUEIR, EGYPT[2]

ELEMENTS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY
Mean Air Temp. Dry Bulb °C	13.3	14.0	16.9	20.5	23.7	26.8	27.9
Mean Air Temp. Wet Bulb °C	9.7	10.1	11.7	14.2	16.8	19.6	21.4
Mean of Dew Point Temp. °C	5.5	5.5	6.2	8.3	10.1	15.1	17.9
Mean of Pressure (Mean Sea Level mbs)	1018.0	1018.0	1015.5	1013.4	1012.7	1011.0	1008.1
Mean Relative Humidity %	66	57	50	46	46	48	54
Mean Number of Hours of Actual Duration of Bright Sunshine X	6.6	7.0	7.5	9.6	10.5	11.7	12.9
Mean Total Sky Cover in Octave	2.8	3.0	2.5	2.4	1.9	0.9	0.9
Number of Days of Clear Sky	8.9	7.0	10.0	10.6	15.9	21.6	27.7

X From Zagazig °C = Degrees Celsius or Centigrade

mbs = Millibars and 1000 mbs = 750 millimeters mercury

TABLE 6.1

CLIMATOLOGICAL DATA FOR

ABU SUEIR, EGYPT[2]

ELEMENTS	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	PERIOD
Mean Air Temp. Dry Bulb °C	28.2	25.9	23.3	19.2	15.1	1957-70
Mean Air Temp. Wet Bulb °C	22.1	20.3	18.2	14.8	11.1	1957-70
Mean of Dew Point Temp. °C	17.9	16.9	14.5	12.2	6.6	1961-70
Mean of Pressure (Mean Sea Level mbs)	1008.02	1012.0	1015.2	1017.1	1018.0	1957-70
Mean Relative Humidity %	56	58	59	64	59	1957-70
Mean Number of Hours of Actual Duration of Bright Sunshine X	10.9	10.0	9.0	7.9	6.5	1961-70
Mean Total Sky Cover in Octave	1.1	1.3	1.9	2.3	2.7	1957-70
Number of Days of Clear Sky	24.6	23.7	15.9	11.4	11.0	1961-70

X From Zagazig °C = Degrees Celsius or Centigrade

mbs = Millibars and 1000 mbs = 750 millimeters mercury

TABLE 6.2

PERCENTAGE FREQUENCIES OF WIND SPEED

ABU SUEIR, EGYPT[2]

(speed in Knots)	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
From 1 to 3	23.2	20.9	15.7	16.8	19.7	21.0
From 4 to 6	21.4	22.0	18.6	20.2	20.8	21.4
From 7 to 10	20.2	23.4	24.4	23.4	22.0	25.2
From 11 to 16	18.3	19.1	25.8	26.7	23.4	24.0
From 17 to 21	6.7	6.1	7.5	7.3	6.6	4.0
From 22 to 27	2.9	2.4	3.6	1.7	1.6	0.5
From 28 to 33	0.6	0.5	0.9	0.2	0.1	0.0
$\geqslant$34	0.0	0.0	0.2	0.0	0.0	0.0

TABLE 6.2

PERCENTAGE FREQUENCIES OF WIND SPEED

ABU SUEIR, EGYPT[2]

(speed in knots)	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
From 1 to 3	22.8	24.0	27.6	24.2	26.6	25.3
From 4 to 6	24.4	26.5	26.2	23.3	23.3	21.2
From 7 to 10	28.0	25.1	21.6	22.7	22.9	20.3
From 11 to 16	20.9	17.5	17.5	17.9	14.8	17.8
From 17 to 21	0.9	1.6	1.0	1.7	2.5	5.1
From 22 to 27	0.3	0.2	0.1	0.3	0.7	2.8
From 28 to 33	0.0	0.6	0.0	0.0	0.1	0.4
$\geqslant 34$	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 6.3

PERCENTAGE FREQUENCIES OF WIND DIRECTION

ABU SUEIR, EGYPT[2]

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Calm	6.7	5.6	3.3	3.7	5.8	3.9
Variable	0.4	0.4	0.4	0.4	0.2	0.1
From 345° to 014°	3.3	6.8	7.8	11.6	16.6	20.0
From 015° to 044°	4.7	8.2	10.9	16.9	21.6	13.5
From 045° to 074°	5.2	7.8	7.9	11.0	10.7	6.4
From 075° to 104°	2.9	4.6	4.3	4.7	4.1	2.8
From 105° to 134°	5.1	4.8	5.8	3.4	2.8	1.6
From 135° to 164°	4.0	4.0	5.0	1.8	1.4	1.2
From 165° to 194°	4.6	3.7	2.9	1.1	1.1	0.3
From 195° to 224°	16.7	10.4	7.0	4.3	1.6	1.5
From 225° to 254°	22.2	19.0	17.4	10.4	5.4	6.9
From 255° to 284°	11.7	10.6	10.8	11.0	7.6	9.2
From 285° to 314°	7.6	8.1	9.3	11.2	9.5	14.9
From 315° to 344°	4.9	6.0	7.2	8.5	11.6	17.7

REMARKS: Wind Direction on the Scale 000° to 360° East of North.

...BLE 6.3

PERCENTAGE FREQUENCIES OF WIND DIRECTION

ABU SUEIR, EGYPT[2]

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Calm	2.7	4.5	6.0	9.9	9.1	7.1
Variable	0.1	0.2	0.3	0.4	0.2	0.2
From 345° to 014°	13.7	16.4	20.3	17.5	14.2	4.0
From 015° to 044°	6.3	7.4	14.1	17.0	16.1	7.6
From 045° to 074°	1.2	1.8	4.1	9.0	6.2	5.2
From 075° to 104°	0.6	0.6	1.5	3.1	2.1	3.8
From 105° to 134°	0.3	0.4	0.9	1.8	0.9	4.7
From 135° to 164°	0.2	0.2	0.4	1.2	1.1	3.5
From 165° to 194°	0.3	0.5	0.5	0.7	2.8	4.9
From 195° to 224°	1.8	2.4	2.8	3.8	9.4	17.6
From 225° to 254°	10.7	9.4	6.6	7.4	12.2	22.8
From 255° to 284°	13.6	11.2	9.0	7.8	8.2	8.4
From 285° to 314°	25.3	21.4	14.3	9.3	8.3	5.7
From 315° to 344°	23.2	23.6	19.2	11.1	9.2	4.5

REMARKS: Wind Direction in Degrees on the Scale 000° to 360° East of North.

