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ENVIRONMENTAL REVIEW of Proposed Power Plants at

HELWAN and TALKHA
ARAB REPUBLIC of EGYPT
April 1976

SANDERSON & PORTER INC
New York New York

Agency for International Development/Work Order No. 6/Contract No. [redacted]

SANDERSON & PORTER, INC.

ENGINEERS - CONSTRUCTORS - MANAGEMENT CONSULTANTS
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May 12, 1976

Project Manager, Egypt Division
Office of Capital Development
Near East Bureau
Agency for International Development
Washington, D. C. 20523

Attn: Mr. Thomas A. Sterner

AID Requirements Contract No. AID/otr-C-1305
Work Order No. 6
Environmental Review of Proposed Power
Plants at Helwan and Talkha
Arab Republic of Egypt
Final Report
S&P J/O No. 4985

Gentlemen:

In accordance with the instructions contained in Article IV A of Work Order No. 6 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. Based on additional study and review, we have changed our recommendation that the gas turbine units be housed in a building. While you may wish to give consideration to this for other reasons, such as ease of maintenance in a relatively dust free environment, we cannot justify the expenditure for this method of noise attenuation. Consequently, we now recommend that sound attenuated gas turbine units be purchased.

Your work order for this project encompassed three sites, namely, Ismailia, Helwan, and Talkha. The Ismailia site, however, was not confirmed at the time of our field work. AID/Cairo accordingly instructed our field team to make only a cursory inspection of three tentative sites in the Ismailia area. In further compliance with these instructions, we have omitted Ismailia from this Final Report.

It has been a pleasure to undertake this Environmental Study and we trust that this study has been completed to your satisfaction. We will be glad to review this study with you at your convenience, and to undertake the Environmental Review of the Ismailia Plant when the location of the site is confirmed.

Very truly yours,

SANDERSON & PORTER, INC.

A. H. Ferber

A. H. Ferber
Manager of Consulting Engineering

MST:tmd

encls.

ENVIRONMENTAL REVIEW
OF
PROPOSED POWER PLANTS
AT
HELWAN AND TALKHA
ARAB REPUBLIC OF EGYPT

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

APRIL, 1976

SANDERSON & PORTER, INC.
NEW YORK, NEW YORK

TABLE OF CONTENTS

		PAGE NO.
1.0	INTRODUCTION	1
2.0	CONCLUSIONS AND RECOMMENDATIONS	3
3.0	PROPOSED HELWAN COMBUSTION GAS TURBINE GENERATING PLANT	7
3.1	Overall Project Description	7
3.1.1	Site Description	7
3.2	Nature of Surrounding Environment	9
3.3	Proposed Utility Services	10
3.3.1	Fuel	10
3.3.2	Water	12
3.3.3	Sewerage	13
3.3.4	Power	13
3.4	Proposed Power Generating Facilities	13
3.5	Probable Environmental Impact	14
3.5.1	Impact on Human Activities During Construction	14
3.5.2	Impact on Air Quality During Construction	15
3.5.3	Impact on Surrounding Ecology	15
3.5.4	Physiological Impact	16
3.5.5	Impact on Land Utilization	16
3.5.6	Impact on Water Resources	16
3.5.7	Noise	16
3.5.7.1	Noise Level Criteria	16
3.5.7.2	Existing Noise Levels	20
3.5.7.3	Expected Noise Levels From Operation of the Proposed Power Plant	20
3.5.7.4	Effects of Noise on the Environment	22
3.5.8	Expected Air Emissions From Operation of the Combustion Gas Turbines	23
3.5.8.1	Effects of Air Emissions on the Environment	29

TABLE OF CONTENTS (Cont'd)

		PAGE NO.
4.0	PROPOSED TALKHA COMBUSTION GAS TURBINE GENERATING PLANT	30
4.1	Overall Project Description	30
4.1.1	Site Description	30
4.2	Nature of Surrounding Environment	33
4.3	Proposed Utility Services	34
4.4	Proposed Power Generating Facilities	35
4.5	Probable Environmental Impact	36
4.5.1	Impact on Human Activities During Construction	36
4.5.2	Impact on Air Quality During Construction	37
4.5.3	Impact on Surrounding Ecology	37
4.5.4	Physiological Impact	37
4.5.5	Impact on Land Utilization	38
4.5.6	Impact on Water Resources	38
4.5.7	Noise	38
4.5.7.1	Noise Level Criteria	38
4.5.7.2	Existing Noise Levels	39
4.5.7.3	Expected Noise Levels From Operation of the Proposed Power Plant	39
4.5.7.4	Effects of Noise on the Environment	39
4.5.8	Expected Air Emissions From the Operation of the Combustion Gas Turbines	41
4.5.8.1	Effects of Air Emissions on the Environment	44

LIST OF TABLES AND FIGURES

TABLE NOS.	DESCRIPTION
3.2	Climatological Data for the Helwan Area
3.3	Threshold Noise Exposure Levels
3.4	Egyptian Standard Specification for Gas Oil (Solar Oil)
3.5	Approximate Composition of Sales Gas from Abu Gharadic
3.6	Expected Total Mass Emission Rates from the Proposed Helwan Station
4.2	Expected Total Mass Emission Rates from the Proposed Talkha Station

FIGURE NOS.	
3.1	Site Plan Helwan
4.1	Site Plan Talkha

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 for the construction and operation of two proposed power plants.

The report has been prepared in compliance with directions received from the Agency for International Development (AID), as described in their Work Order No. 6 to Contract No. AID/otr-C-1305, dated March 5, 1976. This work order encompasses an Environmental Review, very brief in nature due to the short period of time allotted for the study.

The general objectives of this study are to review the effects upon the physical environment which will result from the construction and operation of two power plants whose sites were selected by EEA, to analyze possible remedial measures designed to alleviate any of such effects, and to provide order-of-magnitude estimates for such remedial measures. The two power plants are identified as:

1. A 120 MW plant at Helwan consisting of several combustion turbines.

2. A 180 MW plant at Talkha consisting of several combustion turbines.

The specific objectives of the study are:

1. To review the effects of noise pollution on the environment resulting from the combustion turbines at the Helwan and Talkha power plants.

2. To make recommendations for alleviating pollutional problems including order-of-

magnitude cost estimates.

To accomplish this work, S&P dispatched a three-man study team to Egypt during the month of March, 1976, to confer with representatives of EEA and to perform field inspections of the two proposed power plant sites. The group spent a period of approximately two weeks in Egypt collecting data and making field inspections of the two proposed power plant sites.

