THE ARAB REPUBLIC OF EGYPT

THE FEASIBILITY STUDY REPORT

ON

THE CONSTRUCTION OF THE FIRST COAL FIRED THERMAL POWER PLANT IN SINAI (A.R.E.)

DECEMBER, 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In response to the request of the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a Feasibility Study on the Coal-Fired Power Plant Project in Sinai (A.R.E) and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to the Arab Republic of Egypt a survey team headed by Mr. T. Wachi three times; from January 8 to March 9, 1983, from May 24 to July 7, 1983 and from November 30 to December 14, 1983.

The team exchanged views with the officials concerned of the Arab Republic of Egypt and conducted a field survey in Sinai area. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the team.

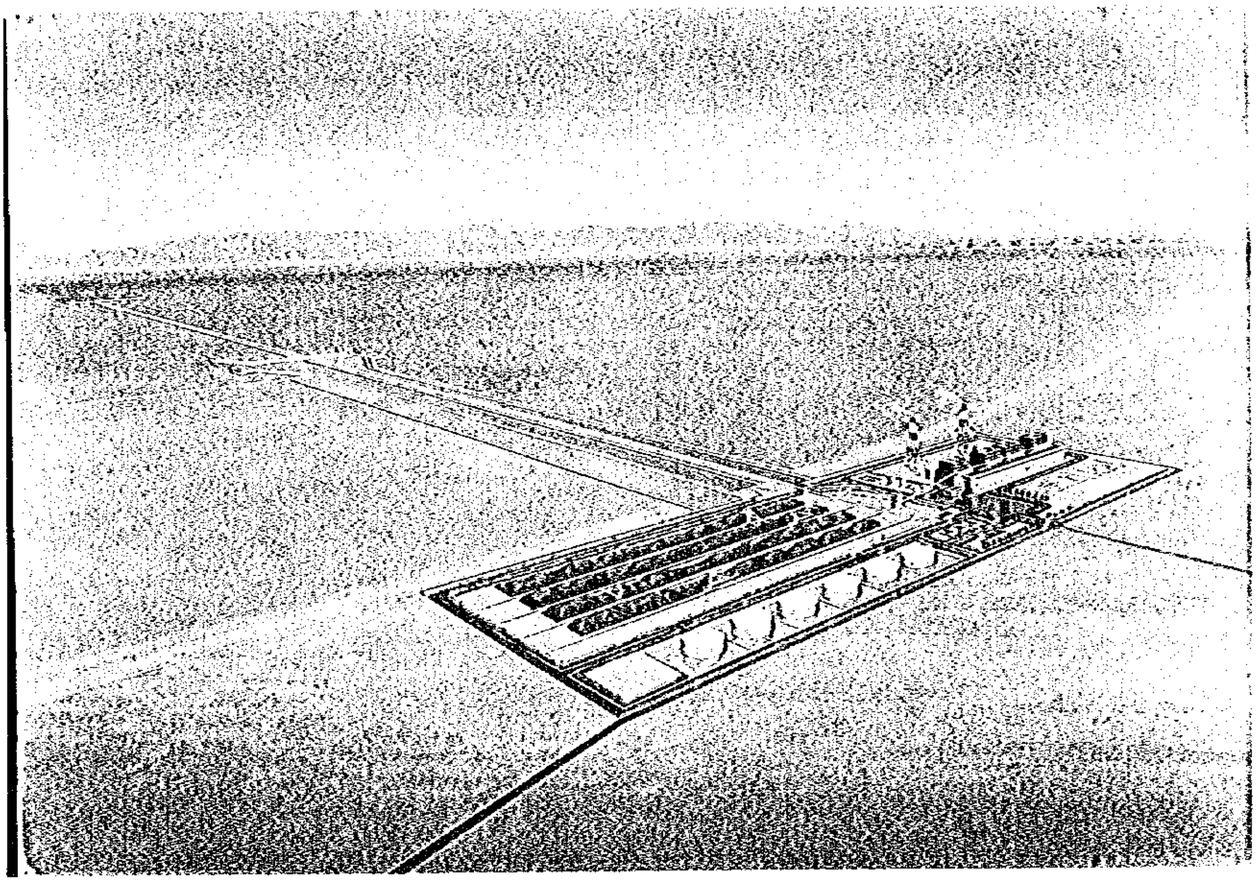
Tokyo, December 1983

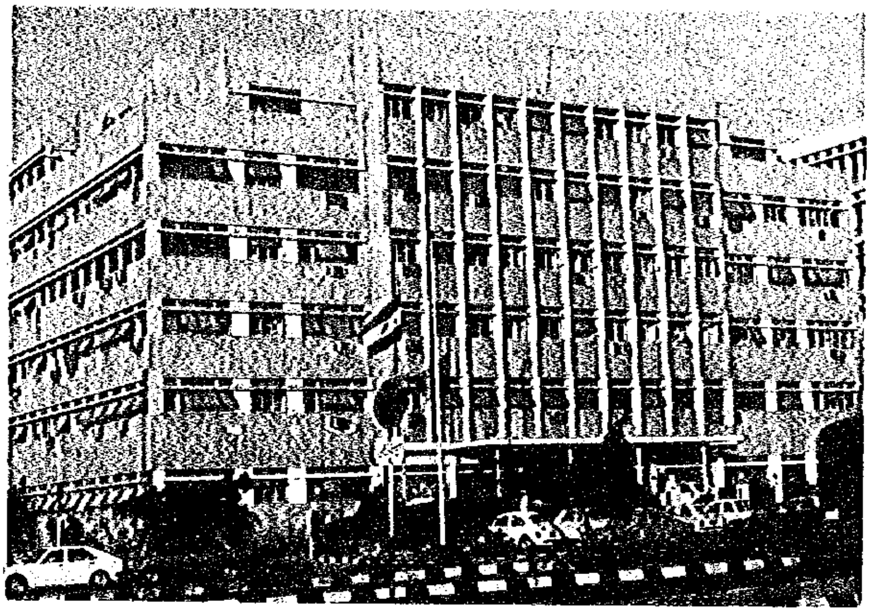
Keisuke Arita

President

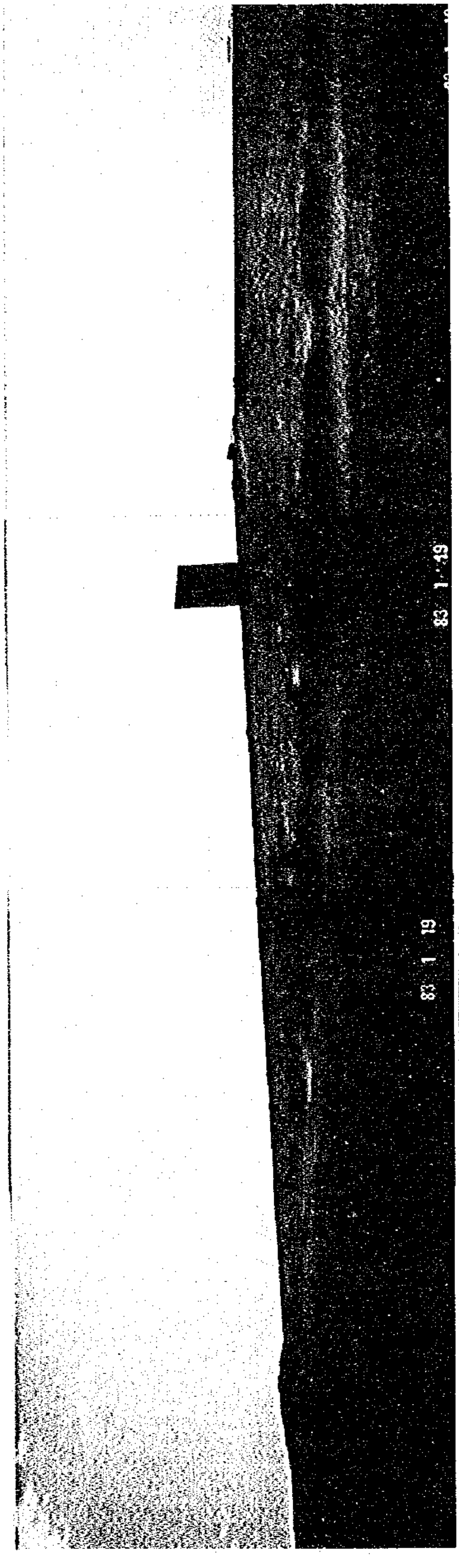
Japan International Cooperation Agency

PHOTOGRAPHS



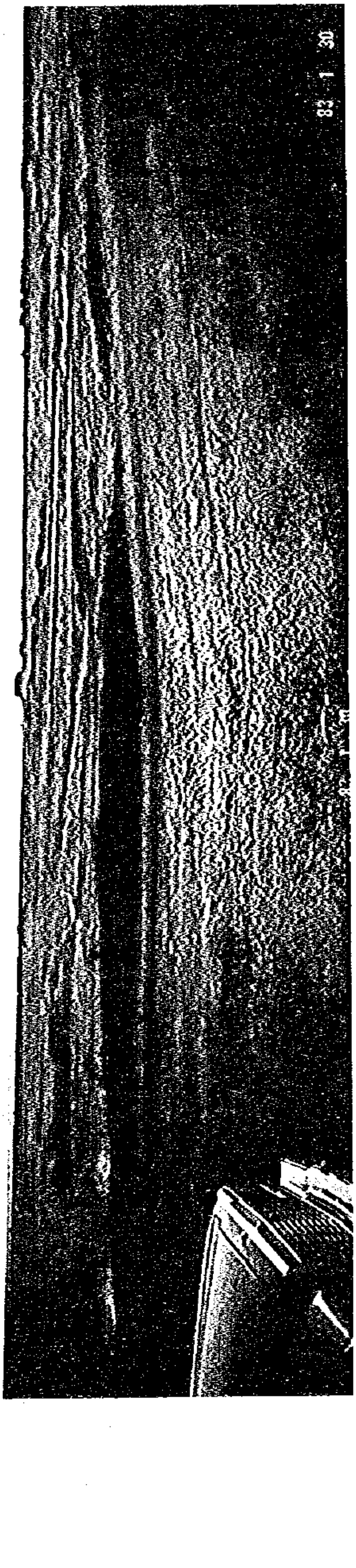


EEA Head Office

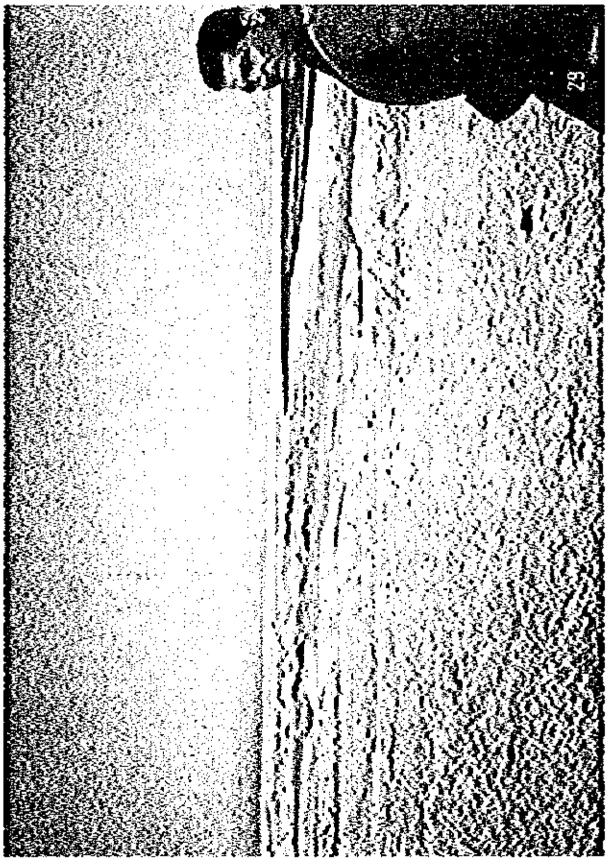


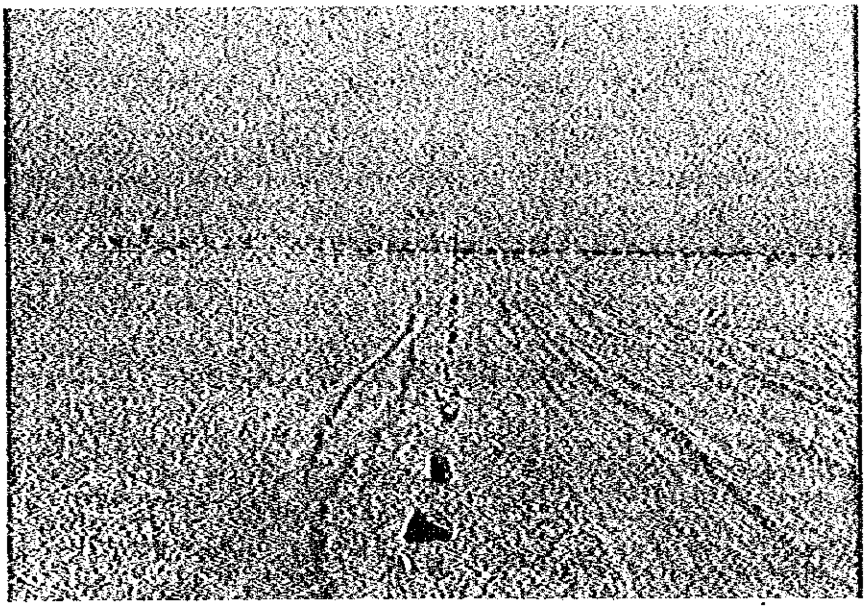
North Ayun Musa Site (View From National Road Route 66)

South Ayun Musa Site (View From National Road Route 66)