SECTION 6.4

STABILITY CLASS DISTRIBUTION
CAIRO, EGYPT

Stability Class	Frequency %	Average Wind Speed Knots
1	6.53	4.99
2	19.35	5.16
3	18.36	5.03
4	19.32	5.32
5	5.50	5.66
6	23.52	4.43
7	7.43	4.30

TABLE 6.5

WIND FREQUENCY BY STABILITY CLASS AND DIRECTION

CAIRO, EGYPT

DIREC-TION	1	2	3	4	5	6	7	TOTAL	AVG SPEED (Knots)
N	0.011688	0.041471	0.028560	0.018633	0.002836	0.022203	0.007287	0.132678	5.033
NNE	0.005379	0.026817	0.021811	0.018290	0.003717	0.019660	0.006162	0.101037	5.068
NE	0.002054	0.014280	0.017948	0.015796	0.004157	0.020931	0.004842	0.080008	5.070
ENE	0.001320	0.006553	0.011541	0.012520	0.004793	0.019122	0.004646	0.060495	4.994
E	0.000685	0.002347	0.007140	0.009145	0.008558	0.029000	0.005086	0.061962	4.888
ESE	0.000245	0.000391	0.002396	0.003472	0.005037	0.007678	0.001614	0.020833	4.963
SE	0.000098	0.000245	0.001663	0.003032	0.004010	0.006358	0.001174	0.016579	4.994
SSE	0.000098	0.000831	0.002005	0.004450	0.003179	0.006944	0.001125	0.018633	4.976
S	0.000391	0.001761	0.004695	0.015747	0.008216	0.010612	0.002543	0.043965	5.379
SSW	0.000391	0.004597	0.007776	0.014280	0.003863	0.007727	0.002934	0.041569	5.373
SW	0.000880	0.004695	0.006211	0.008656	0.001858	0.004255	0.002152	0.028707	5.306
WSW	0.000929	0.003717	0.007482	0.011493	0.001809	0.008118	0.003326	0.036874	5.132
W	0.003374	0.013400	0.016530	0.016383	0.001516	0.011052	0.006211	0.068466	4.945
WNW	0.008020	0.014769	0.011884	0.010221	0.000147	0.006602	0.004744	0.056387	4.803

TABLE 6.5

WIND FREQUENCY BY STABILITY CLASS AND DIRECTION

CAIRO, EGYPT

DIRECTION	1	2	3	4	5	6	7	TOTAL	AVG SPEED (Knots)
NW	0.011444	0.021811	0.011395	0.008363	0.000342	0.007336	0.003521	0.064212	4.869
NNW	0.017410	0.033940	0.016628	0.009781	0.000734	0.012520	0.005771	0.095782	4.874
CALM	0.000929	0.002690	0.007971	0.012960	0.0	0.035065	0.011199	0.070814	4.022
TOTAL	0.065336	0.193515	0.183636	0.193222	0.054773	0.235182	0.074335	61344.000	100.000
AVG SPEED	4.987	5.162	5.031	5.318	5.666	4.434	4.305	100.000	4.949

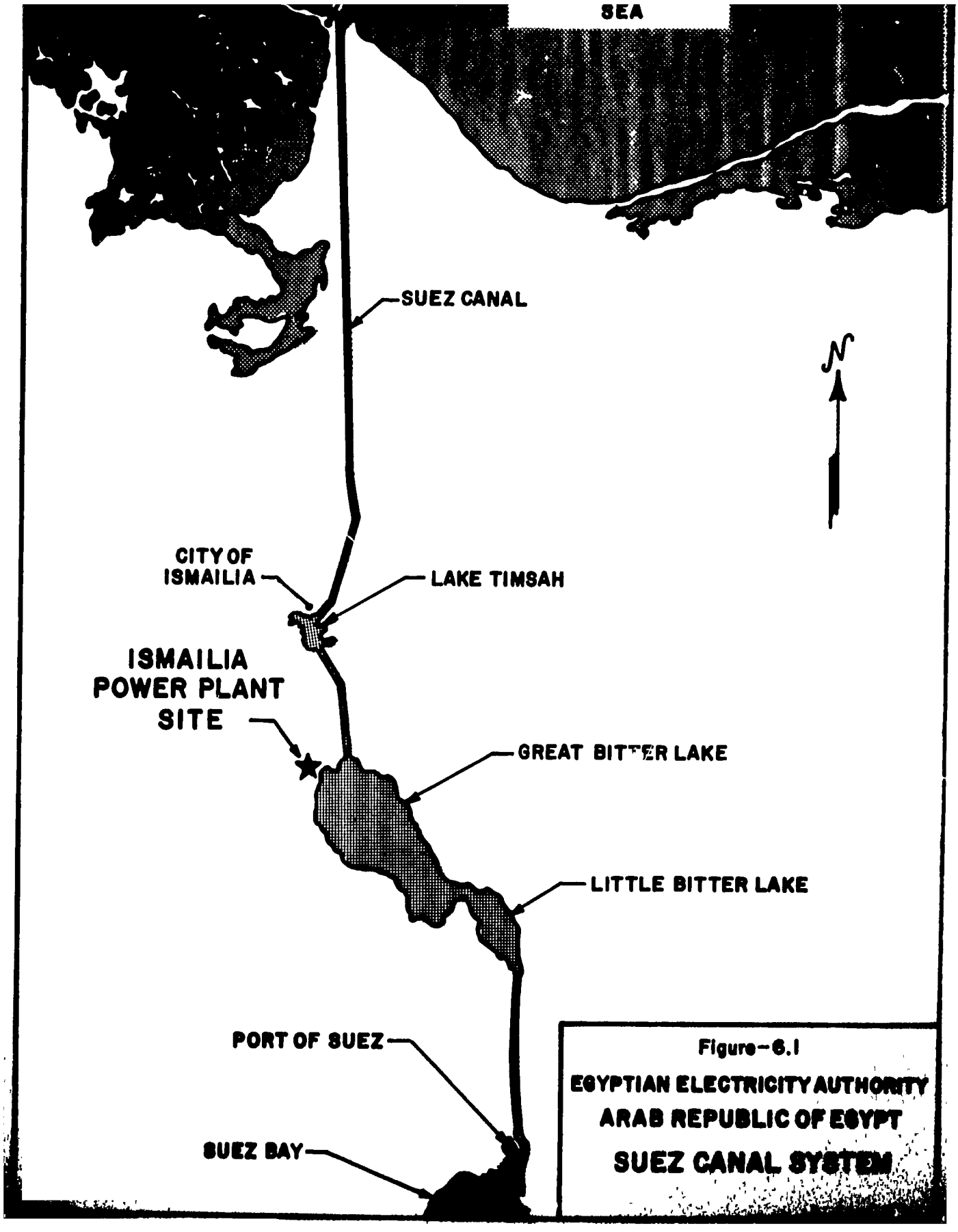


Figure-6.1
EGYPTIAN ELECTRICITY AUTHORITY
ARAB REPUBLIC OF EGYPT
SUEZ CANAL SYSTEM

SECTION 7.0

PROBABLE ENVIRONMENTAL IMPACT

This section discusses the environmental impact associated with the construction and operation of the proposed facility.

