2-2 PREPARATORY WORKS FOR THE EXECUTION OF THE PROJECT

For the execution of this project, the following preparatory works are necessary prior to the construction works.

(1) With regard to finances for the project, it is urgently needed to approach with international financing institution for foreign currency and to prepare budgetary appropriations for local currency in order to secure the necessary finances. Especially with regard to borrowing the fund including local currency, unless the Loan Agreement for the project will not be completed by July 1984 as described in the cosntruction schedule, operation start of No. 1 unit (300 MW) in July 1988 and No. 2 unit (300 MW) in January 1989 will be impossible. Therefore, the arrangement of data required for these financial preparation procedures is urgently needed.

(2) In order to promote and to execute the Project as scheduled, an excellent engineering consultanting firm, who is familiar with financing institutions and versed in their procedures and has abundant technical knowledge and experiences, should urgently be employed as EEA's assistant.

(3) As for Maghara coal to be used for this project, Detailed production program, coal properties and other necessary data on Maghara coal should be obtained so as to prepare the final specifications including boiler design, coal receiving facilities, etc.

(4) To realize the construction of power plant, the following preparatory works should be proceeded by EEA.

a. Lands acquisiton required for the project.

b. Arrangement and coordination with Suez Governorate, Suez Canal Authority, Red Sea Authority, Ahmed Hamdi Tunnel Authority, and other agencies relevant to the site for harbor facilities and canal crossing point for transmission line.

c. Prior to the commencement of construction works for the power plant, the following studies are needed.

a) Soil investigation

EEA carried out preliminary boring at three points with a depth of fifty meters. As a result, it was found that silt layer and sand stone of miocene were distributed horizontally in the power station area and the layer could be used as bearing layer for civil and architectural foundations. However, since soft soil, lime stone and halite (rock-salt) partly appeared, it is needed to confirm soil characteristics and layers by further boring exploration and laboratory tests for detailed design of all foundations.

In situ tests shall include the following items:

- Observation of core-geological layer
- Standard penetration test (every 1 m)
- Ground water observation
- Permeability test

And undisturbed samples shall be collected every 1.5 to 2.0 meters during boring.

Laboratory tests shall include the following items.

- Index property
- Unit weight of soil
- Specific weight of soil

- Moisture content
- Mechanical analysis
- Liquidity and plasticity indices
- Unconfined compressive and triaxial compressive tests
- Consolidation test

i. Power Station

i) Civil facilities

As shown on Fig. 2-15, the boring at heavy oil storage tank and coal yard will be carried out to set an allowable bearing capacity and settlement, and to confirm soil characteristics, the boring at light oil storage tank and switch yard areas will be carried out.

As for the depth of boring, since N-values of more than 30 at the depth of 30 meters from the original ground surface were obtained according to the previous soil investigation by EEA, the depth of 30 to 50 meters for the civil facilities will be appropriate in the next boring works.

ii) Architectural facilities

Severe conditions against settlement and inclining are required of the foundations of the important heavy structures such as powerhouse, turbine-generator pedestal, boiler, stack and other major equipments. Therefore, the foundations of such important structures should be supported by the solid bearing stratum with an

N-value of larger than 50 and with a thickness of 5 meters or more. According to the data of three boring points by EEA, the structures could be supported by piles driven up to the depth of 20 to 30 meters from actual ground level. Thus, boring tests for the major equipments as mentioned above will also be conducted up to the depth of 50 meters.

As the auxiliary buildings are comparatively light, the spread foundations will be adopted and so boring tests with a depth up to 30 meters for auxiliary buildings will be enough.

ii. Harbour facilities

For assumption of allowable bearing capacity and settlement, boring tests for wharf and cause way will be carried out, and the depth of boring in wharf will be 50 meters from the ground surface and in basin 20 meters. Location and number of boring are shown on Fig. 2-16.