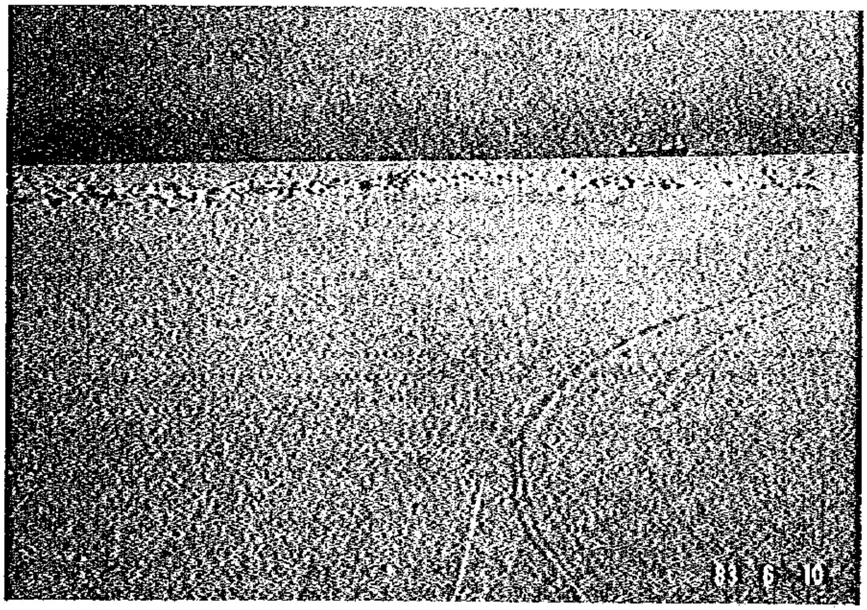


Abu Zenima Site

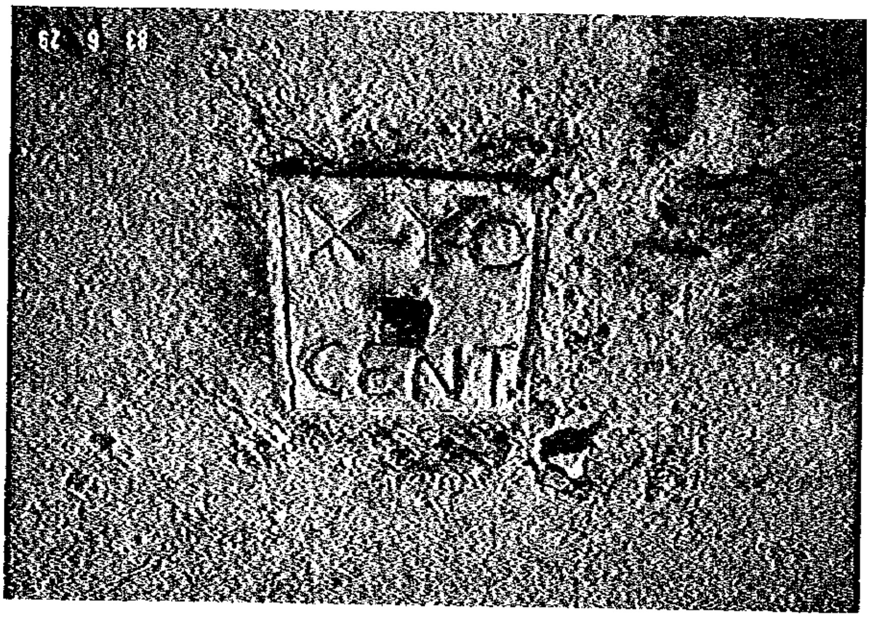




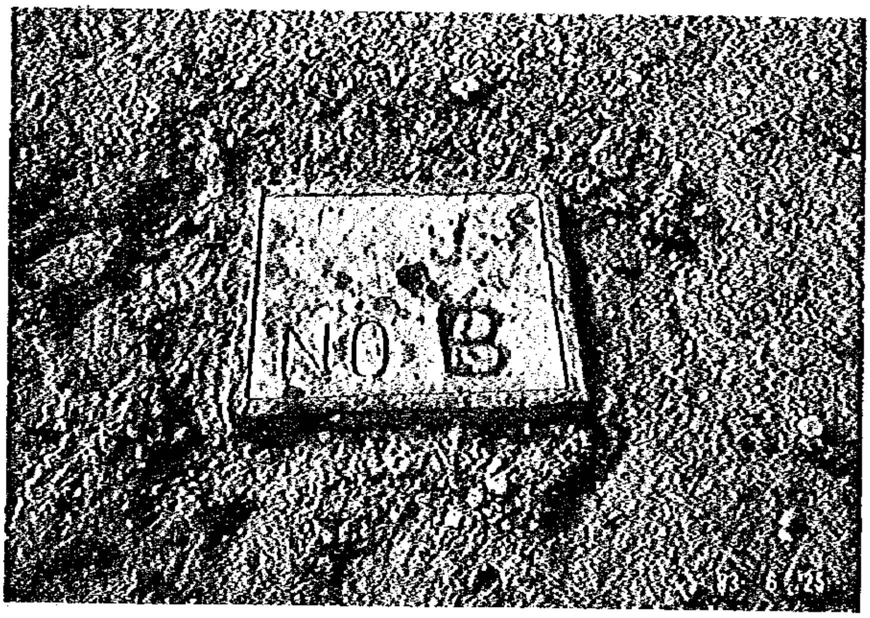
North Ayun Musa Site



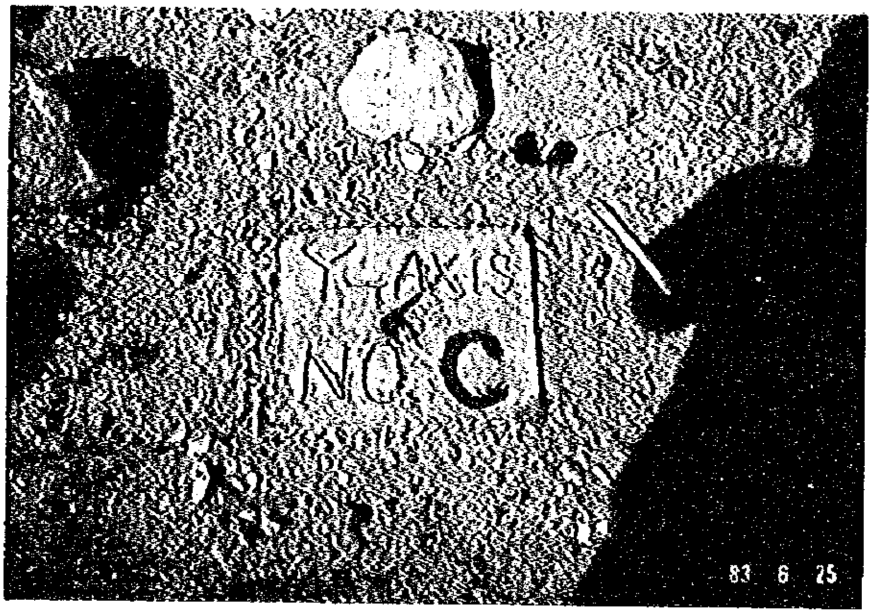
North Ayun Musa Site



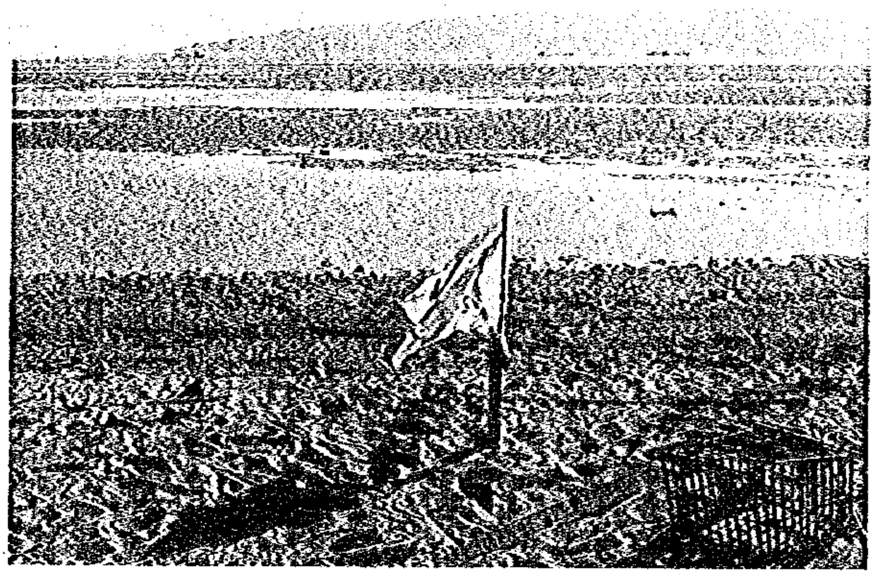
X - Y Axis Bench Mark
(North Ayun Musa Site)



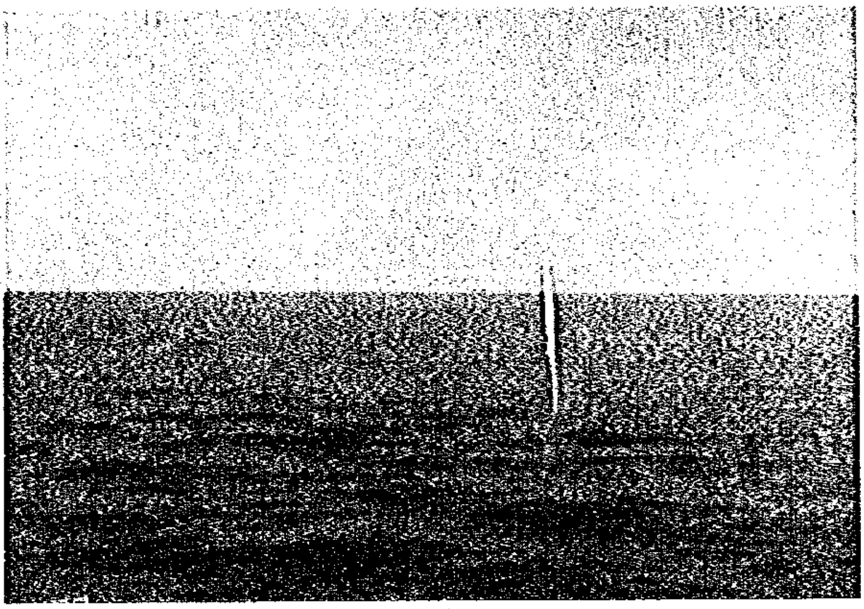
Auxiliary Bench Mark B
(North Ayun Musa Site)



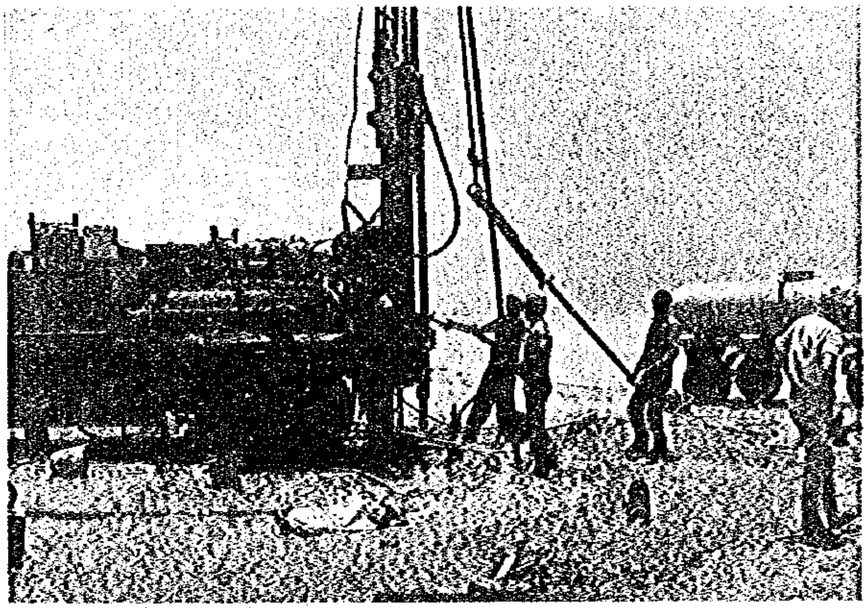
Auxiliary Bench Mark C
(North Ayun Musa Site)



Cooling Water Intake Point
(North Ayun Musa Site)



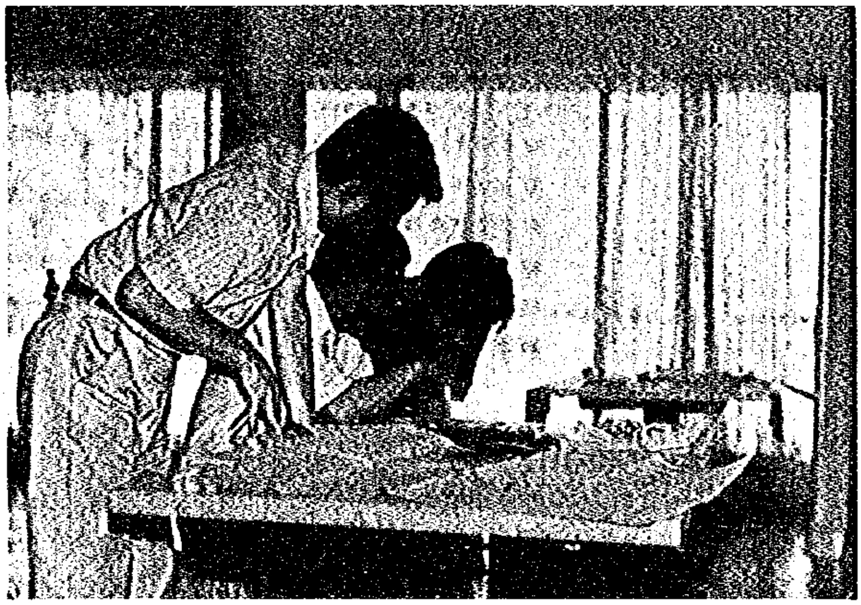
Harbor Site in Front of North Ayun Musa Site



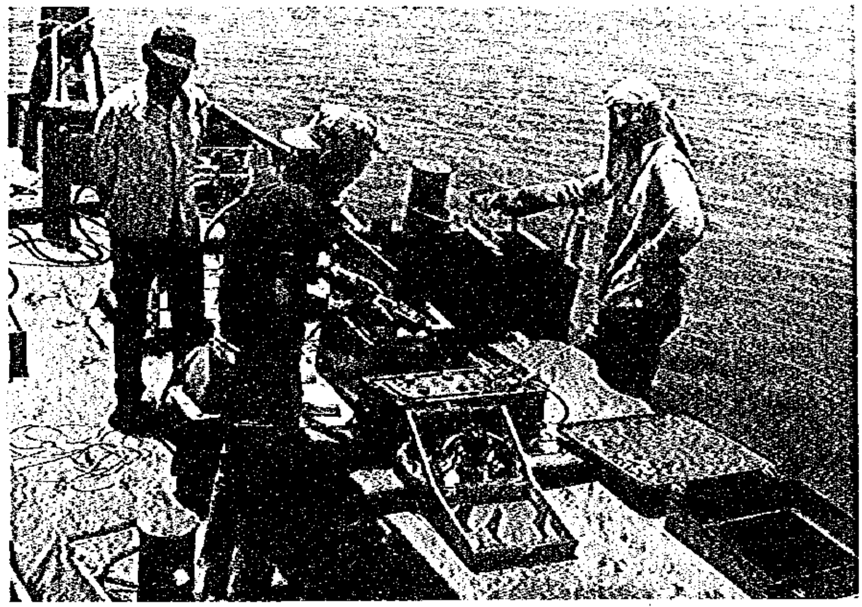
Boring Works in North Ayun Musa Site
(T/G Foundation)