Each of man's construction activities generates some degree of disruption to the environment. By the use of sound engineering and ecological principles, the anticipated adverse environmental impact, accompanying the construction and operation of the proposed facility, can be minimized. The impact on air and water quality, human activities, ecological systems and land use are discussed in the following sections.

7.1 EXPECTED IMPACTS ON AIR QUALITY FROM CONSTRUCTION AND OPERATION OF THE THERMAL ELECTRIC POWER STATION

7.1.1 IMPACT DURING CONSTRUCTION

Construction activities, if unsupervised, can produce increased local fugitive dust conditions. Fugitive dust raised by vehicles and machinery will create an off-property nuisance. However, it should be noted that the dust raised by vehicles and machinery will not be more than the dust raised by normal farming activities in the area or by high wind. If these conditions prove to be severe, they should be controlled by spraying with water and/or chemicals.

7.1.2 EXPECTED AIR EMISSIONS FROM OPERATION OF THE THERMAL ELECTRIC POWER STATION

The major pollutants from a thermal station are oxides of sulfur, oxides of nitrogen and particulates. The oxides of sulfur result from the combustion of the fuel and are proportional to the sulfur content of the fuel burned. It is assumed that all the sulfur in the

fuel will be emitted as sulfur dioxide. The oxides of nitrogen result from the high temperature oxidation of the nitrogen from the air and oxidation of the nitrogen in the fuel. In general, the particulates, other than soot, result from ash in the fuels, the oxidation of ash-producing substances, and other matter which forms solids or liquids. It is proposed to operate the Ismailia Thermal Electric Power Station on natural gas and/or Mazout. Tables 7.1 and 7.2 show the typical analyses of natural gas and Mazout respectively.

The major pollutant emissions from the power station when operating with Mazout will be particulates, oxides of sulfur and oxides of nitrogen. The rates of emission of pollutants from the power station will be as follows:

Mazout Fired Operations	lb/MBTU	g/Mcal
Particulates	0.17	0.31
Sulfur Dioxide	3.51 - 5.85	6.3 - 10.4
Nitrogen Dioxide	0.78	1.4
Natural Gas Fired Operation		
Nitrogen Dioxide	0.36	0.65

Mass emission rates of the pollutants from the Ismailia Thermal Power Station were calculated from the fuel composition shown in Tables 7.1 and 7.2 and an assumed heat input of 10,000 BTU/KWhr. The power station will also be equipped with an auxiliary steam generating unit, which will operate on light oil. The typical analysis of light oil is shown in Table 7.3. The pollutant emissions from this unit were also estimated. Table 7.4 presents the total mass emission data for the station at full load operation.

The Arab Republic of Egypt presently has no emission or ambient air quality standards. United States Environmental Protection

Agency emission standards for oil and gas fired power generating stations are presented below for comparative purposes.

	Oil	Gas
Particulates - lb/MBTU	0.1	0.1
Sulfur dioxide - lb/MBTU	0.8	-
Nitrogen dioxide - lb/MBTU	0.3	0.2

It will be noted that the emissions from the Ismailia Power Station will not comply with these standards. However, technology is presently available to reduce pollutant emissions to the desired level.

7.1.3 EFFECTS OF AIR EMISSIONS ON THE ENVIRONMENT

Studies conducted in the United States and other countries on the effects of pollutants on the environment indicate that certain pollutant concentrations may be detrimental to the environment. Table 7.5 presents United States Environmental Protection Agency National Ambient Air Quality Standards. These values suggest limitations which the United States Environmental Protection Agency believes are "requisite to protect the public welfare". The ground-level concentrations of pollutants resulting from the plant emissions have been calculated by mathematical techniques which account for the rise and dispersion of the plume in the atmosphere and the dispersion at ground level. Two adaptations of the basic Gaussian dispersion equation [3] and the American Society of Mechanical Engineers dispersion coefficients have been used.[4]

Diffusion climatology shown in Tables 6.4 and 6.5 was used to calculate the average annual concentration of pollutants in the vicinity of the site. The maximum 24-hour average concentrations were calculated using records of persistent wind conditions at Cairo, Egypt. For the calculation, the wind direction is assumed to remain within a 22-1/2° sector for the entire period.

Table 7.6 presents the estimated plant design parameters used for diffusion analysis. Common values of parameters such as stack exit temperatures, stack diameter and stack height have been

assumed since the plant design data are not available at the present time. The total mass emissions of pollutants from the Ismailia Power Station operating at full load are presented in Table 7.4.

The ground level concentration of pollutants was estimated using the mass emission of pollutants from the station (Table 7.4) and the parameters for diffusion analysis (Table 7.6). The existing ambient air quality will deteriorate by an amount equal to the estimated ground level concentration of pollutants. Table 7.7 presents the estimated deterioration of existing air quality due to operation of Ismailia Power Station.

Figures 7.2 and 7.3 depict graphically the distribution of annual average concentration of sulfur dioxide and nitrogen dioxide. Similar graphical representation for particulates was not presented because the ground level concentrations were low. These figures show that the maximum ground level concentration occurs about 2 kilometers south of the site in the Great Bitter Lake. High concentrations are also obtained in the agricultural area south of the site. The damages to the materials and vegetation due to the above annual concentration (24 $\mu g/m^3$ or 0.009 ppm) of oxides of sulfur pollutants will be minimal. Research in the field of dose-response indicates adverse effects to the materials at annual average sulfur dioxide concentration of 345 $\mu g/m^3$ or 0.12 ppm [5]. Similar studies concerning vegetation indicate that an annual mean concentration of sulfur dioxide of 85 $\mu g/m^3$, or 0.03 ppm, produces adverse effects on vegetation [5].

The long term and short term ambient air quality resulting from the installation of the plant would be acceptable according to the United States National Ambient Air Quality Standards with the exception of the short-term (24-hour) ground level concentration of sulfur dioxide.

The amount of pollutants released into the atmosphere could be reduced by the installation of pollution control equipment, and/or modifying the plant design.

7.2 IMPACT ON GREAT BITTER LAKE

7.2.1 IMPACT OF WATER INTAKE ON AQAUTIC BIOTA

It is possible that there will be impingement of aquatic forms, such as juvenile and adult fish, shrimp, crabs and other invertebrates

that might be indigenous to the Great Bitter Lake at the circulating water intake structure. Assuming 100% mortality, the worst condition possible, it is believed that the lake is large enough to absorb these potential losses without any detrimental effect on the aquatic life of the lake. The degree of impingement is dependent upon the water velocity and the type of traveling screens of the circulating water intake structure. Selectionof intake velocities should be a cost-effective choice with a major consideration being the swimming data of fishes at the proposed intake site. Fish swimming ability is a function of species, age, size, water temperature and dissolved oxygen. Based on field studies at several United States power stations, incorporation of less than 0.3 m/sec approach velocity will reduce potential impingement effects considerably.