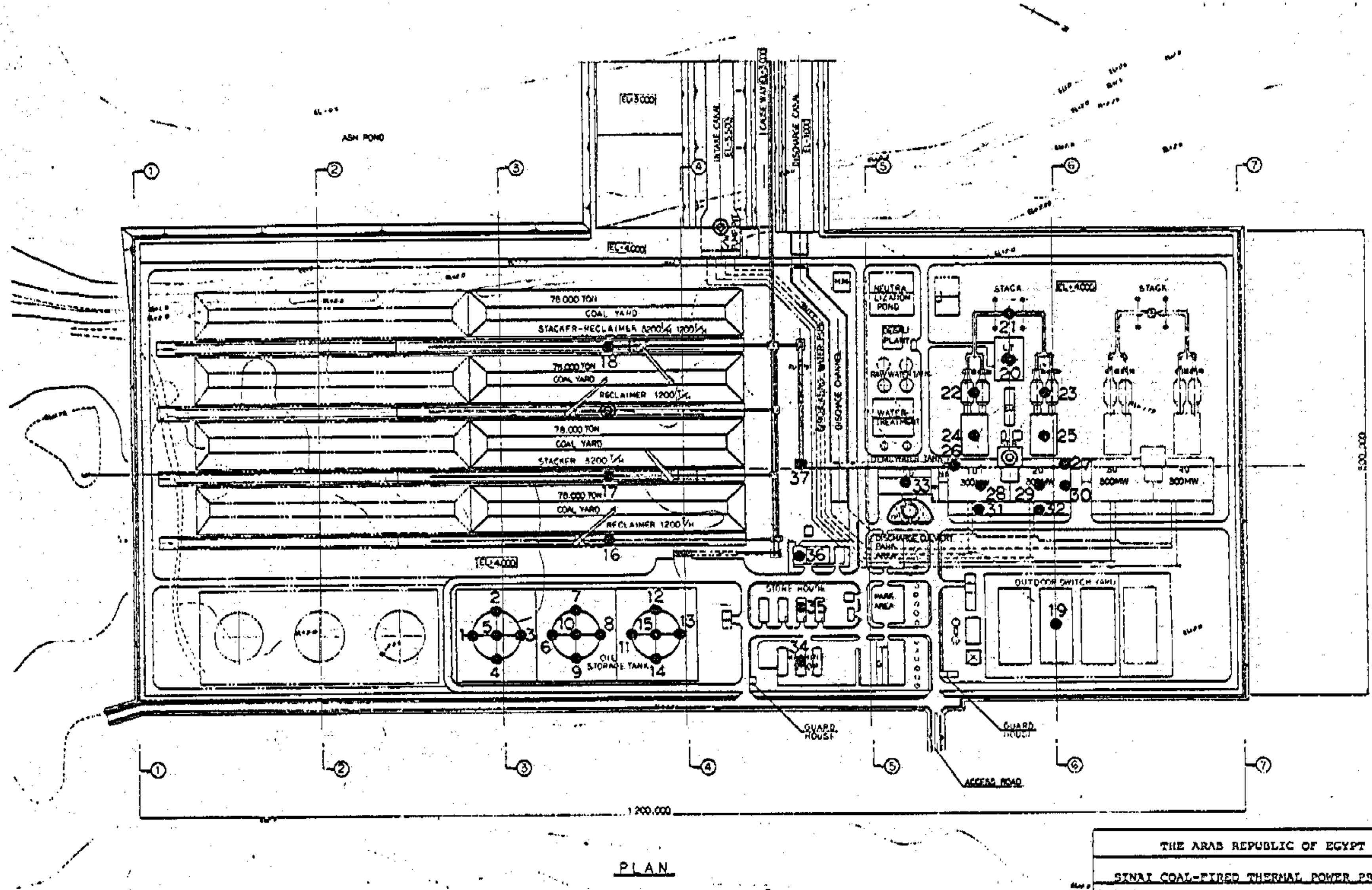
As a result of the soil investigation with the above-mentioned manner, bearing capacity will be determined and bearing layer will be confirmed for all the foundations, and length and bearing capacity of piles will be decided for pile foundations. And after the laboratory tests, detail of earth works such as material, slope of fill and heavy machines for filling works, etc. will be specified. All the foundations in the tank yard, coal yard and switchyard will be calculated based on the data of settlement obtained through the laboratory tests.

Prior to the commencement of piling work, penetration, loading and pull-out tests will be carried out according to the JIS, ASTM and other codes.