Outcrop of Miocene Sandstone

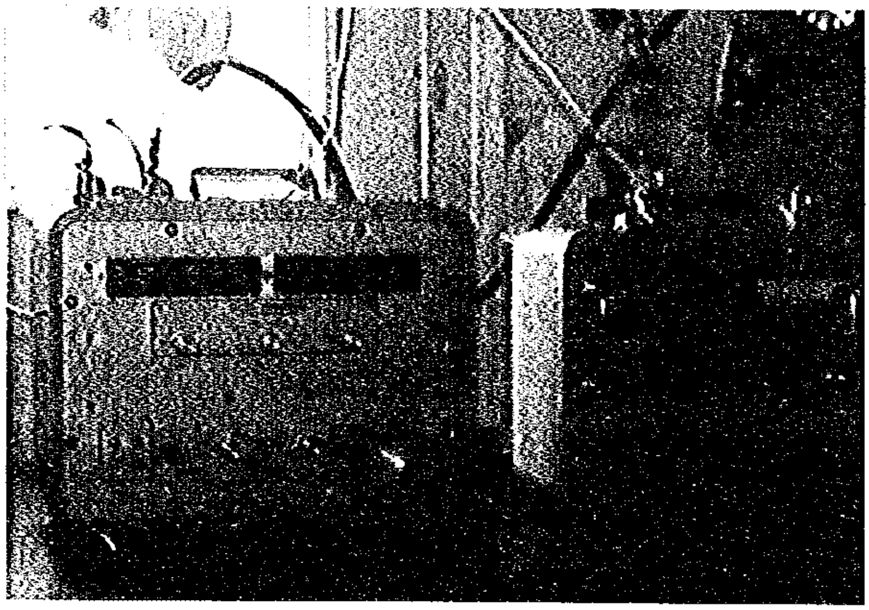
Unconformity between Miocene Sandstone
and Pliocene Conglomerate