Aquatic forms entrained in the circulating water intake will be subjected to:

(1) fractional mechanical disruption due to pump turbulence and physical abrasion,
(2) a temperature increase across the condenser,
(3) rapid pressure changes through the plant, and
(4) chlorination to control the growth of fouling organisms in the cooling water system.

7.2.2 THERMAL ANALYSIS

The heat generated from the power plant cycle is to be rejected to the Great Bitter Lake. Water from the Great Bitter Lake is pumped through the power plant condenser and discharged back to the lake. A simple thermal model was used to determine the temperature distribution of the water discharged from the condenser over an area that included the condenser inlet as the boundary. No plant arrangement plan was available in order to know the exact separation of the intake from the discharge. Hence, the results obtained from this model are believed to be conservative and should not be used as planning tools. The results should only be used to identify potential problem areas.

The thermal model assumed that surface discharge through a flared outlet from the condenser is used. This type of discharge analysis neglects jet entrainment and mixing. The absence of currents in the lake substantiates this assumption. The basic

equations for the thermal model used are described in reference (6).

Additional assumptions which were made for the analysis included:

1. Power station output - 300 MW

2. Fossil fueled power station thermal efficiecy - 40%

3. 50% of the heat input to the power station is rejected to the condenser cooling water or 4.27×10^6 BTU/hr-MW.

4. Cooling lake water temperature rise of $8.3^{\circ}C$ through the condenser.

5. Distance between condenser discharge and condenser intake is 600 meters.

Figure 7.1 presents the temperature distribution from the point of condenser discharge to the condenser intake for the month of July. The total area included between these two points is 140 acres. During the month of July, the natural equilibrium surface temperature of the water is $27.7^{\circ}C$. Figure 7.1 shows that the condenser discharge temperature decays from an initial value of about $45^{\circ}C$ to a value of about $36^{\circ}C$ at the distance of the condenser intake. This latter temperature corresponds to a conservative $9^{\circ}C$ above the natural equilibrium surface temperature of the water.

A large difference between the thermal plume temperatures and the equilibrium surface of the lake should be avoided. The temperature difference expected from the proposed station during the year ranges from about $9^{\circ}C$ in the month of July to about $15^{\circ}C$ in the month of December. The condenser temperature will vary from about $25^{\circ}C$ in December to about $36^{\circ}C$ in July.

The results of this thermal analysis indicate that the temperature differencials may be in excess of those that can be tolerated with a 600 meter separation between intake and discharge.

7.2.3 THERMAL IMPACT ON AQUATIC BIOTA

Since the thermal plume zone is comparatively small throughout the year, adequate zones of passage should be available for aquatic vertebrates and invertebrates to avoid the effects of the thermal plume.

Thermal analysis indicates that the largest temperature differential in the lake as a result of station operations, will occur during the month of December. The expected temperature of the plume at the boundary of the 140-acre thermal plume area will be 15.2°C above the natural equilibrium surface temperature. An area of about 2000 acres (7500 feet separation between intake and discharge) will be required so that the temperature of the plume is approximately equal to the natural equilibrium temperature of the lake. This area is about 3% of the lake's surface.

In the thermal plume area the water quality is degraded and ecological damage may occur. The following effects may occur in the thermal plume area as a result of temperature rises:

1) Essential oxygen is present in smaller concentrations at higher temperatures.

2) High temperature speeds the flocculation of finely suspended particles, which then directly removes oxygen from water and decreases water clarity, thus reducing growth and respiration of algae.

3) High temperatures increase the metabolic rates of fishes and invertebrates; eggs, larvae, and adults are destroyed. Salinity increases, reducing the survival rate of eggs and larvae.

4) In response to increasing temperatures, adult organisms tend to move out of an affected area, but larvae and juveniles cannot and may perish, either directly or by becoming more vulnerable to predators.

5) Increased water temperature may alter the structure, behavior, and migration of fish schools.

6) The rate of feeding of aquatic organisms generally increases gradually, then drops off abruptly as oxygen decreases, a result of increased temperature..

7) Reproductive cycles may be changed by the addition of heated effluents; the number of eggs produced by a species is temperature dependent.

8) A wide range of organic wastes act synergistically at higher water temperatures, rapidly depleting water of oxygen.

9) Destruction of the normal habitat is sufficient to eradicate any number of species without directly killing any of the organisms within a food chain.

7.2.4 IMPACT ON WATER QUALITY

The Arab Republic of Egypt, at the present time, has no effluent guidelines for Steam Electric Power Generation. The United States Environmental Protection Agency Effluent Guidelines for new power generating stations are presented in Table 7.8. This information has been presented as a source of possible future plant design criteria.

Should oil spills occur from any of the storage or oil handling facilities at the site, the potential exists for impacting adversely the Great Bitter Lake and/or the Suez Sweet Water Canal.

7.3 IMPACT ON HUMAN ACTIVITIES

The adverse impact on human activity is expected to be greatest during construction of the proposed facility and that impact is expected to be minimal. Construction activities will be in an area of sparse settlement. Due to the distance of the site location from the nearest large city, noise, dust and smoke from transportation vehicles and construction equipment will not cause any far-reaching impact. The few local residents living in the immediate vicinity of the site will experience some disturbances as a result of construction activities. Although construction will give rise to increased vehicular traffic, the rural nature of the site is such that there are no heavily used roads, and local residents should

not experience inconveniences due to traffic.

Noise generated during the construction period will have a physiological impact on human environment. The noise associated with heavy construction operation is objectionable in confined areas or near developed areas. Since the site is rural, no great disturbances are anticipated.

The expected minimal impact during construction will be balanced by a number of direct and indirect social benefits that are expected to occur as a result of construction and operation of the project. These benefits are viewed as being the construction and operation employment and income generated, and the supply of power for industrial, commercial and residential development within the country in general and specifically the Canal Zone.

7.4 IMPACT ON LAND USE

The area allotted for the proposed facility is presently being used for the cultivation of food crops. As a result of construction activities, this land will be removed from agricultural production. This area is not owned by EEA and will have to be purchased. It should be noted, that the removal of this land from agricultural production has been approved by the Egyptian Regional Planning Board.[7] The shoreline directly adjacent to the site will probably be lost as a recreational area to the local residents. However, this is not expected to be a significant impact since it is confined to a small area along the shoreline.