The team inspected both of the proposed sites, collected pertinent data and prepared informally written interim reports which were presented to AID and EEA representatives in Cairo. Upon return to the United States, copies of the interim reports were sent to the appropriate offices of AID in Washington, D. C.

This final report develops to a greater depth the information contained in the interim reports. Based on additional study and review, it presents conclusions and recommendations that differ in some respects from those in the interim reports. This final report completes the requirements of the assignment.

2.0 CONCLUSIONS AND RECOMMENDATIONS

2.1 Conclusions

The following conclusions have been reached after review and analysis of field observations and pertinent data collected, as related to the environmental impact associated with the construction and operation of the proposed Helwan and Talkha Gas Combustion Turbine Plants.

1. Expected in-plant noise levels resulting from the operation of the proposed generating facilities at Helwan and Talkha will vary from 110 dBA to 120 dBA. These values are based on sound pressure levels generated by typical turbine generators. Exposure of plant personnel to these sound levels for long durations of time may cause hearing impairment.

2. Noise levels resulting from operation of the proposed generating equipment at Helwan and Talkha are not expected to have any adverse effects upon the inhabitants of existing or proposed residential communities in the immediate vicinities of the plant sites.

3. The proposed site at Talkha for the construction of additional electric power generation units is at best marginal with respect to noise criteria effecting in-plant personnel.

4. The area originally allocated by EEA for construction of the 180 MW complex at the Talkha Station is of insufficient size.

5. Construction of the proposed facilities at Talkha, requires expansion of the present plant

area. The acquisition of approximately 16,000 square meters (1.6 hectares) of land potentially suitable for agriculture is necessary. Acquisition of this small parcel of land is justifiable in view of the impending need for expanded generating capability at the Talkha Station.

6. Fugitive dust raised by vehicles and machinery during construction at the proposed Talkha Station will create a nuisance to plant personnel.

7. Field observations of the solar oil storage tank, for the proposed Talkha Station, indicate that a potential oil spill hazard exists. A major rupture could contaiminate the Sahel Canal.

8. Emission rates for the gas turbines at the Helwan and Talkha Stations were calculated. The Arab Republic of Egypt has no regulations governing emissions. The calculated rates are in excess of the United States Environmental Protection Agency standards by a factor of approximately two.

9. Diffusion analyses of the gas emissions from the combustion gas turbines were not performed, therefore, no expected impact upon air quality or local inhabitants could be predicted.

10. The construction of the two proposed gas turbine electric generating facilities will have no significant adverse effects upon the environment.

2.2 Recommendations

As a result of our studies, we recommend that the following measures be taken:

1. Expand the area originally allocated by EEA for construction of the 180 MW complex at the Talkha Station, by approximately 16,000 square meters (1.6 hectares).

2. Construct a dike isolating the proposed solar oil storage tank area at the Talkha Station. The order of magnitude cost estimate for construction of this dike is $300,000. Similar construction could be justified for the other existing tanks. It is not included here since this report is addressed only to the facilities associated with the Gas Turbine Plant.

3. Control fugitive dust at the Talkha Station by wetting or by the application of calcium chloride during construction.

4. Include Noise Control Requirements in the specifications for the procurement of equipment and machinery for both the Helwan and Talkha Stations.

   The specifications must limit the sound pressure levels generated by any piece of machinery or combination of pieces used as a system. This includes auxiliaries not furnished as an integral part of the turbine generator package. The limiting values are as follows:

   A. Ninety dBA at a distance of 3 meters from any part of the machine or system, when measured on the "A" scale of a standard sound level meter.

   B. Impulse noise in excess of one hundred forty

dBA peak sound pressure level at the operator location and also within 1.5 meters of any part of the equipment or system.

C. Seventy dBA at a distance of 120 meters from the gas turbine generators and their auxiliaries, when measured on the "A" scale of a standard sound level meter.

5. Require plant personnel to wear ear protection devices when working for extended periods of time in close proximity to the turbine generators at the Helwan and Talkha Stations.

6. Provide sound attenuated control rooms for the occupational safety and health of control room personnel at the Helwan and Talkha Stations.

7. To ensure environmental compatibility of these projects, the following studies, not within the scope of this assignment, should be undertaken.

Prepare an Oil Spill Prevention Control and Countermeasure Plan for the Talkha Station.

Perform a dispersion analysis of air pollutants for both the Helwan and Talkha Stations.

3.0 PROPOSED HELWAN COMBUSTION GAS TURBINE GENERATING PLANT

3.1 Overall Project Description

The Egyptian Electricity Authority proposes to construct and operate a 120 MW total capacity electric power generating station at a site generally referred to as Helwan. This site is approximately 35 kilometers south of the city of Cairo, Egypt. It is situated in the southern portion of the industrial complex known as the Helwan District. The station will utilize multiple modules of combustion gas turbine electric generators.

3.1.1 Site Description

The site upon which the project is to be constructed is shown in Figure 3.1. This is a plot of vacant land on the southwesterly corner of the tee-shaped junction where Msaged Street terminates at Monrail Highway. The northerly and easterly boundaries of the plot are parallel to these respective highways. The area of the plot is approximately 80,750 square meters (8 hectares). The easterly boundary of the plot is approximately 125 meters from and parallel with the center of Monrail Highway, while the northerly boundary is approximately 50 meters from and parallel with the center of Msaged Street.

Across Msaged Street to the north there is presently being constructed a walled enclosure for a new 66/220 kV electric substation. This walled enclosure is roughly the same size as proposed for the power