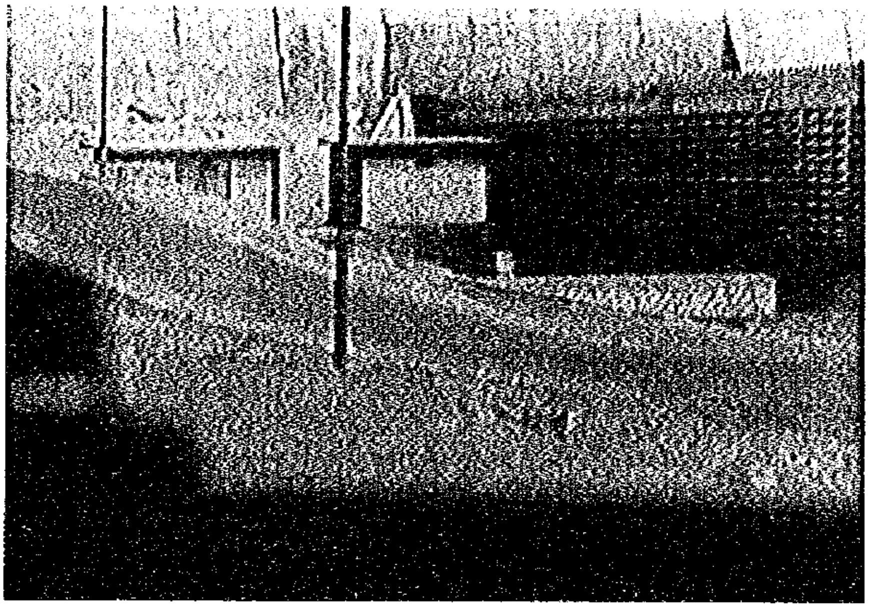
Meeting for Topographical Survey



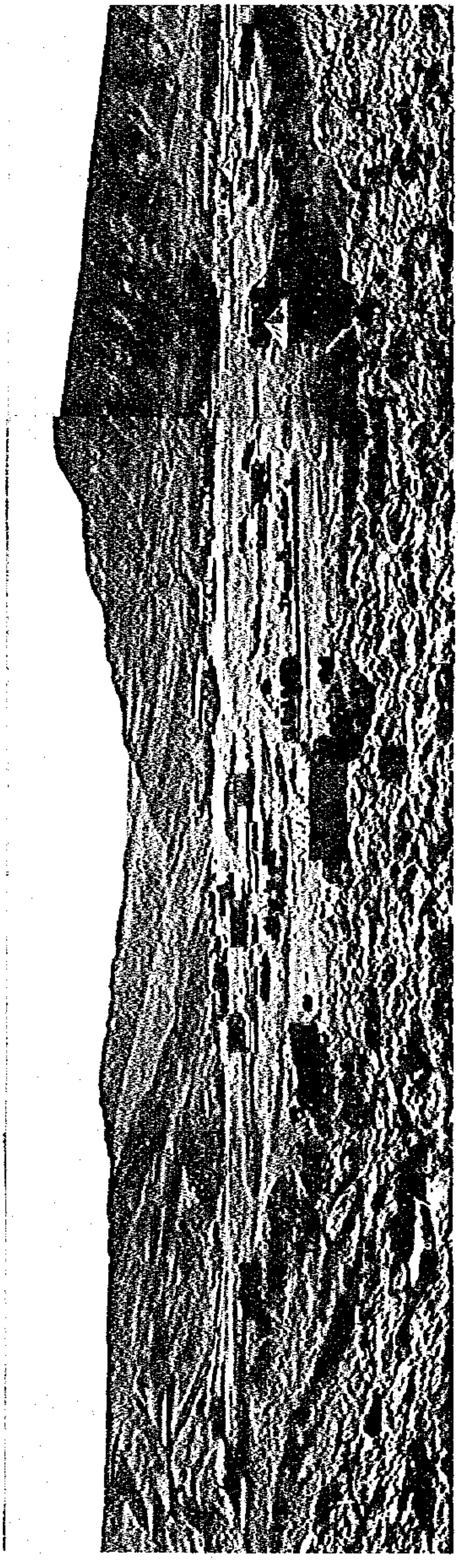
Sounding Survey

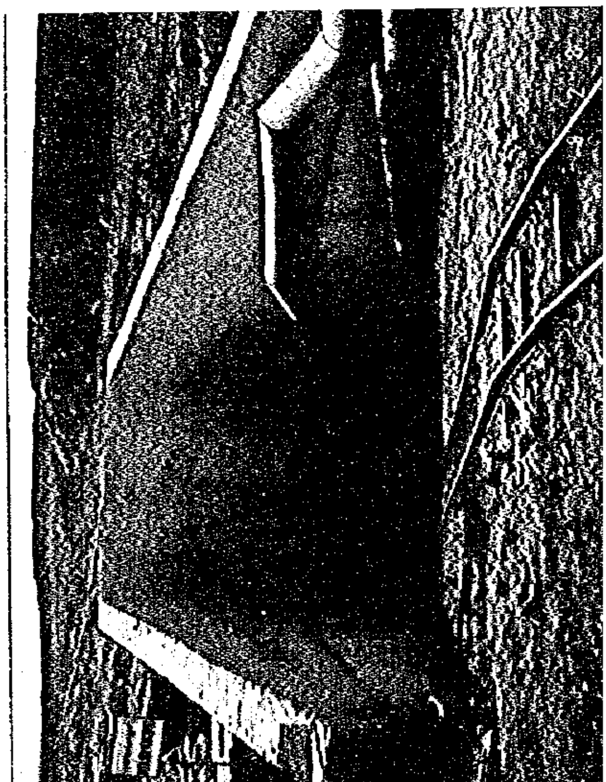


Sounding Machine



Ahmed Hamdi Tunnel

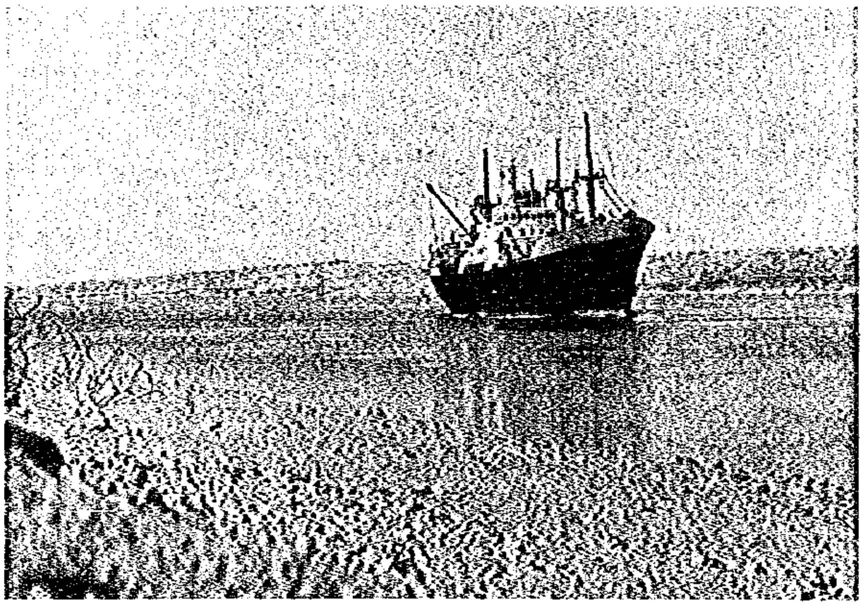




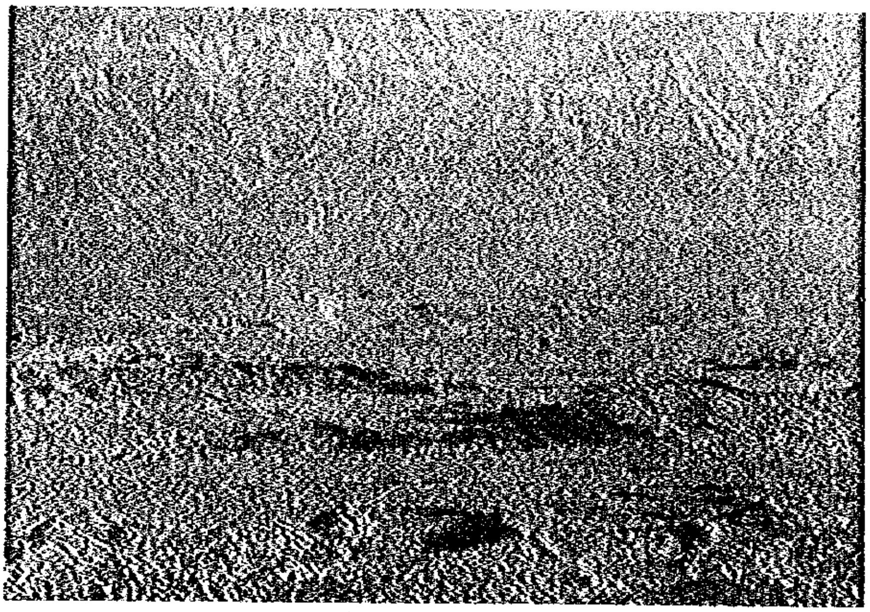
Maghara Coal Mine Site

Proposed Site for Canal Crossing Tower
(Sinai Side)