7.5 IMPACT ON SURROUNDING TERRESTRIAL ECOLOGY

A field visit to the proposed site showed no sign that it was a habitat for any unique flora or fauna. Wildlife forms indigenous to the area are probably present although none were noted during the field inspection. Construction of the proposed facility will disrupt this area as a habitat for indigenous wildlife forms, forcing these species to establish habitats in the surrounding area. It is believed, at the present time, that construction in the area will not exert any lethal stress on wildlife forms or upset the ecological balance of the area. Any wildlife in the general area will experience temporary stimuli, due to noise, dust and smoke. These

stimuli will effect their daily movement and other activities. The ecological impact on the general area due to construction activities is not anticipated to be a long term one. The general area will return to a stable condition soon after the construction of the project is completed.

7.6 NOISE IMPACTS

7.6.1 NOISE LEVEL CRITERIA

Threshold limit values refer to the sound pressure levels under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech.

The medical profession has described hearing impairment as an average hearing threshold level greater than 25 dB[9,10] (ANSI S3.6-1969) at 500, 1000 and 2000 Hz, and limits have been established to prevent a hearing loss in excess of this value.

When employees are subjected to sound levels exceeding those listed in Table 7.9, administrative or engineering measures should be implemented.

If such controls fail to reduce sound levels to within the levels of Table 7.9, protective equipment should be provided. When the daily exposure is composed of two or more periods of noise of different levels, their combined effect should be considered rather than the individual effect of each. If the sum of the fractions, $\frac{C1}{T1} + \frac{C2}{T2} + \frac{C3}{T3} + \ldots\ldots \frac{Cn}{Tn}$, exceeds unity, (Cn indicates the total exposure at a specified noise level and Tn indicates the total time of exposure permitted at the level), then the mixed exposure should be considered to exceed the time value.

Exposure to impulsive or impact noise should not exceed 140 dB Peak Sound Pressure Level.

7.6.2 EXISTING NOISE LEVELS

The proposed site is located in a rural area. The existing ambient noise levels are low.

7.6.3 EXPECTED NOISE LEVELS FROM OPERATION OF THE PROPOSED THERMAL ELECTRIC POWER STATION

Typical sound pressure levels produced by major equipment in the power station will be approximately 90 to 100 dBA [11].

7.6.4 EFFECTS OF NOISE ON THE ENVIRONMENT

The adverse effects of noise are associated principally with residential areas and in-plant personnel.

There is an existing residential area 1 kilometer west of the proposed site. The noise levels expected to be generated by the station are not expected to affect the residential area, since it is located at a sufficient distance from the site. Noise levels inside the station should meet the criteria listed in Table 7.9 or protective equipment should be used.

7.7 REFERENCES

1. General Electricity Corporation, Conditions of Tender and Specifications for the Ismailia Power Plant, Nasr City, Cairo, Egypt, 1975.

2. U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards," U.S. Federal Register 36 FR 22384 November 25, 1971; as amended by 38 FR 25678, September 14, 1973.

3. Turner, D. B., Workbook of Atmospheric Dispersion Estimates, U.S. Department of Health, Education and Welfare, Public Health Service, Bureau of Disease Prevention and Environmental Control, National Center for Air Pollution Control, Cincinnati, Ohio, 1967.

4. Marynard Surity, ed., Recommended Guide for the Prediction of the Dispersion of Airborne Effluents, American Society of Mechanical Engineers, 1968.

5. U.S. Department of Health, Education and Welfare, "Air Quality Criteria for Sulfur Oxides", AP - 50, 1969.

6. Patterson, W.D., Leoporati, J.L. and Scarpa, M.J., "The Capacity of Cooling Ponds to Dissipate Heat" Proc. American Conference, 33, 446-456, 1971.

7. Information provided by Egyptian Electricity Authority Personnel, June 1976.

8. U.S. Environmental Protection Agency, "Effluent Guidelines and Standards - Steam Electric Power Generating Point Source Category," Federal Register Volume 39, No. 196, October 8, 1974.

9. U.S. Environmental Protection Agency, Public Health and Welfare Criteria for Noise, Washington, D.C., 550/9-73-002, 1973.

10. U.S. Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Washington, D.C., 1974.

11. U.S. Department of Labor, "Threshold Noise Exposure Levels, "Federal Register Volume 34, No. 96, Part II; as amended, Federal Register, Volume 39, June 3, 1974.

12. Rittenhouse, R.C. "Noise Control in Power Plants," Power Engineering, Volume 8, No. 7, 1976.

TABLE 7.1

NATURAL GAS SPECIFICATIONS[1]

Composition	%Vol	%Wt
Nitrogen	0.385	0.62
Carbone dioxide	0.688	1.72
Methane	92.766	48.49
Ethane	4.117	7.03
Propane	1.211	3.03
Butanes	0.529	1.74
Pentanes	0.165	0.68
Hexanes	0.138	0.67
Heptanes plus	0.001	0.02
	100.00	100.00

Molecular weight	17.57
Density g/l at N. T. P.	
at 60°F & 14.696 psia	0.784
Specific gravity (Air = 1) at 60°F	0.607
Dew point at delivery conditions	below 0 °C
Gross calorific value	
BTU/lb	23,056
BTU/ft^3 at 60 + °F & 14.696 psia	1,072.6
at N. T.P.	1,133.7
Kcal/m^3 at 60 °F & 14.696 psia	9,545
at N. T. P.	10,090
Sulphur content ppm (max)	10
Ton Fuel Oil	0.781 ton gas
Ton gas	1.282 ton fuel
Ton gas	1,348 M^3 gas at 60°F 14.696 psia
Ton Fuel Oil	1,053 M^3 gas at 60°F 14.696 psia
Ton gas	1,276 M^3 gas at N. T.F
Ton Fuel Oil	997 " " " " " "
Cuft/therm at 60 °F & 14.696 psia	93.2
at N. T. P.	88.2

TABLE 7.2

MAZOUT SPECIFICATIONS[1]

Item	Description	Meas. Unit	Indices of Fuel Quality
1	Specific Weight at 15°C	g/m^3	0.945
2	Viscosity at 38°C	°E	38
	at 50°C	°E	22.6
3	Freezing temperature	°C	13 max.
4	Ignition temperature	°C	70 min.
5	Moisture content	%	1.0
6	Ash content	%	0.3
7	Sulfur content	%	3.0 - 5.0 max.
8	Carbon content	%	85
9	Hydrogen content	%	10.7
10	Oxygen content	%	Not present
11	Nitrogen content	%	Not present
12	Vanadium content	%	0.002 - 0.003
13	Net Heating value	$\frac{kcal}{kg}$	9500

TABLE 7.3

EGYPTIAN STANDARD SPECIFICATION[1]
FOR
GAS OIL (SOLAR OIL)