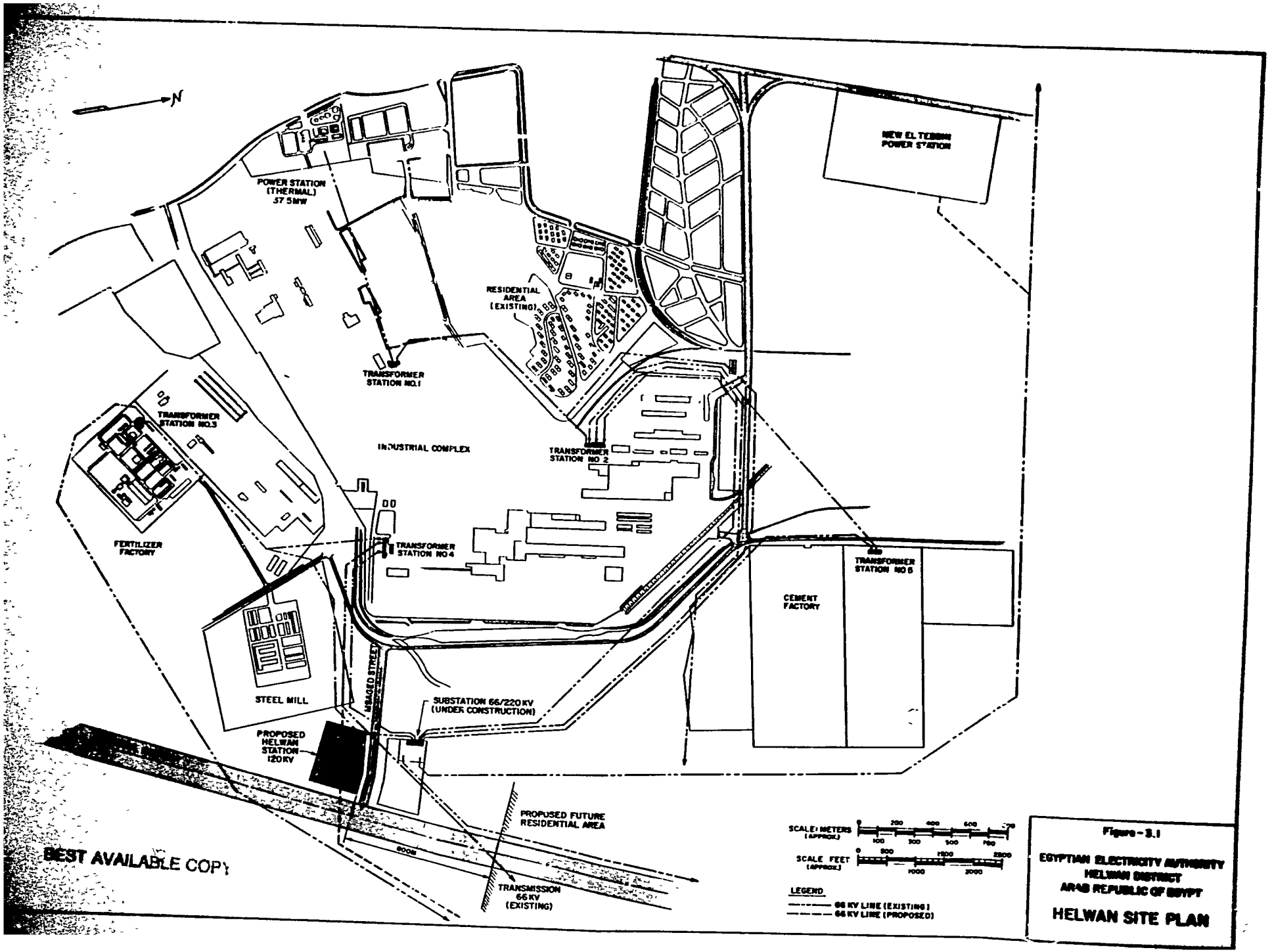

Figure - 3.1

EGYPTIAN ELECTRICITY AUTHORITY
HELWAN DISTRICT
ARAB REPUBLIC OF EGYPT

HELWAN SITE PLAN

BEST AVAILABLE COPY

generation plot complex. The parallel distance between the proposed power station plot boundary and the substation enclosure wall is approximately 120 meters across Msaged Street.

The nearest existing residential housing is approximately 2 kilometers in a northwesterly direction from the nearest proposed site boundary.

3.2 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.

The proposed Helwan combustion gas turbine power generating plant is intended to operate in an existing heavy industrial area, where cement, iron, and steel plants are presently located. All existing industrial development has been to the west and northeast of the intended site. The nearest industry is a steel plant located about 600 meters from the nearest plot boundary.

The general area terrain may be characterized as undulating, sandy and presently in a non-cultivated state. The topography is flat with elevations ranging between 47.5 and 48.5 meters above sea level. The nearest population center is about 2 kilometers northeast of the site.

It has been reported that a population unit of about 20,000 persons is proposed for location at approximately 800 meters from the proposed site boundary. A major highway is being proposed for access to

the site and to the population unit, and this road will be in close proximity to the plant site.

A brief environmental inventory of the proposed plant site indicates that the area is devoid of any native flora and probably sparsely inhabited with indigenous fauna. No rare or unique species or ecosystems were observed in the plant site area.

The climatological data for the area is shown in Table 3.2.

The average maximum air temperature at the site area is 41.5°C and the average minimum air temperature is 1.7°C. The prevailing wind direction at the site varies from northwest to northeast, occurring 34% of the time from the north, 23% of the time from the northwest and 17% of the time from the northeast. The prevailing wind speed varies between 13 km/hr and 20 km/hr.

No historical or archaelogical sites are known to exist in the immediate plant area.

3.3 Proposed Utility Services

It is proposed that general utility services such as fuel, water, sewerage and power will be maintained and expanded in the general area of the site to accommodate not only the plant needs but also the needs of the proposed new population center. This center, planned to accommodate 20,000 persons, is proposed for construction about 800 meters along Monrail Highway in a northerly direction from the proposed power generation site.

3.3.1 Fuel

It is proposed that natural gas will be the base fuel used to fire the gas turbines driving the electric generators. The

TABLE 3.2

CLIMATOLOGICAL DATA FOR THE HELWAN AREA

Mean air temperature and humidity:

May - October	23.5 - 27.5°C	41 - 59%
March	16.4	52
April	20.4	45
November	19.0	62
December-February	12.3 - 14.1	52 - 62
Maximum air temperature (June-August)		41.5°C
Minimum air temperature (February)		1.7°C

Direction and velocity of wind:

Direction	Occurrence
N	34%
NW	23%
NE	17%
The other five directions	4 - 7% each
Calmness	2%
Prevailing wind velocity	13 - 20 km/hr
Max. infrequent wind velocity from SW	122 km/hr

Normal monthly precipitation:

October - May	1 - 5 mm
June - September	0 mm

Maximum value of daily precipitation:

October - May	20 - [illegible]

existing underground gas mains will be extended and enlarged to serve this need. It is expected that natural gas main pressures will not be stable or adequate to serve the turbine combustor nozzles, therefore, gas booster compressors and accumulators would be utilized at the site to serve the gas turbines.