The detail of boring with the serial numbers corresponding to the Fig. 2-15 and 2-16 are as follows:

Table 2-17 Detail of Boring

Location	Number	Depth (m)	Serial Number
POWER STATION			
Heavy oil storage tank	15	30 - 50	No. 1 to 15
Coal storage yard	3	30 - 50	No. 16 to 18
Switch yard	1	30 - 50	No. 19
Light oil storage	1	30 - 50	No. 20
Powerhouse	7	50	No. 26 to 32
Boiler	4	50	No. 22 to 25
Stack	1	50	No. 21
Service building	1	30	No. 33
Machine shop	1	30	No. 34
Store house	1	30	No. 35
Coal handling control house	1	30	No. 36
Mixed coal bin house	1	50	No. 37
Subtotal	37		
HARBOUR			
Wharf	4	50	No. 40 to 43
Cause way	2	50	No. 50 to 51
Basin	6	15	No. 44 to 49
Subtotal	12		
TOTAL	49		No. 1 to 49



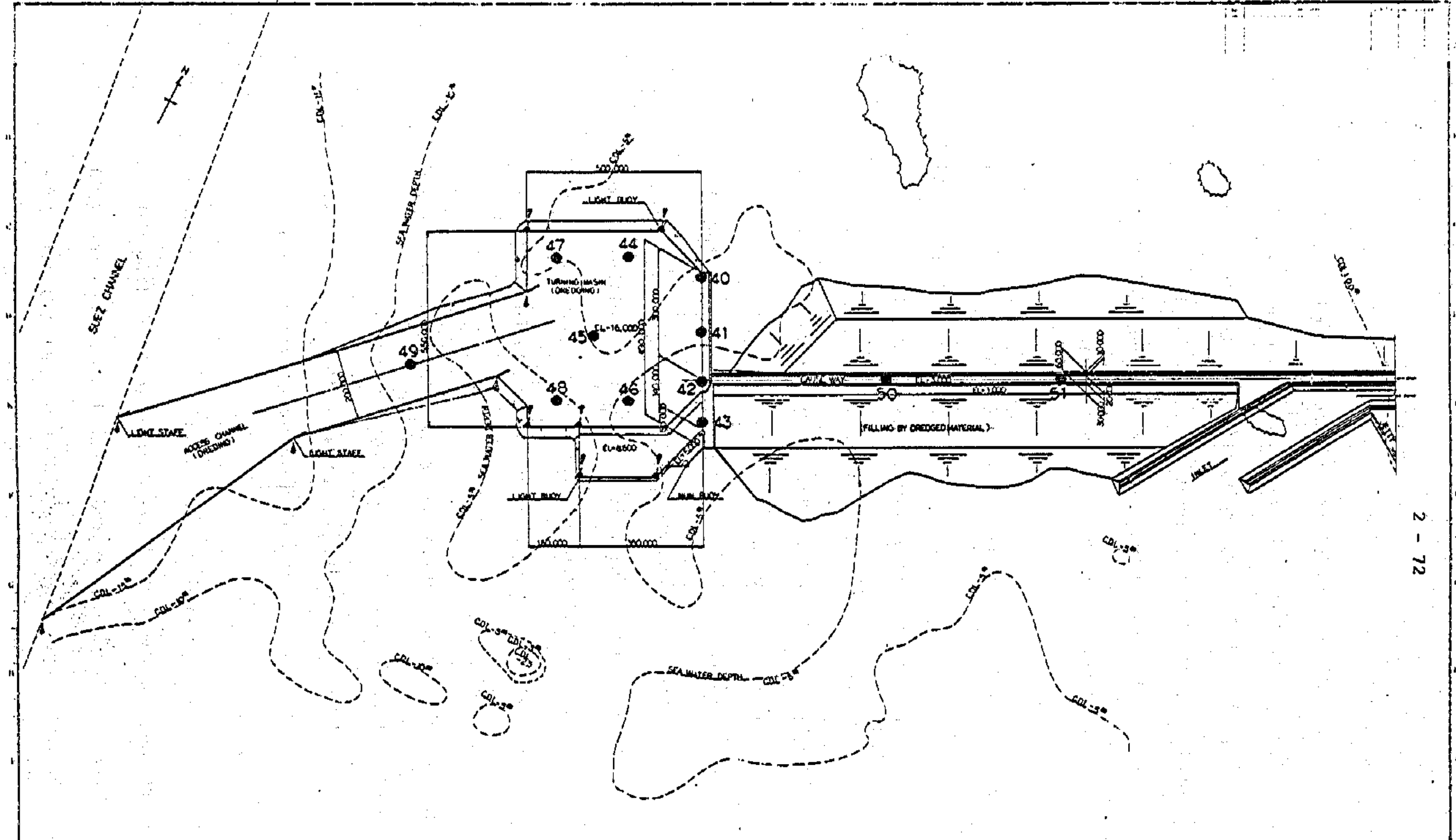
PLAN

Fig. 2-15 Boring Points

◎ : Boring points already conducted

● : Boring points to be conducted

THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE Layout of Civil Work	
SCALE 1/4,000	DRAWING NO. C-01



PLAN

0 100 200

Fig. 2-16. Boring Points in Harbor ● : Boring points to be conducted

THE ARAB REPUBLIC OF EGYPT	
SINAI COAL-FIRED THERMAL POWER PROJECT	
TITLE Plan of Harbour and Cause Way	
SCALE 1/10,000	DRAWING NO. C-11

b) Metrological Survey

The meteorological observation instruments should be placed at site and basic data such as wind direction, wind velocity, rainfall, air temperature and humidity, sand storm, inclusion in atmosphere, noise, etc. should be collected. These observation should be conducted continuously for a long term.

c) Oceanology

i) Water temperature, tidal level and tidal current should be measured at a point of cooling water inlet, where observation instruments located on a constant position is arranged.

ii) Water for construction should be sampled at site and analyzed on Ph, BOD, COD.

In addition, seawater should be collected and analysed and the basic data for specifications of water intake facilities and harbor facilities, and those structures should be collected. These observation should be conducted continuously for a long term.

d. Personnel for construction supervision and operation and maintenance personnel should be secured and trained.

(5) In line with the power development program in Egypt hereafter, review, improvement and expansion program of the power system should be promoted.

a. Review on the unified system upon the installation of second phase of Sinai Coal-fired Thermal Power (600 MW)