Sp. gr. at 15.4°C	(min)	0.82
	(max)	0.87
Colour ASTM	(max)	4.5
Flash point P.M. closed °C	(min)	55
Viscosity red I at 100°F	(min)	30
	(max)	45
Pour point °C winter (xx)	(max)	4.5
summer	(max)	10
Sediment % Wt.	(max)	0.01
Water content % vol.	(max)	0.15
Ash content % Wt.	(max)	0.01
Conradson carbon % Wt.	(max)	0.01 (x)
Total sulphur content % Wt.	(max)	1.5
Inorganic acids and bases		Nil
Distilled at 350°C % vol.	(min)	80
Diesel indexes	(min)	48
Net filtration at 100°C		
before storage	(max)	--
after 24 hrs. storage	(max)	--
Solid asphalt	(max)	--
Copper strip test at 100°C	(max)	Division I
Calorific value (gross) cal/g	(min)	10550

(x) On 10% residue from distillation
(xx) Winter = From 1st of November to end of March
Summer = From 1st of April to end of October

TABLE 7.4

EXPECTED TOTAL MASS EMISSION RATES OF POLLUTANTS FROM THE PROPOSED ISMAILIA THERMAL ELECTRIC POWER STATION OPERATING AT PEAK LOAD

Mazout Fired Operation	lb/hr	kg/hr
Particulates	526	239
Sulfur Dioxide	10,540 - 17,560	4,780 - 7,965
Nitrogen Oxides	2345	1054
Natural Gas Fired Operation		
Particulates	0.1	0.05
Sulfur Dioxide	16	7
Nitrogen Oxides	1105	501

TABLE 7.5

UNITED STATES NATIONAL AMBIENT AIR QUALITY STANDARDS[2]

	Primary Standard Micrograms/ Cubic Meter	Secondary Standard Micrograms/ Cubic Meter
1. Particulate Matter		
a) Annual geometric mean	75	60
b) Maximum 24-hour concentration*	260	150
2. Sulfur Oxides		
a) Annual arithmetic mean	80 (0.0306 ppm)	
b) Maximum 24-hr concentration*	365 (0.14 ppm)	
c) Maximum 3-hr concentration*	-	1,300 (0.497 ppm)
3. Nitrogen Dioxide		
a) Annual arithmetic mean	100 (0.053 ppm)	100 (0.053 ppm)
4. Carbon Monoxide		
a) Maximum 8-hr concentration*	10,000 (9 ppm)	10,000 (9ppm)
b) Maximum 1-hr concentration*	40,000 (35 ppm)	40,000 (35 ppm)
5. Hydrocarbons		
a) Maximum 3-hr concentration* (6 am - 9 am)	160 (.24 ppm)	160 (.24 ppm)

[illegible] to be exceeded more than once per year at a location.

TABLE 7.6

ESTIMATED PLANT DESIGN PARAMETERS
FOR DIFFUSION ANALYSIS

(MAZOUT FIRED)

Normal Rating (MW)	300
Heat Input (MBTU/hr)	3000×10^6
Fuel Rate (lb/hr)	175,440
Flue Gas Exit Velocity (m/sec)	13.72
Heat Release (cal/sec)	0.1164×10^8
Stack Exit Temperature ^oC	148.8
Stack Height (m)	45.72
Stack Diameter (m)	6.1

TABLE 7.7

ESTIMATED DETERIORATION OF AIR QUALITY
DUE TO OPERATION OF ISMAILIA POWER PLANT
OPERATING AT PEAK LOAD

MAZOUT

Pollutant	Type and Period of Averaging	Estimated Degradation of Air Quality ($\mu g/m^3$)
Suspended Particulates	Max. Annual (Geometric Mean)	0.7
	Max. 24 Hour	21
	Max. Hourly	36
Sulfur Dioxide	Max. Annual (Arithmetric Mean)	24
	Max 24 Hour	716
	Max. Hourly	1211
Nitrogen Dioxide	Max. Annual (Arithmetric Mean)	7
	Max. 24 Hour	95
	Max. Hourly	161

TABLE 7.8

SUMMARY OF UNITED STATES ENVIRONMENTAL PROTECTION AGENCY EFFLUENT LIMITATION GUIDELINES FOR NEW GENERATING SOURCES[8]

Pollutant	Limitation
a) 1. Heat (except heat in blowdown, low and intermediate volume source*)	No discharge permitted effective July 1, 1979. Must be at coldest point in the system
2. Heat from blowdown	
b) Clarification Water Treatment	No discharge permitted
c) Free available chlorine (from circulating water system)	0.2 mg/l Average (Avg) 0.5 mg/ l 2-Hr max. per day
Total residual chlorine	No discharge except as above-forementioned and only 1 unit may be chlorinated at any given time.
d) Polychlorinated biphenyl Transformer fluid	No discharge permitted
e) Total Iron (low-vol sources)	1 mg/l x Q - Daily Avg. Amount (flow)
Total Copper (low-vol sources)	1 mg/l x Q - Daily Avg. Amount
f) 1. T.S.S. (low-vol sources)	30 mg/l x Q - Daily Avg, Amount 100 mg/l x Q - One Day Max.
2. T.S.S. (recirculating cooling water systems)	30 mg/l x Q - Daily Avg. Amount 100 mg/l x Q - One Day Max.
3. T.S.S. (non-recirculating ash sluicing & non-recirculating air pollution wet scrubbers)	30 mg/l x Q - Daily Avg. Amount 100 mg/l x Q - One Day Max. above inlet amount
4. T.S.S. (waste from rainfall runoff including coal pile, yard & roof drainage, and construction)	30 mg/l Avg. concentration during time span of event 100 mg/l Max. at any time
g) pH (all streams discharged except non-recirculating cooling water.)	6.0 - 9.0 range
[illegible] Waste Water	Applicable [illegible]

Table 7.8
(Cont'd)

i) Debris (intake screens)	No discharge
j) 1. Oil & Grease (Low-Vol)	15 mg/l x Q - Daily Avg. Amount 20 mg/l max. concentration
2. Oil & Grease (recirculating cooling water system)	15 mg/l x Q - Daily Avg. Amount
3. Oil & Grease (rainfall runoff source)	15 mg/l during time span 20 mg/l at any time
4. Oil & Grease (nonrecirculating ash sluicing & nonrecirculating wet scrubber)	15 mg/l x Q - Daily Avg. Amount
k) Combined Wastes: Pollutant Amount Pollutant Concentration	Sum of each individual amount Appropriate dilution factor Actual amount where actual amount is less than the effluent limitation.

*The term "low-volume waste sources" means waste water from boiler blowdown, exchange water treatment wastes, water treatment evaporator blowdown, boiler tul cleaning, boiler fireside cleaning, air preheater cleaning, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes, blowdown from recir ulating ash handling systems, blowdown from recirculating wet-scrubber air pollut control systems, stack cleaning, miscellaneous equipment cleaning, recirculating l service water systems, and other waste sources of comparable volume.

The term "intermediate volume waste sources" means blowdown from recirculating main condenser cooling water systems, waste water from nonrecirculating ash han systems, and waste water from nonrecirculating wet-scrubber air pollution control systems.