Since the gas turbines will have a two-fuel capability for selective firing, No. 2 fuel oil (solar oil), or equal viscosity distillate will also be used. This fuel oil will be transported to the site by truck and stored in welded steel storage tanks. It will be pumped from storage to day tanks in such an arrangement as best suits the mechanics of the operation. It is contemplated that neither storage tanks or day tanks will be located inside structures.

3.3.2 Water

It is noted that water mains in the general area adjacent to Msaged Street will be maintained and expanded to serve the power plant as well as the new population center to the north.

While the specifications provided by EEA for bidding by contractors states that no water supply for cooling is available, this generally refers to once-through or evaporative cooling. It is expected that the successful contractor will use water in a closed loop for sensible cooling, using air as the heat sink for both oil cooling and generator ventilation thermal depression.

It is anticipated that there will be approximately five men stationed at the site during

normal plant operation. These men will be furnished with toilet, drinking and washing facilities requiring water in addition to that provided for tank make-up for the closed system cooling.

3.3.3 Sewerage

It is proposed that existing sewerage facilities in the form of maintained and expanded mains along Msaged Street will be utilized for washing and toilets at the plant, together with the proposed new population center to the north.

3.3.4 Power

Power for installation and auxiliary use at the site will be furnished at the site through station service step down transformers. Black start will be provided through an auxiliary internal combustion engine driven generator. All station export power will be fed underground through conduit under Msaged Street to the 66/220 kV substation.

3.4 Proposed Power Generating Facilities

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

Four 30 MW combustion gas turbine generators or six 20 MW units, to be left to the discretion of the successful bidder, to provide a total nominal capacity of 120 MW as available export capacity from the plant.

One diesel type internal combustion engine generator of sufficient capacity to serve as a station auxiliary and to provide black start capability.

Fuel oil storage tanks and day tanks.

Radiators and storage tanks for sensible cooling, with water to air cooling in a closed loop system.

Office and toilet facilities for plant personnel.

3.5 Probable Environmental Impact

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

Each of man's construction activities generates some degree of disruption to the environment. Temporary disruptions may be reversed, whereas permanent ones cannot. The anticipated environmental changes accompanying the construction and operation of the proposed facility will be minimal. The impact on human activities, land use, and ecological systems and noise pollution are discussed in the following sections.

The only source of pollutants from the plant operation that might possibly have an adverse effect upon the environment are those generated from the burning of natural gas or solar oil and the noise levels produced by the turbines and generators. No liquid or solid wastes will be generated by this station; therefore, no thermal or solid waste disposal impacts are considered in this report.

3.5.1 Impact on Human Activities During Construction

The impact on human activity during construction of the proposed facility can best be described as a positive one. Construction will be in an area of sparse

settlement and the construction period should be of relatively short duration. Due to the distance of the site location from the nearest city, noise, dust and smoke disturbances from transportation vehicles and construction will be of an inconsequential nature. Although construction will give rise to increased vehicular traffic, the rural nature of the site location is such that there are no heavily used roads, and local residents should not experience inconveniences due to traffic.

3.5.2 Impact on Air Quality During Construction

Construction activities, if unsupervised, can produce increased localized fugitive dust conditions. At the proposed site the nearest dwellings are sufficiently far removed to minimize off-property public nuisance. Fugitive dust raised by moving vehicles and machinery is not expected to create an off-property dust nuisance of greater magnitude than the dust normally raised by the severe winds.

3.5.3 Impact on Surrounding Ecology

Little or no impact is expected upon flora, and fauna of the area as a result of construction and operation activities. Any wildlife in the area will experience temporary stimuli, due to noise, dust and smoke. These stimuli will effect their daily movement and other activities. The actual area affected will be only a small fraction of the total ecological region and serious disturbances to any ecosystems are not expected. Ecological impact due to construction is not anticipated to be a

long term one, with the area returning to its present state soon after the building project is completed.

3.5.4 Physiological Impact

Noise generated during the construction period will have a physiological impact on the human environment. The noise associated with heavy construction operation is objectionable in confined areas or near-developed areas. The rural and industrial nature of the proposed site location is such that no great disturbances are anticipated.

3.5.5 Impact on Land Utilization

No discernable impact on land utilization at the site area will occur. The proposed facility is located in an existing industrial complex area. The construction and operation of the power generating plant will be compatible with existing facilities and land use patterns.

3.5.6 Impact on Area Water Resources

The proposed plant will have minimal water usage and its construction and operation should exert little or no stress upon the area water supply or the aquatic environment.

3.5.7 Noise

3.5.7.1 Noise Level Criteria

Threshold limit values refer to the sound pressure levels that represent conditions 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 defined hearing impairment as an average hearing threshold level in excess of 25 dB (ANSI 53.6 - 1969) at 500, 1000 and 2000 Hz, and limits have been established to prevent a hearing loss in excess of this value. This level should be used as a guide in the control of noise exposure and should not be regarded as a fine line between safe and dangerous levels.

When employees are subjected to sound levels exceeding those listed in Table 3.3, feasible administrative or engineering control should be utilized. If such controls fail to reduce sound levels to within the levels of Table 3.3 personnel protective equipment should be provided.

The Intersociety Committee on Noise Exposure (USA), American Academy of Opthamology and Otolaryngology and Western Electric Hawthorne Works studies have indicated that long exposure to high levels of continuous noise may cause a hearing impairment. The more common form of

TABLE 3.3

THRESHOLD NOISE EXPOSURE LEVELS

Duration Hours per Day	Sound Level - dBA (Slow Responses)
8	90
6	92
4	95
3	97
2	100
$1\frac{1}{2}$	102
1	105
$\frac{1}{2}$	110
$\frac{1}{4}$ or less	115

Source: U.S. Department of Labor - Federal Register, Vol. 34, No. 96, Part II, and Amended, Federal Register, Vol. 39, Page 19468, June 3, 1974.

damage encountered in industry is called noise induced hearing loss. This hearing loss occurs when an individual is exposed to high noise levels over a long period of time. Noise induced hearing loss appears as a result of the damage done to tiny hair cells in the inner ear or nerve endings by the high level sound pressure waves. This type of hearing loss is caused primarily by the higher frequencies in the hearing range of the ear. Noise induced hearing loss occurs gradually over a worker's years on the job.