In 1990, Sinai Coal-fired Thermal Power Station (600 MW) and North Upper Egypt Power Station (600 MW) are planned to be installed. Furthermore, a nuclear power plant (900 MW) and another coal-fired thermal power plant are planned to be additionally installed in 1991.

For the desirable conditions for the main trunk line system with the introduction of such big capacity power plants, study on system planning including review and analysis on the power flow, short-circuit capacities and system stabilities should be conducted so that the big capacity generators will be utilized effectively based on the result.

b. For voltage stability, supply reliability, etc., planning and execution of improvement program including 66 kV transmission system will be a subject to be settled thereafter. EEA should solve vigorously the above subject in corporation with the local distribution companies.

c. Economical operations of these power plants depend largely upon the establishment of a sophisticated communication system including adoption of protection signal transmission and remote control and supervision. The emphasis should be placed on increase of technical staff related to the communication system and the facilities arrangements in response to system expansion and increase in the demand.

(6) Electricity tariff: The current tariff of 7.47 millimes/kWh is 1/5 - 1/10 of tariffs in foreign countries, and it is planned that this tariff will be increased to 33.65 millimes/kWh by 1990. This tariff hike should be effected by all means with attention paid to the balance of the sound development of the electric power industry and the promotion of industries.

(7) Decision of contractor: Since the project is the first coal-fired thermal power plant in Egypt, it is advisable to give the whole contract to single responsibility for efficient execution of the construction works, overall responsibility on the whole works, performance guarantee after commissioning, quick response in case of troubles, etc.

CHAPTER 3

BACKGROUND OF THE PROJECT AND POWER DEMAND/SUPPLY FORECAST

CHAPTER 3. BACKGROUND OF THE PROJECT AND POWER DEMAND/SUPPLY FORECAST

3-1 GENERAL SITUATION IN EGYPT

3-1-1 Land and Climate

Arab Republic of Egypt lies in north east African Continent on the shores of the Mediterranean and Red Seas and includes the Sinai Peninsula, lying between the Gulfs of Suez and Aqaba. The country occupies slightly more than 1 million square km of land. In the west the 25°E longitude forms the greater part of the boundary with Libya and in the south boundary between Egypt and the Sudan is the 22°N latitude.