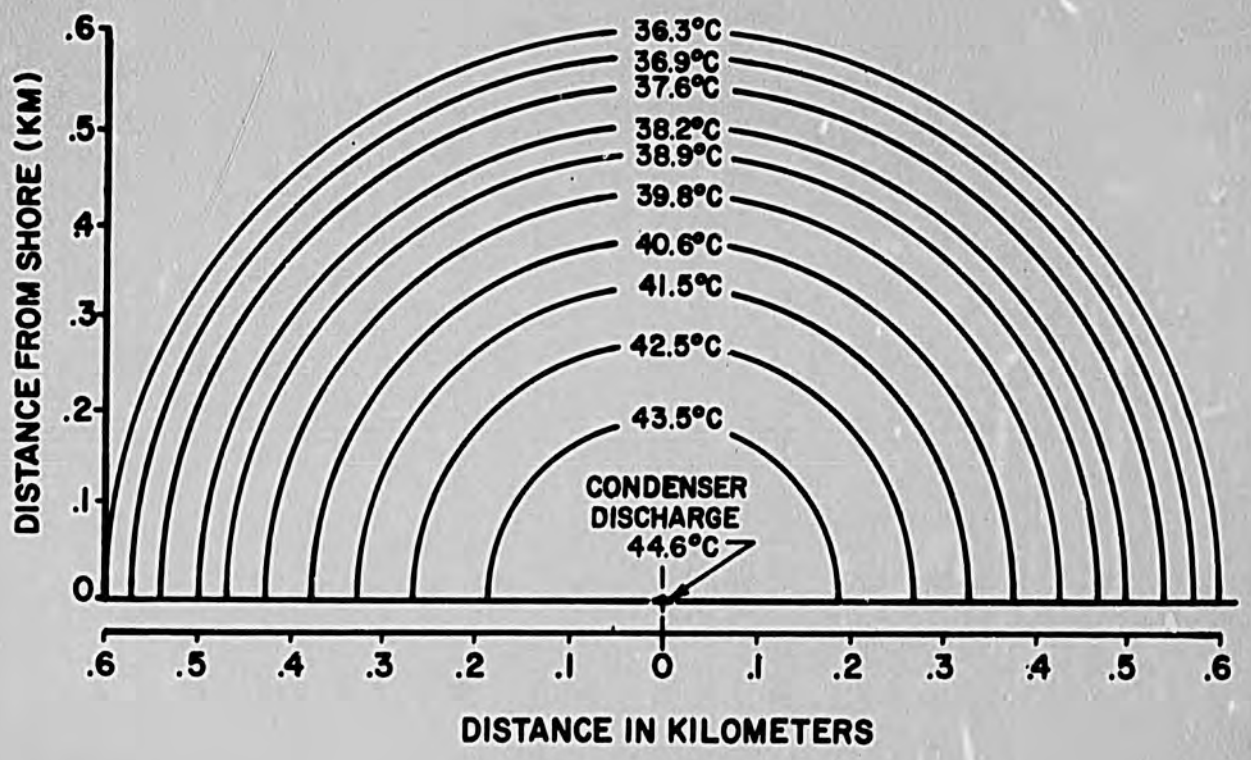
TABLE 7.9

THRESHOLD NOISE EXPOSURE LEVELS[12]

Duration Hours per Day	Sound Level dBA (Slow Response)
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

TEMPERATURE PROFILE FOR CONDENSER DISCHARGE TO GREAT BITTER LAKE

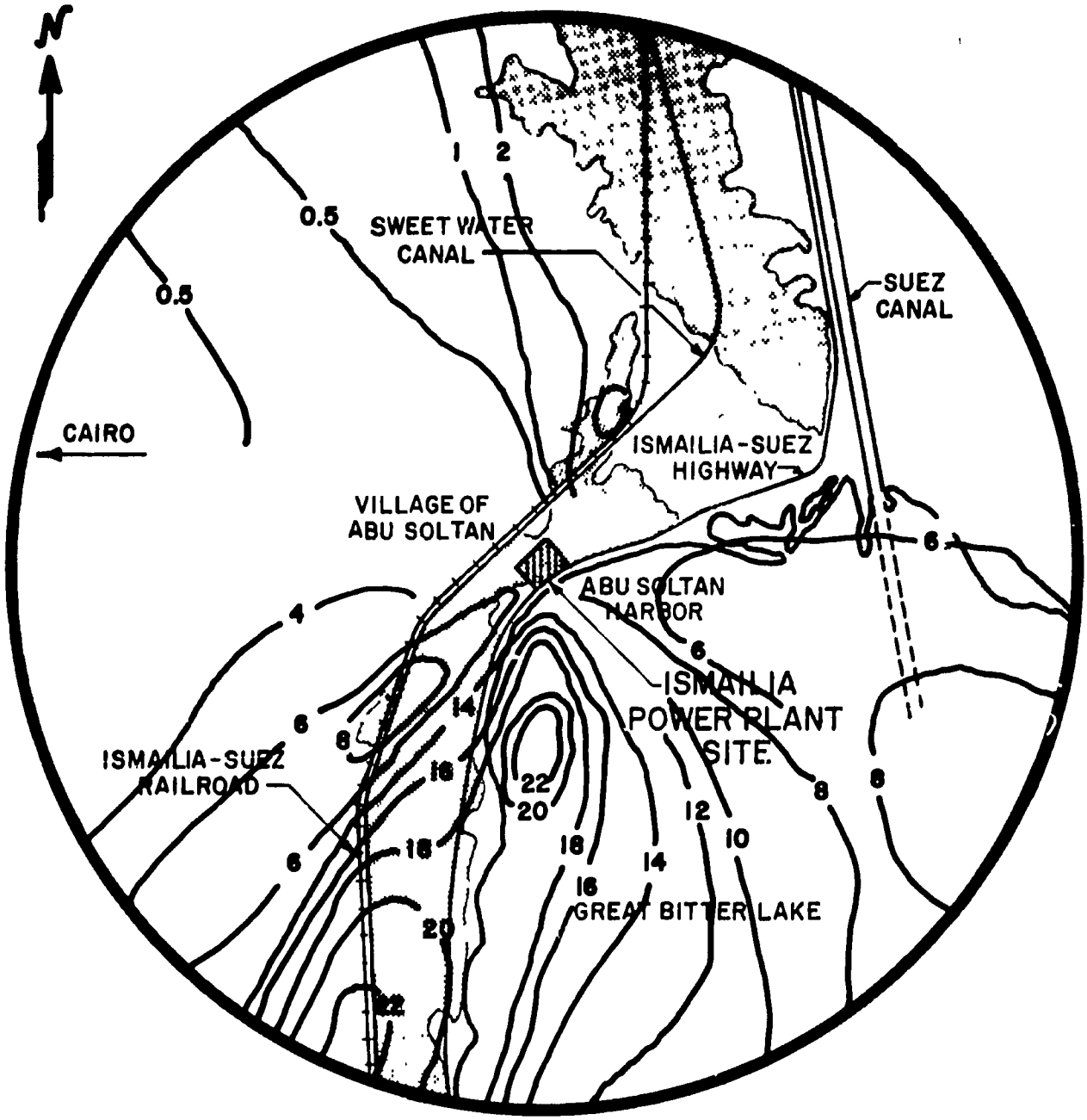
(FOR MONTH OF JULY)