Investigations in the field of noise exposures and hearing impairment have indicated that noise level exposures greater than those shown in Table 3.3 are detrimental and may cause hearing impairment. When the daily exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered rather than the individual effect of each. If the sum of the fractions -

$$\frac{C1}{T1} + \frac{C2}{T2} + \frac{C3}{T3} + \ldots \frac{Cn}{Tn}$$

exceeds unity, (Cn indicates the total time of exposure at a specified noise level and Tn indicates the total time of

exposure permitted at that 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.

3.5.7.2 Existing Noise Levels

The existing ambient noise levels at the plant site, based on noise level measurements taken on a single visit to the site, varied between 20 dBA to 30 dBA.

3.5.7.3 Expected Noise Levels from Operation of the Proposed Power Plant

There are five primary sources of noise on the typical gas turbine power installation: the gas turbine intake; the gas turbine or free turbine exhaust; the body or casing of the gas turbine; the electric generator and the gas turbine auxiliaries such as the oil cooler, natural gas compressors, fuel pumps and diesel generator.

Typical sound pressure levels produced by a single gas turbine installation may vary from 90 dBA to 110 dBA at a distance of 1.5 meters from the gas turbine generator and its accessory equipment.

These values are dependent upon the turbine manufacturer and the type of installation.

In order to calculate the combined sound pressure level resulting from the operation of several combustion gas turbines, information concerning their installation configuration is required. This information was not available for the Helwan Station. We therefore assumed for our calculations, that six gas turbine units will be mounted parallel to each other. The combined sound pressure levels produced by such an installation arrangement will vary from 110 dBA to 120 dBA.

The total sound pressure level at the Helwan Station is the sum of the sound pressure levels generated by the proposed units and the existing ambient sound pressure levels. Since existing ainbient sound pressure levels are low, their addition to the levels generated by the proposed units will not change the total sound pressure level at the station significantly. Expected total sound pressure levels will be approximately 110 dBA to 120 dBA.

3.5.7.4 Effects of Noise on the Environment

The adverse effects of noise are associated principally with residential areas and in-plant personnel. The critical factors in the analysis of noise exposures are overall noise levels, composition of spectrum of the noise, duration and frequency of noise exposure, and total exposure time.

There is an existing residential area at a distance of 2,000 meters from the proposed plant site. It is reported that a residential area will be developed about 800 meters from the proposed plant boundary. The noise levels expected to be generated by the plant will not affect these two areas as they are of sufficient distance from the plant.

In general, the noise levels will be attenuated to half of their original value at a distance of about 120 meters. If one may assume a 110 dBA ambient noise level at the plant, the noise level at 120 meters will be approximately 55 dBA, and at 800 meters the level will be approximately 40 dBA.

Noise levels inside the station may vary between 110 dBA and

120 dBA. Exposure of personnel to these sound levels for long durations of time may cause hearing impairment unless protective equipment is used.

Earmuffs or plugs should be used by operators working in close proximity to the units for any extended period of time.

3.5.8 Expected Air Emissions from Operation of the Combustion Gas Turbines

The Arab Republic of Egypt, at present, has no emission limitations nor ambient air quality standards. The anticipated emissions from the gas turbines, were estimated during the general environmental assessment of the Helwan Plant. Various pollutants are emitted by combustion gas turbines. 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.

The formation of particulates can be very complicated but, in general, the particulates, other than soot, result from the ash in the fuels, the oxidation of ash-producing substances, and other matter which form solids or liquids. It is proposed to operate the Helwan combustion turbines on natural gas or solar oil. Tables Nos. 3.4 and 3.5 show the typical analyses of

TABLE 3.4

EGYPTIAN STANDARD SPECIFICATION FOR GAS OIL (SOLAR OIL)

Sp. gr. at 15/4°C	(min)	0.82
	(min)	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/gm	(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

Source: Conditions of Tender and Specifications Helwan Gas Turbine Plant - 120 MW

TABLE 3.5

APPROXIMATE COMPOSITION OF SALES GAS FROM ABU GHARADIC

	Average Vo. %	Average Wt. %
Nitrogen	0.51 - 0.68	0.75 - 1.03
Carbon	2.83 - 4.00	6.50 - 9.48
Methane	83.37 - 86.38	69.61 - 74.41
Ethane	10.18 - 8.13	15.94 - 13.13
Propane	3.02 - 0.75	6.93 - 1.77
I-Butane	0.06 - 0.04	0.18 - 0.12
N-Butane	0.03 - 0.02	0.09 - 0.06
Formula Weight	19.16 - 18.58	
Density g/l at N.T.P. at 60°F & 14.696 psia	0.855 - 0.829 0.809 - 0.784	
Specific gravity (air=1) at 60°F	0.662 - 0.641	
Dew point at delivery conditions	Below 32°F	
Gross calorific value BTU/lb BTU/cu.ft. at 60°F & 14.606 psia at N.T.P. K cal/M^3 at 60°F & 14.696 psia at N.T.P.	 21,427 1,071 1,132 9,530 10,078	
1 Ton fuel oil	0.840 Ton gas	
1 Ton gas	1.19 Ton fuel oil	
1 Ton gas	1256 M^3 gas at 60°F & 14.696 psia	
1 Ton fuel oil	1055 M^3 gas at 60°F & 14,696 psia	

Cont'd....

TABLE 3.5 (cont'd)

1 Ton gas	1187 M^3 gas at N.T.P.
1 Ton fuel oil	997 M^3 gas at N.T.P.
Cu. Ft./Ton at 60°F at N.T.P.	93.3 M^3 gas at N.T.P. 88.3 M^3 gas at N.T.P.

Note: The above limits of composition are not minimum and maximum values.

Source: Conditions of Tender and Specifications Helwan Gas Turbine Plant - 120 MW.

solar oil and natural gas respectively.

The major pollutant emissions exhausting from the gas turbines when operating with solar oil will be particulates, oxides of sulfur, and oxides of nitrogen. The ash content of the solar oil is 0.01% (max.) by weight; and the particulate emissions will be 0.009 g/million BTU, (a very small amount). The sulfur dioxide emissions from the gas turbine will be 2.8 g/million calories, (1.6 lb/million BTU). Similarly, the nitrogen oxide emissions will be approximately 1.2 g/million calories, (0.7 lb/million BTU).

The major pollutant emissions from the gas turbine when operating with natural gas fuel will be oxides of nitrogen. The nitrogen oxides emissions will be approximately 0.65 g/million calories, (0.36 lb/million BTU).