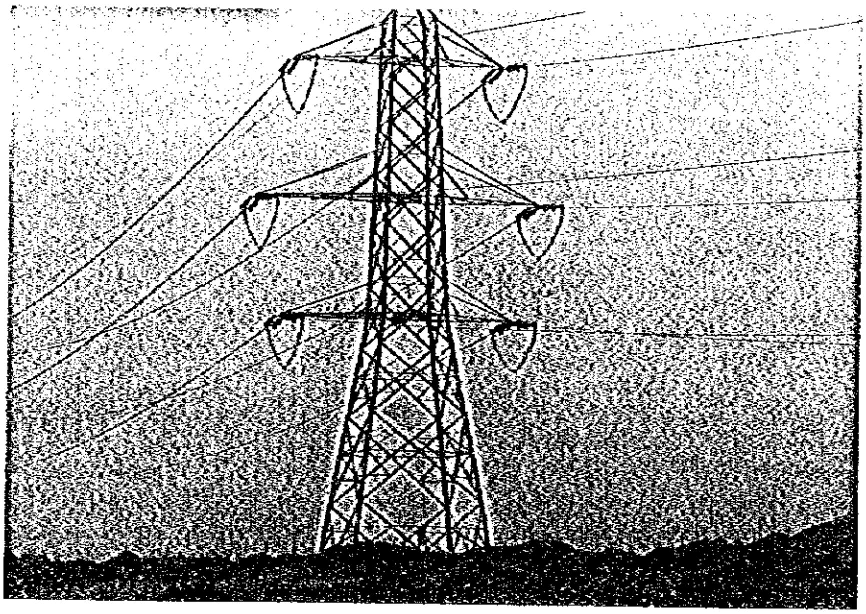
Proposed Site for Canal Crossing Tower
(Egypt Main Land Site)



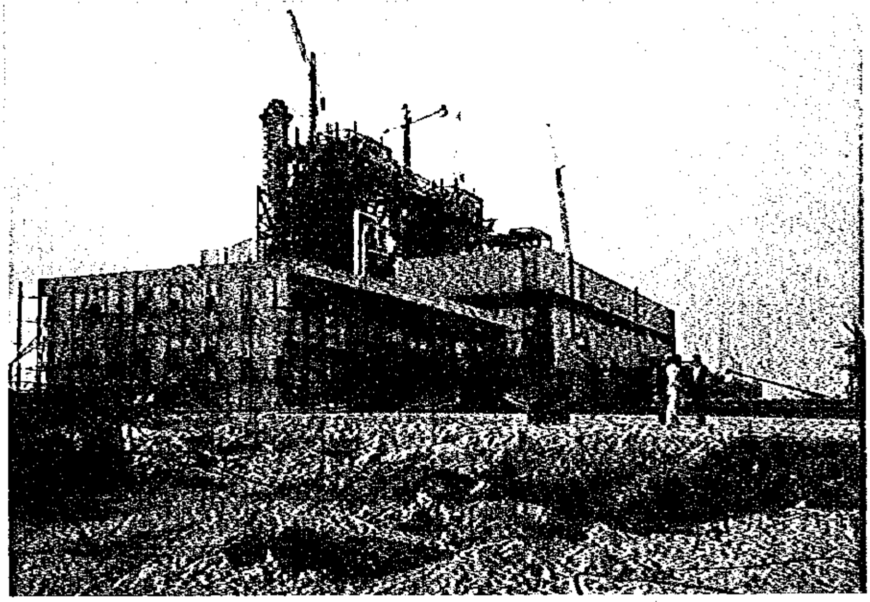
Suez Canal Near T/L Crossing Point



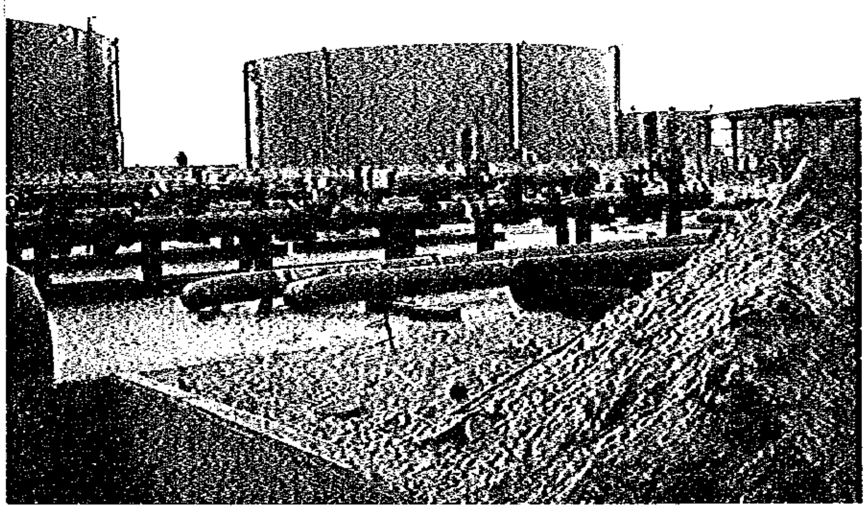
New Suez Substation Site



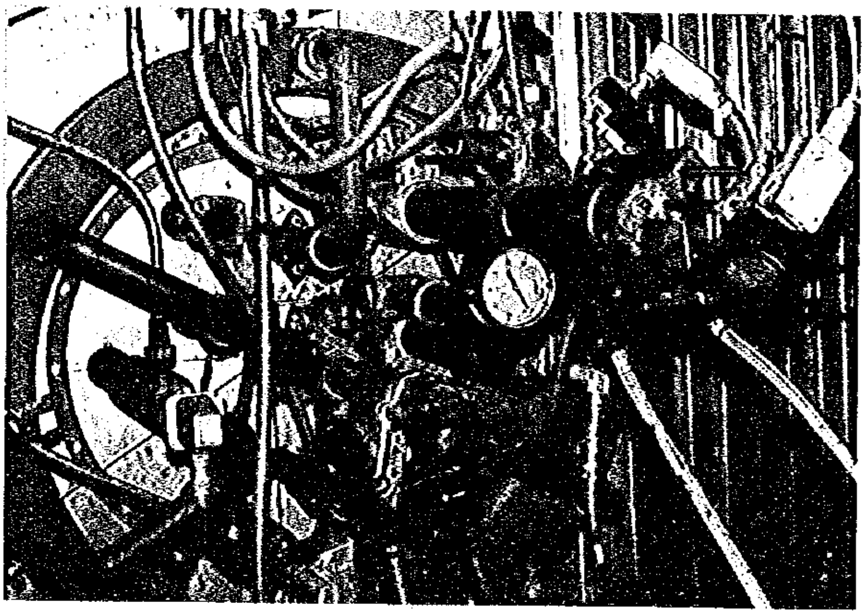
220 kV Existing Transmission Line



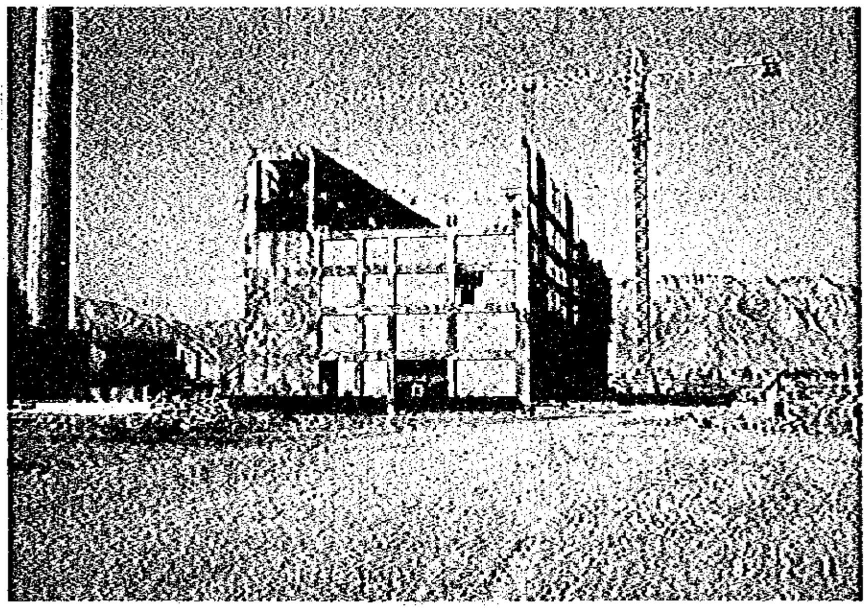
Abu Sultan Power Station (Under Construction)