The country is low-lying, with extensive desert plains westward from Sinai and the hills along the Red Sea. The highest point is Jebel Katherine (2,642 m) in Sinai. The rugged highlands drop steeply to the sea but level out northwards into broad sand and gravel plains along the Mediterranean coast. The country bordering the Red Sea coast is similar with deeply dissected hills rising 2,000 m before dropping down to the Nile Valley. This forms the Eastern Desert. On the other side of the Nile, the Western Desert opens out into broad plateau separated by extensive depressions. The highest points rise to over 2,000 m in the south west and the lowest is the Quattara Depression in the north which occupies as large as 19,500 km² at zero meter above sea water level with the deepest point at -144 m.

The Nile River penetrates the country forming the Nile Valley with a 9 - 12 km width, cliff-walled trench from Aswan to just south of Cairo. In the south of Aswan, the valley is flooded by the man-made Lake Nasser, created by the completion of Aswan High Dam. And north of Cairo it opens out into a triangle-shaped delta, with about 200 km coast line.

The climate is classified as a sub-tropical one with a low humidity. But a tropical climate prevails in a part of Upper Egypt. Winter temperatures, from November to April, average 16°C in Cairo. In summer, the heat is tempered by sea breezes along the coast but gets hotter in day time and colder at night inland. The temperature difference between day and night sometimes reaches 20°C to 30°C. It is very humid in late summer when the Nile is in flood. Every year in spring, the climate often changes abruptly, and the "Khamsin" wind blows and brings dust and hot storm from the south, most frequently during a period from April to June.

Annual rainfall is about 200 mm along the coast and in the delta but it rains only 30 to 70 mm at the south of Cairo. The highest percentage of average humidity is 62% and the lowest 40% in Cairo.

3-1-2 Administration and People

Egypt is a democratic socialist state with a 360-member People's Democratic Assembly elected by universal suffrage from 176 electoral units. The last election was held in 1976. According to the Constitution of 11th of September, 1971, the head of this presidential republic is nominated by the Assembly, and confirmed by a plebiscite. The President assumes the Office for a 6-year term. The President of the Republic appoints the members of his government and the prime minister.

Administratively, the country is divided into two, Lower Egypt and Upper Egypt, and administrated by 25 governorates and 4,033 villages.

In 1981 the population was estimated at 43.47 million, growing at roughly 3% a year, or an additional 1.3 million in 1982 while the country's habitable and cultivated land is limited to only about 4% along the Nile and scattered oasises in the broad desert.

Thus the habitable areas' population density is one of the highest in the world. Urban population densities average around 90/km² as unemployed people pour into the cities, especially the capital city of Cairo whose population including Giza is said to be around 14 million. And Alexandria, the second largest city in Egypt, has a population of nearly 3 million. Suez, Ismailia and Port-Said are today in the reconstruction boom and are each likely to have a population reaching 1 million mark before 1990.

Under such continuous population increase, some 0.5 million job seekers entered the market. The government is promoting the family planning campaign, and is advancing the development of the Sinai Peninsula and encouraging the people to immigrate and settle there.

The evolution and increase rates of population for the past ten years are tabulated as follows:

	1970	1975	1976	1977	1978	1979	1980	1981
Population	33.33	37.01	37.87	38.79	39.82	40.98	42.29	43.47
Increase Rate		2.1%	2.3%	2.4%	2.7%	2.9%	3.2%	2.8%

Unit: Million

Source: Monthly Bulletin of Statistics, United Nations October 1982

3-1-3 Economical Conditions

1) Economic Policy

During 6 years from the cease-fire of the 3rd Middle East War in 1967 to the outbreak of the 4th Middle East War in 1973, the execution of the National Development had been suspended, and the increased cost of living as well as the problem of unemployment had come to assume a grave aspect bringing the national economy to a worst condition.

However, the 4th Middle East War which came to an end with the recovery of Sinai for Egypt has brought a drastic turnover "from Hostilities to Peace" to allow Egypt to secure from 1974 up to the present a high growth rate of national economy, namely 12.3 % per annum on an average from 1975 to 1980, through liberalization of economy and induction of foreign investment.