Mass emission rates of the major combustion products from the Helwan Station were calculated from the fuel compositions shown in Tables 3.4 and 3.5 and an assumed heat input. Table 3.6 presents the total mass emissions data at full load operation. This data is presented for future guidance and possible estimation of ground level concentrations of pollutants.

Determination of the acceptability of the pollutant emissions from the Helwan Station could not be made. 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 plants are presented

TABLE 3.6

EXPECTED TOTAL MASS EMISSION RATES OF POLLUTANTS FROM THE PROPOSED HELWAN STATION

At Full Load Operation

Gas Oil (Solar Oil), Fired Operation	lb/hr	Kg/hr
Particulates	9.5	4.3
Sulfur Dioxide	2844	1290
Nitrogen Oxides	1260	571
Natural Gas Fired Operation		
Nitrogen Oxides	648	294

below for comparative purposes. It will be noted that the emissions from the Helwan Station do not comply with these standards.

	Oil	Gas
Sulfur Dioxide-lb/MBTU	0.80	-
Nitrogen Oxides-lb/MBTU	0.30	0.20

3.5.8.1 Effects of Air Emissions on the Environment

The effect of pollutant emission on the environment depend on the pollutant concentrations reached in the atmosphere and at ground level. Studies conducted in the United States and other countries on the effects of pollution on the environment indicate that certain pollutant concentrations may be detrimental to the environment.

The concentration of pollutants resulting from the gas turbine source can be calculated by a technique which combines a plume rise calculation and a calculation of the dispersion of the plume in the atmosphere and back down to ground level. However, such pollution dispersion calculations are outside the scope of services specified for this brief study on the Helwan Station.

4.0 PROPOSED TALKHA COMBUSTION GAS TURBINE GENERATING PLANT

4.1 Overall Project Description

The Egyptian Electricity Authority proposes to construct additional electric power generating units of 180 MW total capacity at the existing Talkha Thermal Electric Power Station. The proposed facility will include the conversion of an existing undiked mazout fuel oil storage tank to hold solar oil. For this study, the tank selected for solar oil storage is considered as part of the proposed facility.

The existing Talkha Thermal Electric Power Station has a total generating capability of 127.5 MW. The station generating complex consists of three 30 MW and three 12.5 MW oil fired generating units, all located indoors. Proposed units of the combustion gas turbine type, are to be located on a site within the station confines, approximately 165 meters from the existing power plant building. The proposed additional 180 MW capacity, when added to the present station capability will provide the Talkha Station with over 300 MW of export potential.

4.1.1 Site Description

The area upon which the project is to be constructed is shown in Figure 4.1. The site is located at the rear or northwesterly side of the existing Talkha Plan, and is entirely within an existing fenced or walled perimeter enclosure. The area of the project site is approximately 7820 square meters (0.8 hectares). It lies to the north-west of three small fuel oil tanks having