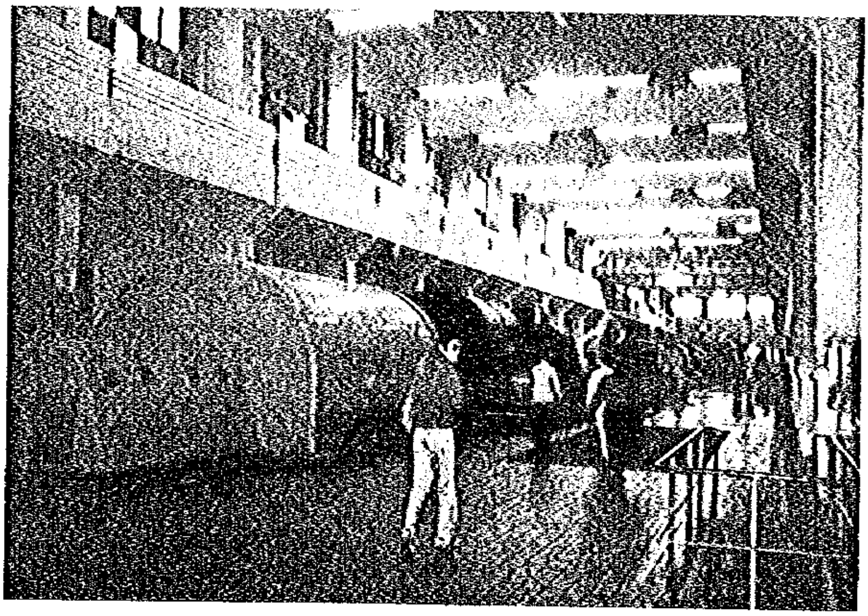
Abu Sultan Power Station (Under Construction)
Fuel Gas Facilities and Fuel Oil Storage Tanks
(Dual Type System)



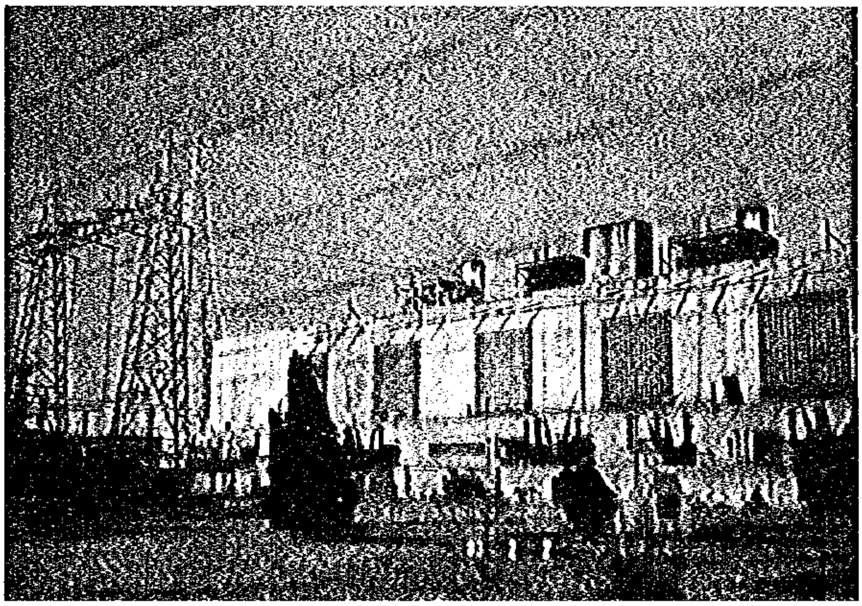
Abu Sultan Power Station (Under Construction)
(Dual Type Burner)



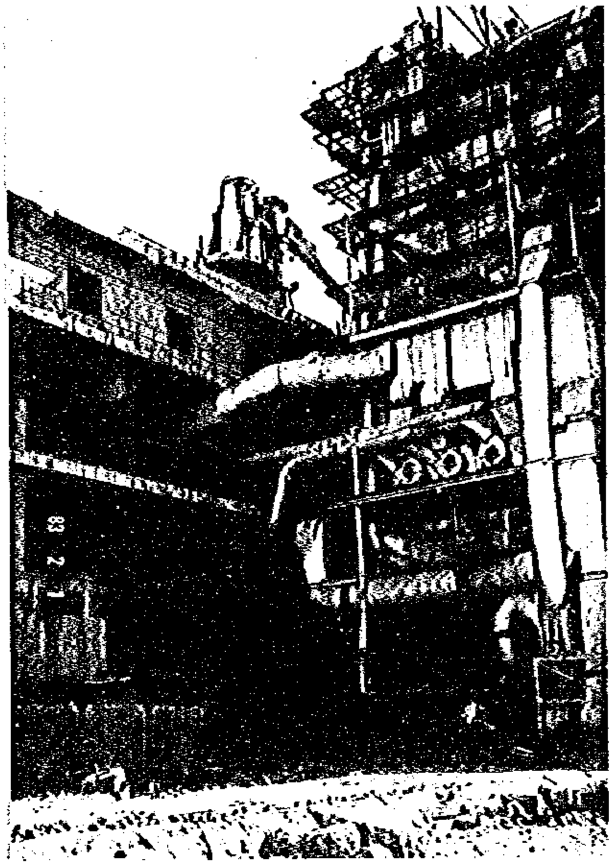
Ataka Power Station (Under Construction)



Cairo South Power Station



Cairo West Power Station



Suez Power Station

CONCLUSION AND RECOMMENDATIONS

1. CONCLUSION

At the request of the Egyptian Government, the Japanese Government entrusted Japan International Cooperation Agency (JICA) to carry out the Feasibility Study of the First Coal-fired Thermal Power Plant in Sinai. This Project is a very important national project, and the power plants under this Project, therefore, should start their operation by 1988-1989. By procurement of low-interest, long-term soft loan, this Project could be very feasible. The construction takes 50 months from the first phase contract to the taking-over of the second unit according to the schedule. Therefore, the preparatory works for construction should be started in 1984.

The results of study conducted from January to December 1983 are summarized as follows:

Organization

The power sector in Egypt is undertaken by Egyptian Electric Authority (EEA), Rural Electrification Authority (REA), Nuclear Plants Authority for Power Generation (NPA) and Quattra Hydro and Renewable Energy Authority (QHREA) under the Ministry of Power and Energy. And EEA manages the general electric industries and the Project is undertaken by EEA.

Power Situation

Power generating facilities in Egypt are represented by Aswan High Dam Power Station with a total capacity of 2,100 MW (175 MW x 12) commissioned in 1970, which is located about 1,000 km upstream of the Nile. The power generating facilities in 1970 were composed of hydro power of 2,445 MW and thermal power of 1,330 MW, or a total of 3,775 MW. The proportional rate of power generating facilities was 65% of hydro power to 35% of thermal power.

Since the 65% of power generating facilities were centralized at one power station, power supply conditions at the time were not always efficient or stable, especially at an accident in the power system.

Therefore, expansion of base load thermal power plants and extension of power supply networks were successively implemented under a 5-year program from 1976. The implementation resulted in increasing power supply stability as the proportional rate of generation facilities becomes 2,445 MW (48%) of hydro power to 2,687 MW (52%) of thermal power out of a total installed capacity of 5,132 MW. As of 1982, available output as against the total installed capacity of 5,132 MW was 4,077 MW, or 79.4%, and the rate of reserve capacity against peak demand of 3,900 MW was 4.54%. The available output should be increased up to 90% of the installed capacity in the future. And the reserve capacity, an essential factor for power supply reliability, is generally said to be kept at 15%.

Power Demanding Industries

For power demand by industries, there are fertilizer, aluminum and pipe industries, chemical and oil-refinery plants, cement and textile factories, ship yard, irrigation, etc. Of energy actually sold amounting to 17,165.5 GWh in 1981, about 10,800 GWh, or 63% were supplied to such industries. Power demand from industries has been growing with an annual increase rate of approximately 9%. Further, demand from the new industries in or after 1982 such as ferro silicon, steel industries, petroleum chemical plants, and another cement and aluminum industries, subway, etc. are considered.

Demand Forecast

Power demand forecast was studied covering the whole area of Egypt from 1983 to 1995. Namely, each peak demand was studied for 1982 (3,900 MW), 1987 (6,735 MW), 1992 (10,360 MW) and 1995 (12,645 MW). Electric power source development under a new 5-year program from 1983 will be: hydro; 300 MW (1 site), thermal; 3,220 MW (6 sites), and gas turbine; 500 MW (4 sites) and retired thermal power plants; -383 MW (4 sites). Thus, the total installed capacity will increase by 3,637 MW. The total installed capacity will be 8,769 MW and total available capacity will be 7,786 MW in 1987.

As Peak demand in 1987 will be forecast at 6,735 MW, therefore, reserve margin will be 1,051 MW, or 15.6% of the peak demand which satisfies the standard reserve rate of power supply capacity.