BASIS:

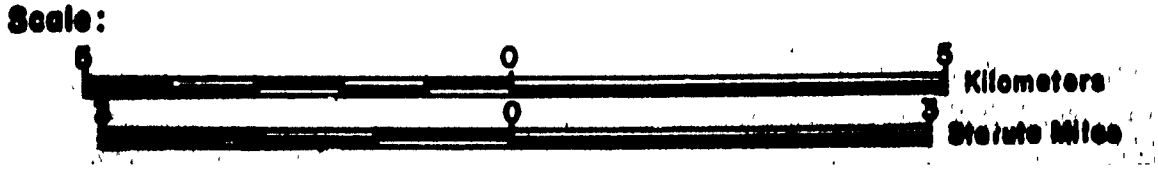
1. HEAT DISSIPATION AREA = 140 ACRES
2. DISTANCE BETWEEN CONDENSER DISCHARGE AND INTAKE = 0.6 KM

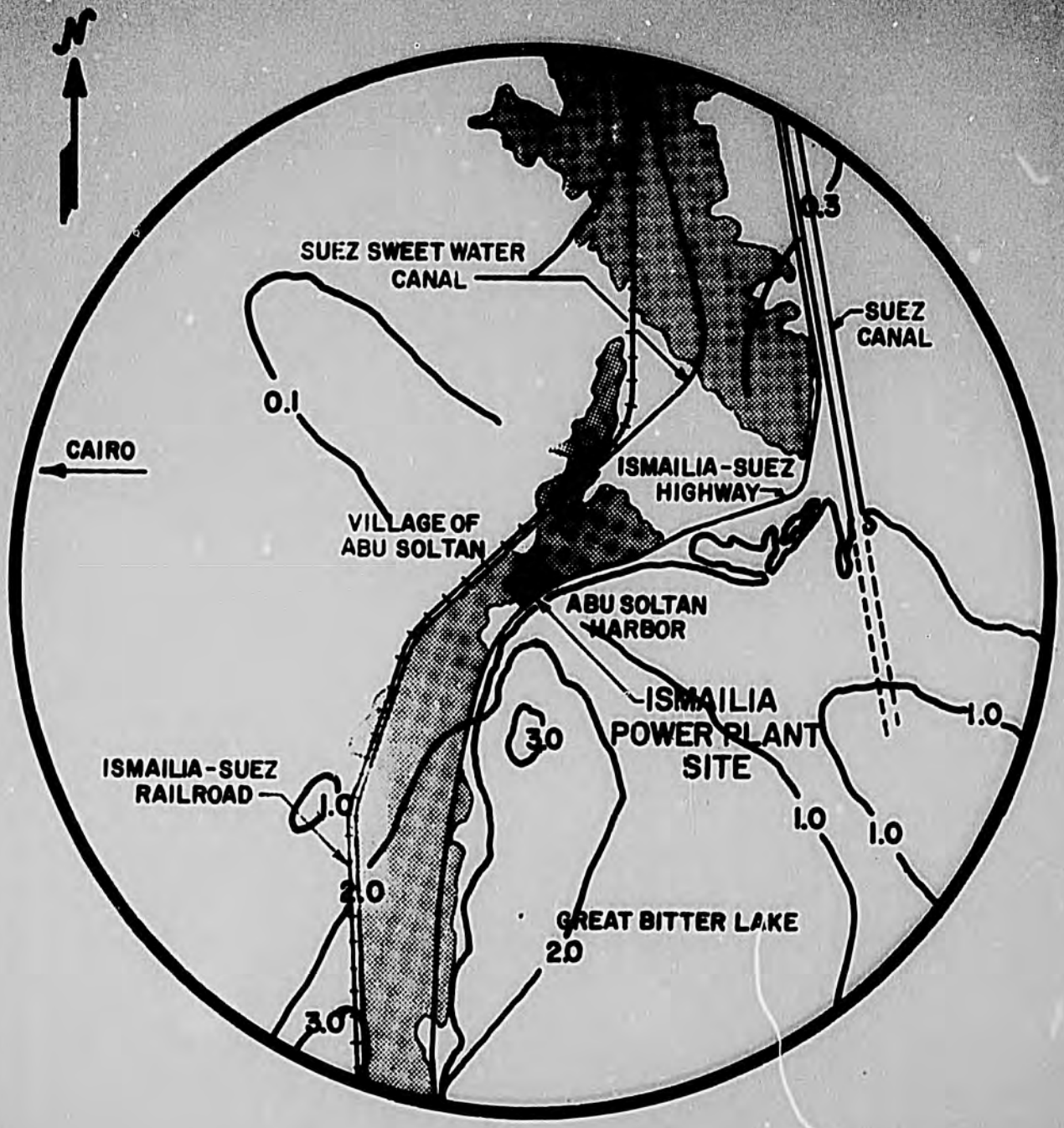
Figure-7.1
EGYPTIAN ELECTRICITY AUTHORITY
ARAB REPUBLIC OF EGYPT
DISCHARGE [illegible]
[illegible]



ANNUAL AVERAGE GROUND LEVEL CONCENTRATION ($\mu g/m^3$) OF SULFUR DIOXIDE MAZOUT FIRED

Figure-7.2





ANNUAL AVERAGE GROUND LEVEL CONCENTRATION ($\mu g/m^3$) OF NITROGEN DIOXIDE MAZOUT FIRED

Figure-7.3

Scale:

5 0 5 Kilometers

0

SECTION 8.0

GLOSSARY OF TERMS AND ABBREVIATIONS

BTU	British Thermal Unit
cal	Calories
dBA	Decibels 'A' Scale
Kcal	Kilo Calories
KW	Kilowatts
MBTU	Million British Thermal Units
Mcal	Million Calories
MW	Megawatts
^{o}C	Degrees Celsius
g	Grams
hr	Hour
m	Meters
μg	Micrograms (10^{-6} grams)
sec	Seconds
g/l	Grams Per Liter
Kcal/kg	Kilo Calories Per Kilogram
lb/hr	Pounds Per Hour
lb/MBTU	Pounds Per Million British Thermal Unit
ppm	Parts Per Million