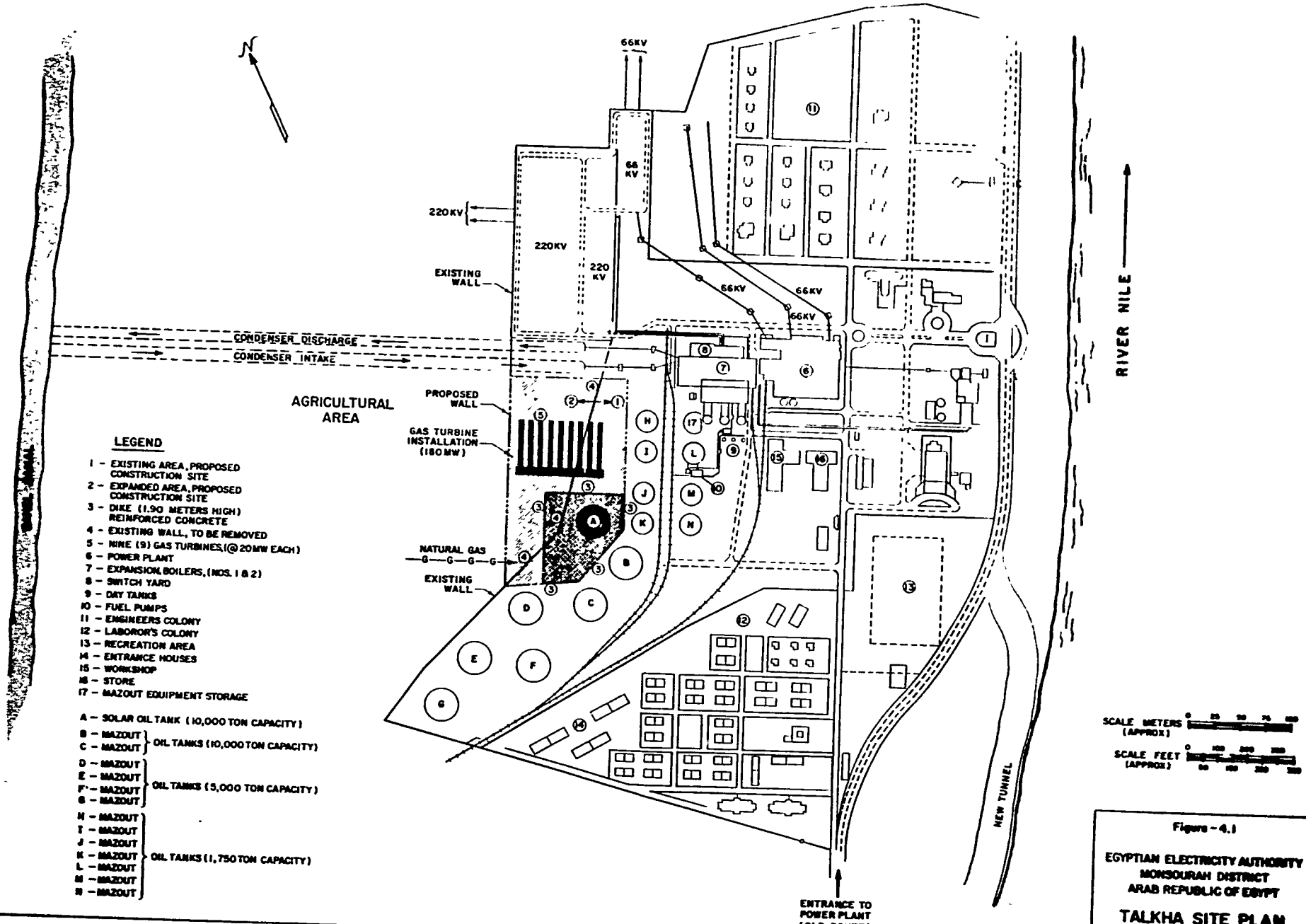

Figure - 4.1

EGYPTIAN ELECTRICITY AUTHORITY
MONSOURAH DISTRICT
ARAB REPUBLIC OF EGYPT

TALKHA SITE PLAN

a capacity of approximately 500,000 US gallons each. An existing large fuel oil storage tank is located just outside of the southwesterly boundary of the site. This tank has a capacity in excess of 2.5 million US gallons. Within the total tank farm area, including the above four tanks, there are eleven existing fuel oil storage tanks having a total capacity of 19.5 million US gallons. This tank farm has sufficient fuel capacity to accommodate th present thermal station total capacity of 127.5 MW for a period of approximately two months. It is proposed that the existing 2.5 million US gallons storage tank located at the southwesterly side of the project site will be used for the storage of solar oil. Oil is intended as the auxiliary fuel, supplementing natural gas as the primary fuel energy for the 180 MW addition. This tank will provide gas turbine auxiliary fuel storage, sufficient for about 120 hours of 100% capacity base load operation.

The total existing Talkha Power Station represents an area of approximately 220,900 square meters, (22 hectares), including a substation yard. The area presently reserved for construction of the 180 MW complex is only 7820 square meters (0.8 hectares). This area is considered too small for the combined space required. If the contractor's space requirements are more than the allocated 7820 square meters, then the enclosure wall on the west by northwest side will have to be moved to line up with the substation wall and the new wall extended south by southwest to intersect the present walled boundary. This enlarged area would represent an additional space of 15,985 square meters (1.6 hectares)

giving a total area of 23,805 square meters (2.4 hectares) for the project site. It is believed, at present, that there will have to be an acquisition of land to provide this additional space and EEA intends to request permission to acquire this area and more, if needed.

4.2 Nature of Surrounding Environment

In order to assess the environmental impact of the proposed combustion gas turbine additions to the Talkha Thermal Electric Power Station, it is first necessary to appraise the existing environment. The following text describes the land and water resources in the vicinity of the existing plant and serves as the basis for prediction of the environmental effects of the proposed unit additions on the environment.

The Talkha Thermal Power Station is located in the District of Monsourah approximately one km from the town of Talkha. Since this project is planned for construction at an existing plant, this study considers the proposed facility as an expansion on a previously developed site.

A visual inspection of the proposed site showed no signs of this area being used as a habitat for any wild life, and no sensitive ecosystems were noted. The site area is presently being used for the storage of miscellaneous materials and debris associated with plant operation and maintenance. The area is divided into cleared and non-cleared sections, with indigenous weeds being the predominant vegetation. It was observed that the cleared sections in close proximity to the undiked oil storage tanks contained puddles of mazout fuel. This is probably due to the leakage and spills occurring during the unloading of oil tanker cars and the repair of oil lines and storage tanks.

No archaeological finds were uncovered during construction of the existing station and thus no problems are anticipated during construction and excavation of the proposed facility.

The general area surrounding the station is in a cultivated state with a large fertilizer plant in the vicinity.

4.3 Proposed Utility Services

1. Fuel Oil - Solar oil will be transported to the site by rail car in the same manner as is presently used to provide mazout fuel to the existing tank farm serving the thermal power station. Piping to transport this solar oil between receiving nozzle and tank will have to be separated from existing and modified to suit.

2. Natural Gas - Gas will presumably be transported from existing and enlarged pipe service that is located west by northwest of the existing site. It was reported that gas is not used for ignition or as the prime firing fuel for the burners firing the boilers at the existing thermal station.

   It is expected that gas service will enter the site at the south by southwest corner of the new triangular construction area. The gas train will be adjacent to the fuel oil storage area and somewhat isolated from the transformer and power feeder end of the site.

   Gas will have to be fed to an accumulator tank from which it will be introduced to a gas compressor and the pressure elevated to serve the turbine combustor nozzles.

3. Water - Water will have to be supplied from the existing thermal station. This water will be used for closed loop cooling as is presently being contemplated for Helwan. No water consumption is expected other than for closed loop start and make-up.

4. Sewerage - There are presently no active sewers at the proposed construction site. It is planned that operators of the 180 MW station will use existing washing and toilet facilities presently located in the thermal station.

5. Power - Power for black start and auxiliaries will be provided from the existing grid. No auxiliary engine generator will be used.

   It is proposed that power will be transformed from 11 kV to 66 kV and carried by overhead lines to the existing substation at the north by northeast end of the complex.

4.4 Proposed Power Generating Facilities

The proposed power generating facilities comprising the 180 MW addition to the present station complex, in general, is expected to be arranged in repetitive modules using one of the following combinations:

1. Six modules of 30 MW each, or

2. Two units, each consisting of three 30 MW modules, or

3. Two units, one of four 20 MW modules plus one of five 20 MW modules.

Conversion of the existing 2.5 million US gallon capacity undiked fuel oil storage tank to handle solar

oil in lieu of the present mazout.

Suitable day tanks with pumping facilities.

Gas trains and compressors to suit.

Office for operating personnel.

Radiators and storage tanks for sensible cooling, with water to air cooling comprising closed loop systems for bath oil and ventilation.

4.5 Probable Environmental Impact

The construction of additional generating units at the Talkha Thermal Electric Power Station will have no significant adverse effects on the surrounding environment. Since the proposed facility is an expansion on a previously developed site, any major adverse environmental impacts would have occurred during the construction of the existing station.

The only sources of pollutants from the plant operation that might possibly have an adverse effect upon the environment are those generated from the burning of either natural gas or solar oil, and the noise levels produced by the gas turbine installations. No liquid or solid wastes will be generated by this station and, therefore, no thermal or solid waste disposal impacts are considered in this report.

4.5.1 Impact on Human Activities During Construction

The construction of the proposed facility will result in increased employment for construction trade workers. Since the site is adjacent to an existing power plant a minimal amount of road buidling would be necessary. Existing paved and unpaved roads will provide the main access for employees and materials.

During the construction phase of the proposed project, there will be increased vehicular and worker traffic. These disturbances will be confined to the boundaries of the existing plant and, therefore, will not have any deleterious effects upon the surrounding inhabitants and environs.