Development Program

However, the peak demand in 1988 and 1989 will be 7,360 MW and 8,000 MW respectively, and this means that the available capacity of 7,786 MW in 1987 will not cope with the total power demand in 1989. Therefore, the expansion of at least 1,200 MW power generating facilities will be needed in 1989. (Supply margin rate will be about 11%, even if 1,200 MW generating facilities are completed. In or after 1990, further reinforcement of the facilities will be needed.)

Based on the aforementioned reason, this Sinai Coal-fired Thermal Power Project should be rated at 600 MW (1st Stage) and be constructed between 1988 - 1989. In addition to this Project, another 600 MW thermal power unit will be needed in 1989.

Power station site was selected at Ayun Musa located in the Sinai Peninsula, on the coast of the Gulf of Suez, where land transportation of Maghara coal and construction of a harbor for unloading of imported coal are easy. The interconnection of the transmission line from the power station will be led to the existing Suez-Cairo line via Ahmed Hamdi tunnel, extended about 44 km, 220 kV x 2 cct x 2 lines.

The plant specifications, equipment foundations, civil facilities, etc. for the construction of the Project could be designed without any difficulty, and there will be no remarkable aspect to hinder construction works. Therefore, the plant will be, upon completion of the Project, operated smoothly.

The development of this Project at Ayun Musa would make a great contribution to the reconstruction of Sinai Peninsula, together with the existing Ahmed Hamdi tunnel connecting the peninsula with the main land and the development of Abuzenima petroleum project.

Fuel Plan

Security of electric energy supply after 1988 is considered to be vital deeply affecting the national policy and economy. While, as of 1982, the oil reserve in Egypt is approximately 2.5 billion barrels (400 million tons), and the crude oil production is about 30 million tons/year, out of which about 19 million tons are appropriated for export as the most important national revenue, and the foreign currency income by the export amount to about 3 billion dollars which shares 60% of a total export of the country.

On the other hand, as of 1982, the annual rate of increase of domestic consumption lies between 15% to 20% per year, and if the consumption continues to increase at this rate, the domestic consumption would become about 30 million tons in 1987, and it would seriously affect the earning of foreign currency of the country obtained from the crude oil export.

In order to cope with ample demand of electricity, therefore, it is necessary to proceed the development of power plants by the substitute fuel instead of oil-fired thermal power plants as much as possible.

As for the substitute fuel, the natural gas reserve of about 131 billion m^3 and coal reserve in Sinai Peninsula of about 40 million tons are available, and utilization plan of natural gas is putting into execution.

Consequently, this Project is to construct the first coal-fired thermal power station in Egypt based on the mass production program of Maghara Coal Mine in Sinai Peninsula.

For fuel of the power generation by the Project, 300,000 tons of Maghara coal and about 1,200,000 tons of imported coal mainly from Australia and the United States will be materialized.

In Egypt, the dual fuel system, generated by two kinds of fuel, has been adopted along the national policy for the sake of stable supply of fuel, irrespective of domestic or imported fuel. The dual fuel system, coal for main fuel and oil for alternative or emergency fuel, is employed for the Project.

Construction Cost and Economy

The construction cost of this Project will be 620.1×10^6 US$, made up of 529.0×10^6 US$ of foreign currency, and 91.1×10^6 US$ of local currency (230 yen = 0.823 LE/US$). With respect to the foreign currency portions required for this Project, long-term and low-interest funds will necessarily be procured.

Namely, 80% out of 529.0 x 10^6 US$ of foreign currency portion could be procured with an interest rate of 4% and a repayment period of 25 years including a grace period of 5 years, and 20% of the foreign currency portion with an interest rate of 9% and a repayment period of 10 years including a grace period of 5 years. 91.1 x 10^6 US$ of local currency portion could be borrowed with an interest rate of 8% and a repayment period of 12 years including a grace period 3 years.

With the terms and conditions of the loan above, the equalizing discount rate (FIRR) will be 11.29% at the point of Benefit/Investment = 1, which is well feasible from the view point of a financial aspect. The total cash flow balance in durable life would amount to +1,335 x 10^6 US$ and the Project proves well profitable.

The result of economic comparison (of generating costs) between oil-fired and coal-fired plants shows that the coal-fired plant is 23.5 mill./kWh and oil-fired plant is 42.9 mill./kWh (at generator end with a unit of US$), proves coal-fired plant is more economical; assuming that the international coal and oil price is 59 US$/ton and 180 US$/ton, respectively. On the other hand, appropriation of oil for export would increase by about 960,000 tons/year which is equivalent to about 172 x 10^6 US$, and coal consumption per annum would equivalent to about 85.9 x 10^6 US$. Accordingly earning of foreign currency of the country obtained from crude oil export will be about 86.5 x 10^6 US$ per annum.

From the above, this Project is the most important national project that must start the commercial operation in 1988/1989, and is amply feasible by obtaining a low-interest, long-term soft loan.

2. RECOMMENDATIONS

Based on the studies, it is recommended to arrange or execute the followings, as soon as possible.

1) As aforementioned, it is needed to start the preparatory works in 1984, especially to make contact with international financing institutions for foreign currency, and the excellent engineering consultant should be urgently employed.

2) As for the concrete production plan of Maghara Coal Mine, it is needed to make coordinate with the agencies concerned.

3) To secure land acquisition required for the Project, it is also needed to make arrangements and coordination with the authorities and agencies concerned.

4) Detail study should be made for the cables for 220 kV x 2 circuits x 2 lines to be laid through the existing Ahmed Hamdi tunnel.

   Soil investigation by boring, etc. should be made for foundations of major facilities of power station, harbor facilities and sub-station.

5) To attain higher reliability of power supply, stability analysis for the main trunk line system in Egypt should be made.

6) It should be considered that rise of electricity tariff, which is very low in comparison with foreign countries could be put into effect as soon as possible.

7) This Project is the first coal-fired thermal power plant in Egypt, it is advisable to conclude the whole contract with one contractor for overall responsibility on the whole works and performance guarantee after commissioning.

INITIAL CONDITIONS FOR STUDY

The following initial conditions were, based on the basic idea of the study, concluded through discussions between EEA and JICA Team on the practical study program during a period from January to March 1983.

1. General

1) An optimum proposed site for the power plant will be selected out of the sites at Ayun Musa and Abu Zenima in the Sinai Peninsula and Zafarana in the main land.

2) An optimum proposed site of the harbor facilities for coal unloading will be selected out of the proposed sites for power plant above in addition to the sites in El Galala and Adabiya.

3) For selecting the proposed power plant site, easy receiving of the domestic coal from Maghara Coal Mine and the imported coal from overseas, shorter length of the interconnection transmission line and economical construction of the plant will be taken into account. In principle, however, the Ayun Musa site will be considered to be the most prospective site.

4) The power plant output will be 600 MW at the first stage and 600 MW at the second stage, or 1,200 MW ultimately. The study will be made for construction of the first 600 MW power plant.

5) Fuel of the plant will be domestic and imported coal. As same as the other thermal power plants in Egypt, the generating facilities will be of a dual type capable for applying two kinds of fuel, coal and stand-by fuel.

6) The stand-by fuel will be heavy oil or gas available in Egypt.

7) Required area for ultimate 1,200 MW generating facilities will be secured.

8) Plant layout will be arranged in due consideration of environmental conditions as well as meteorological conditions.

9) As for the design standards of the study, standards of Japan and/or internationally acceptable standards will be applied.

2. Power Plant

2-1 Generating Facilities

1) An ultimate output of the power plant will be 1,200 MW as a net available output after deduction of station service power. Therefore, the study will be made on the power plant under the first stage with a net available output of 600 MW.

2) Boiler will be of a dual type and the burner system will be capable for both the main fuel and stand-by fuel. The plant could always be operated using either kind of fuel.

3) Coal unloading and handling facilities will be so designed that a large quantity of imported coal could be managed smoothly and efficiently. Facilities for receiving the domestic coal will also be considered.

4) Make-up water and house service water will be considered to be produced mainly by seawater desalination plant.

5) Being located along the seashore, the power plant will be designed on salt contamination and sand storm taken into account and environmental pollution by flue gas and sea water contamination will be also considered.

6) Coal ash will be disposed in a ash disposal area. And a study on the utilization of fly ash and bottom ash will be made.

7) Greening in and around the power station will be considered since the proposed sites are located in desert areas.

2-2 Civil Facilities

1) Land Reclamation	Area will be considered to accommodate ultimate 1,200 MW power station and the specified height of the reclaimed level will be EL +4.00 m.
2) Access Road	The road to entrance of power station will be of asphaltic concrete pavement (4 m x 2 ways with 4 m greenbelt).
3) Circulating Water System	
Intake Channel	Intake: 61.4 m^3/sec (for 1,200 MW) Temperature of sea water: Less 27°C Discharge from condenser will not be recirculated to intake channel.
4) Intake Pump Pit	Extension work of intake pump pit of 2nd stage will not hinder normal operation of the power plant.
5) Circulating Water Transmission System	The system will be planned only for the first 600 MW.
6) Circulating Water Discharge System	The system will be planned for ultimate 1,200 MW. The system will be so designed that level difference between discharge point and center of condenser will be kept to attain siphon effect.
7) Coal Storage System	The system will be of outdoor pile with receiving and dispensing system by stacker and reclaimer. The storage capacity will be planned to be 335,000 tons for 60-day operation of 600 MW of the first stage.

8) Heavy Oil Storage Tank Foundation (Stand-by Fuel)	Foundations for 3 tanks with a storage capacity of 36,000 kl each for 30-day operation of 600 MW at the first stage will be planned.
9) Ash Disposal Area	The disposal area for operation of the first 600 MW for 10 years will be planned. A long term plan for ash disposal for 30 years will be formulated considering utilization of fly ash and bottom ash after the second stage.

2-3 Architectural Facilities

1) The required area for powerhouse to accommodate 300 MW x 2 units will be studied.

2) Based on the future mobilization of personnel for ultimate capacity of 1,200 MW, room layout in service building will be made.

3) Study on a scale and layout of residential quarter will be made but the construction cost will be excluded from the studies.

4) The number of house in residential quarter for personnel working for 300 MW x 2 units will be 300 houses.

2-4 Harbor Facilities

The main fuel of the power plant will be coal, partly domestic coal and mainly coal imported from Australia and America. And Domestic heavy oil as stand-by fuel will be supplied by tankers. Considering the above, the location of the harbor will be considered to be selected at the proposed power plant sites since costs of fuel transportation will be minimized and the receiving of fuel could be managed efficiently.

1) Site Conditions

Considering sea bottom topography, geology, tidal level, current, wave height, etc., the location of the harbor will be studied.

2) Conditions of Facilities

a. The harbor facilities will have a capacity to manage receiving, unloading and handling of a large quantity of coal, 1,221 x 10^3 tons/year of imported coal and storage of 60-days operation for 600 MW.

b. Since the power plant will be designed to be of dual type capable for generation by heavy oil as stand-by fuel, the harbor facilities will have unloading facilities to accommodate domestic heavy oil of 1,000 x 10^3 kl/year and storage of 30 days operation.

(Reference)

The site conditions at Ayun Musa site which will be the most prospective site for power station will be outlined below:

a. Sea Bottom Topography

The seashore in front of the site shelves down till about 3,000 m offshore with a bottom slope of 1/600, and thereafter depth of water becomes deeper. There is a Suez Canal approach channel with a depth of 23.5 m at about 5 Km offshore from the site.

b. Geology

The surface layer at the sea bottom is composed mainly of sand, sandy silt and sandy clay and partly of coral, and lower layer mainly of mudstone and sandstone and partly of limestone.

c. Tidal Level

High water level of ordinary spring tide: 1.9 m

Low water level of ordinary spring tide : 0.4 m

Spring range : 1.5 m

d. Current

The current flows towards north on the flow tide and towards south on the ebb tide with a maximum velocity of 1.5 knot (2.8 Km/hour).

e. Waive Height

Significant wave height ($H_{1/3}$) to be used for design ranges from 1.3 to 1.5 approximately. Frequency of such wave generation at the area is quite few and the sea area is considered to be calm generally.

3. Transmission Line and Substation Facilities

1) The study will be made on voltage of interconnecting lines from the proposed plant to the existing trunk lines in addition to the system constitution in the existing system.

2) As for the transmission line route, areas allocated for Suez Development Plan will be avoided from the overhead transmission line route and comparative study of 4 methods for Suez Canal crossing, overhead line, cable line through the existing tunnel and a new tunnel to be constructed, and submarine cable line, will be made.

3) Optimum location and design condition of a new substation to be constructed for interconnecting system will be studied.

4) As for the communication facilities for the project concerned, microwave circuit connecting between the power station and Cairo will be planned.

4. Demand Forecast and Development Plan

Objective area of the demand forecast will be the whole area in Egypt and macro forecast will be applied in consideration of a new 5-year development program starting from 1983. As compared between the results of demand forecast by EEA and the Study Team, the demand forecast will be finalized through a discussion between EEA and JICA Team.

Upon studying basic matters such as the fuel plan, reserve capability, etc. as well as the new 5-year development program starting from 1983 taken into account, the development plan will be formulated.

5. Others

Other items for study will be as per the agreed minutes executed between JICA and EEA.

GLOSSARY

GLOSSARY

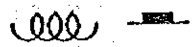
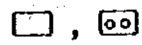
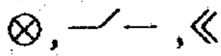
Unit Of Measure	Unit	Symbol
Length	millimeter	mm
	centimeter	cm
	meter	m
	kilometer	km (10^3m)
	nautical mile	n. mile (1,852 m)
Area	square millimeter	mm^2
	square centimeter	cm^2
	square meter	m^2
	square kilometer	km^2 (10^6 m^2)
	hectare	ha (10^4 m^2)
Volume	cubic centimeter	cm^3
	cubic meter	m^3
	liter	ℓ (10^3 cm^3)
	gallon	gallon (3.785 liters)
	barrel	barrel (31.5 gallons)
Time	hour	h
	minute	min
	second	sec
Mass	gram	g
	kilogram	kg
	metric ton	t
Speed	meter per second	m/sec
	miles per hour	mph (0.297 m/sec)
	nautical mile per hour	knot (1.852 km/h)
Flow	cubic meter per second	m^3/sec

Temperature	centigrade degree	$°C=\frac{5}{9}(°F-32)$
	Fahrenheit degree	$°F=\frac{9}{5}°C+32$
Pressure	kilogram per square centimeter	kg/cm^2
	millimeter of mercury	mmHg
	gauge pressure	atg (kg/cm^2g)
	absolute pressure	ata (kg/cm^2)
Thermal Energy	calorie	cal (4.1840 Jule)
	kilocalorie	kcal
Heating Value	kilocalorie per kilogram	kcal/kg

Electric Power	Unit	Symbol
Electric Energy	watt hour	Wh
	kilowatt hour	kWh (10^3 Wh)
	megawatt hour	MWh (10^6 Wh)
	gigawatt hour	GWh (10^9 Wh)
Electric Power	watt	W
	kilowatt	kW (10^3 W)
	megawatt	MW (10^6 W)
	gigawatt	GW (10^9 W)
Reactive Power	kilovar	kVar
	megavar	MVar
Apparent Power	kilovolt ampere	kVA
	megavolt ampere	MVA
	gigavolt ampere	GVA
Voltage	volt	V
	kilovolt	kV

Current	ampere	A
	kilo ampere	kA
Frequency	herz	Hz
	kilo herz	kHz
	megaherz	MHz
Rate	percentage	%
<u>Currency</u>	Yen	¥
	Egyptian Pound	LE
	Millimes (10^{-3} LE)	mill.
	US dollars	US$
	Mill (10^{-3} US$)	mill
<u>Exchange Rate</u>	1 US$ = 230 ¥ = 0.823 LE	

Symbol

Line Trap (Blocking Coil)	
Circuit Breaker	
Disconnecting Switch	
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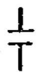
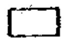
Y Connection	
Delta Connection	
Coupling Capacitor	
Protective Relay	
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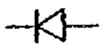
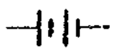
Current Transformer	
Lightning Arrester	
Power Line Carrier	
Line Tuning Unit	
Carrier Relaying Protection	
Automatic Exchange	
Rectifier	
Battery	

Abbreviation

APA	Atomic Power Authority
A.R.E	Arab Republic of Egypt
EEA	Egyptian Electricity Authority
IBRD	International Bank for Reconstruction and Development
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
NPA	Nuclear Plants Authority for Power Generation
QHREA	Quattara Hydro and Renewable Energy Authority
REA	Rural Electrification Authority

Economic Terms

C/A	Contract Agreement
CY	Calendar Year
CIF	Cost, Insurance and Freight
E/L	Export Licence
FC	Foreign Currency
FOB	Free on Board
FY	Fiscal Year (from July to June in Egypt)
GDP	Gross Domestic Product
GNP	Gross National Product
IP	Implementation Program
IRR	Internal Rate of Return
L/A	Loan Agreement
L/C	Letter of Credit
LC	Local Currency

Technical Terms

AAAC	All Aluminum Alloy Conductor
ACSR	Aluminium Cable Steel Reinforced Conductor
BC	Blocking Coil
BIL	Basic Impulse Insulation Level
B.T.G	Boiler Turbine Generator
ch	Channel (Telecommunication line)
CB	Circuit Breaker
cct	Circuit
CCPD	Coupling Capacitor Potential Device
CDL	Chart Datum Line
CRP	Carrier Relaying Protection
DC	Direct Current
D/L	Distribution Line
DWT	Dead Weight Ton
EL	Elevation Level (meter)
EP	Electrostatic Precipitator
EX	Automatic Exchange
FL	Floor Level
FM	Frequency Modulation
GL	Ground Level
GT	Gross Ton
HV	High Voltage
H.W.L	High Water Level
LV	Low Voltage
LT	Line Trap
LTC	Load Tap Changer
LTU	Line Tuning Unit
L.W.L	Low Water Level

MCR	Maximum Continuous Rating
M.H.W.S	Mean High Water Spring
M.S.L	Mean Sea Water Level
MV	Medium Voltage
OCB	Oil Circuit Breaker
OLTC	On Load Tap Changer
P/S	Power Station
R.C	Reinforced Concrete
SF_6	Sulfur Hexafluoride
S/S	Substation
SSB	Single Side Band
SVR	Step Voltage Regulator
PD	Condenser Type Potential Divider
PLC	Power Line Carrier
TACSR	High Temperature Endurance ACSR
T/L	Transmission Line
Tr.	Transformer
UHV	Ultra High Voltage
VHF	Very High Frequency
WHM	Watt Hour Meter

Definition

Utilization Factor:

The ratio of the average load on a machine or equipment for the period of time considered, to the rating of the machine or equipment

Load Factor:

The ratio of the average load over a designated period to the peak load occurring in that period

Available Capacity:

The load carrying ability for the time interval and period specified when related to the characteristics of the load to be supplied. Available capacity of a station is determined by such factors as capability, operating power factor and portion of the load which the station is to supply.

Plant Efficiency:

The ratio of the energy delivered from the station to the energy received by it under specified conditions.

N Value:

Number of strokes required in driving the sampler of the standard penetration test 30 cm (12 in) into the soil