4.5.2 Impact on Air Quality During Construction

Construction activities, if unsupervised, can produce increased localized fugitive dust conditions. At this site the nearest dwellings are sufficiently far removed to minimize off-property public nuisance. Fugitive dust raised by vehicles and machinery is not expected to create an off-property dust nuisance of greater magnitude than the dust raised by the severe winds, or average farming activities. The fugitive dust due to construction activities will create a problem to plant personnel.

4.5.3 Impact on Surrounding Ecology

Construction activities will not have a significant effect on the overall ecology of the surrounding area. The increased traffic, noise, and activity associated with construction may cause some temporary variation in the daily life patterns of local wildlife.

4.5.4 Physiological Impact

Noise generated during construction will have a physiological impact on the human environment. The noise associated with heavy construction operation is objectionable in confined areas or near-developed areas. The nature of the site location is

such that no great disturbances are anticipated.

4.5.5 Impact on Land Utilization

The proposed facility, as a result of its location within an existing station will be aesthically and physically compatible with existing land use patterns.

It has been stated by Egyptian Electricity Authority personnel that, if the area allotted for the proposed facility is found to be insufficient in size, the site will be expanded in a westerly direction from the present plant boundary. This area is not owned by the Egyptian Electricity Authority and will have to be purchased. We have been informed that there will be no problems encountered in acquiring this property. This area is presently under cultivation and if required by the plant, approximately 16,000 square meters (1.6 hectares) will be removed from potential agriculture production.

4.5.6 Impact on Water Resources

The proposed plant will have minimal water usage and its construction and operation should have little or no effect upon the areas water supply or the aquatic environment.

4.5.7 Noise

4.5.7.1 Noise Level Criteria

The noise level criteria will be the same as discussed for the Helwan Gas Turbine Generating

Station in Section 3.5.7.1.

4.5.7.2 Existing Noise Levels

The existing ambient noise level measurements taken on a single visit to the proposed site, varied between 35 dBA and 45 dBA. However, it should be noted that, when these observations were made, the station was not in full operation.

4.5.7.3 Expected Noise Levels from the Operation of the Proposed Power Plant

The combined sound pressure level produced by the proposed units at the Talkha Station will vary from 110 dBA to 120 dBA. This estimation is based on the assumption that the units will be installed parallel to each other.

Expected total sound pressure levels at the Talkha Station will be approximately 110 dBA to 120 dBA. The addition of the existing ambient sound pressure levels, to the levels generated by the proposed units, will not change the total sound pressure level at the station significantly.

4.5.7.4 Effects of Noise on the Environment

The adverse effect of noise on the environment due to the operation of Talkha Gas Turbines would

be similar to that of the Helwan Gas Turbine Station. A residential area for station personnel is located approximately 150 meters from the proposed site. Assuming a 110 dBA noise level at the plant, the noise level at the residential colonies will be approximately 55 dBA. The effect of noise on in-plant personnel would be the same as that of the Helwan Plant.

The distance between the boundary of the proposed gas turbine station and the existing plant structure is approximately 130 meters. Elsewhere in this report it is estimated that the sound pressure level generated at the gas turbine installation will be approximately 110 dBA to 120 dBA. At a distance of 130 meters it is estimated that this figure will be reduced to 60 to 65 dBA. The sound pressure levels prevailing at the existing plant are not available. Assuming that the sound level at the existing plant is in the same order of magnitude, that is 60 to 65 dBA, then the combined effect of the two sources will be to increase the sound level by a maximum of 3 dBA. The incremental effect will be diminished if the existing noise level is greater than 60 to 65 dBA.

The distance between the existing boilers and the boundary of the proposed gas turbine station is approximately 50 meters. At

this distance the sound pressure level due to the proposed gas turbine installation is expected to vary between 65 to 75 dBA. These sound pressure levels may be of some annoyance to personnel working near the boilers. However, the sound pressure levels generated by the existing boilers may be higher than 75 dBA. From the foregoing it may be concluded that the site at Talkha is at best marginal with respect to noise criteria.

The effect of noise generated by the proposed gas turbine installation on the personnel working at the existing plant can be minimized. This can be achieved by limiting the exterior noise level to a value of 70 dBA at a distance of 120 meters. This value was chosen to protect personnel at the existing power plant from hearing damages. Specifications for the procurement of machinery and auxiliaries should include an exterior noise criteria of 70 dBA.

4.5.8 Expected Air Emissions from Operation of Combustion Gas Turbines

It is proposed to operate the Talkha Combustion Gas Turbines with natural gas the base fuel and solar oil as the standby fuel.

For the purpose of emission calculations it was assumed that the chemical composition

of natural gas and solar oil would be approximately the same as that shown in Tables 3.4 and 3.5 of the Environmental Review for the proposed Helwan Combustion Gas Turbine Generating Plant.

The major air pollutant emitted by the combustion gas turbine operating on natural gas will be the oxides of nitrogen. The approximate rate of emission of oxides of nitrogen will be 0.65 g/million calories (0.36 lb/million BTU).

The major pollutant emissions from the combustion gas turbine operating on solar oil will be particulates oxides of sulfur and oxides of nitrogen. The rate of emission of particulates, sulfur dioxide, and oxides of nitrogen will be approximately 0.009 g/million calories (0.005 lb/million BTU), 2.8 g/million calories (1.6 lb/million BTU) and 1.2 g/million calories (0.7 lb/million BTU), respectively.

Mass emission rates of the major combustion products from the Talkha Station were calculated from the fuel compositions shown in Tables 3.4 and 3.5 and an assumed heat input. Table 4.2 presents the mass emission data at full load. This data is presented for future guidance and possible estimation of the ground level concentrations of pollutants.

These emission values are in excess of the United States Environmental Protection Agency Emission Standards shown in Section 3.5.8.

TABLE 4.2

EXPECTED TOTAL MASS EMISSION RATES OF POLLUTANTS FROM THE PROPOSED TALKHA STATION

At Full Load Operation

Gas Oil (Solar Oil) Fired Operation	lb/hr	kg/hr
Particulates	14	6.3
Sulfur Dioxide	4265	1935
Nitrogen Oxides	1890	857
Natural Gas Fired Operation		
Nitrogen Oxides	972	441

4.5.8.1 Effects of Air Emissions on the Environment

The effects of pollutant emissions on the environment depend on the concentrations reached in the atmosphere and at ground level. The ground level concentrations of pollutants can be estimated by a dispersion analysis. However, no such pollution dispersion calculations were made for the Talkha Gas Turbine Power Generation Station