<u>Actual Annual Growth Rate (GDP)</u>
(Real Terms)

1970-1980	8.3%
1970-1975	4.3%
1975-1980	12.3%

In July, 1974 after the war, the government promulgated Law 43 of 1974 on Arab and foreign capital investment and free zones, later amended by Law No. 32 of 1977, which provides preferential treatment of the capital investment by foreigners. And the Egyptian government concluded investment guarantee treaties with the USA, Germany, France, England, Japan, Switzerland, Iran, etc., one after another. With those efforts, foreign capitals have flown into Egypt.

The previous 5-year plan attained the target with an 8.5% growth rate and total investment amounting to L.E. 18,304 million, a new 5-year plan for 1982/83 to 1986/87 is now being formulated with the following target:

Investment

Private Sector:	L.E. 8,272 million
Public Sector:	L.E. 27,215 million
Total	L.E. 35,487 million

Expected Growth Rate of GNP in Real Term

8.6% annum

2) Major Industries

Agriculture, mining and petroleum industries are counted as major industries of Egypt. Foreign exchange revenue of the government relies mainly on exports of petroleum products and cotton, Suez Canal due, remittance from the Egyptian expatriate, and tourism receipts.

a. Agricultural Industries

Egypt's economy is based on agriculture, but its share in the GNP has decreased: the agricultural products accounted for 31% of the GNP in 1975 but dropped to 24% in 1979, lower than the sum of petroleum and other manufacturing industries accounting for 26% in 1979. Similarly, 47% of the working force depending on the agricultural business in 1975 decreased to 39% in 1979 and the decreasing trend continues. The share of agricultural products in the total export at 45% in 1975 sharply declined to 27% in 1979. Such a decrease of the agricultural production is due to the decrease of investment in the agricultural sector after 1973 in addition to the increase of petroleum revenue with a sharp rise of oil price.

The government concentrates on the production of cotton, orange and potato, which can be exported for earning foreign exchange, while a large part of wheat, millet, corn are imported since the domestic production cannot meet the demand.

Thus, more than 20% of the total import was spent on import of foods in 1980.

b. Manufacturing Industries

Egyptian industrial standard is substantially higher than the other Middle East countries. Industrialization of the country has been encouraged to attain its economic development since the first 5-year development plan concentrated on the development of industries. Under the plan (1957 - 1967), several industrial projects including Helwan steel, cement, chemical and fertilizer plants were created. And almost all major industries were nationalized in 1962.

The Egyptian economy has relied upon food and textile industries based on the agriculture, but recently a production increase of metallurgical sector, iron and steel, and aluminum, has come to be prominent. The total production of these industries is nearing the traditional textile and food products. In addition, other industries showing remarkable increases are chemical and pharmaceutical/medical products owing to the Law 43 of 1974 encouraging the investment by the private sectors.

The industrialization policy implemented before the 4th Middle East War was to develop public industries under centralized control. So a large part of the investment was made in the heavy industrial sector, or capital-intensive industries such as iron and steel, cement and oil refinery. On the other hand, the investment in light industries was limited. As a result, aging of the facilities in the light and heavy industries progressed and hampered efficient production and supply.

As a measure to seek a way for further economic development of the country, the government put the "open door policy" aiming at:

- Decentralizing decision making
- Strengthening private sector, and
- Attracting foreign investment

Owing to the policy, participation of the private sector in manufacturing industries became intensive and contribution to the industrial production by private sectors reached 40% and contribution of the manufacturing sector to the GNP became 17.2% in 1979.

c. Oil Industry

Egypt's oil industries have been nationalized since Revolution and Egyptian General Petroleum Corporation (EGPC) monopolizes petroleum production, refinery and selling in the country. As for the discovery and exploration, EGPC is conducting the exploration of a part of the oil field by itself, and at many other oil fields, the exploration has been done by the joint ventures of EGPC and foreign petroleum companies since early days. And recently, exploration and production has been implemented under production sharing agreements. In the period from 1973 to the end of 1980, about 80 oil exploration agreements were concluded and now some ten groups have been exploring the oil fields at the Gulf of Suez, Delta, offshore of the Nile, Western Desert, etc. Oil production in 1980 was about 29.4 million tons with an increase rate of 13% from the previous year. Of the production, about 11 million tons, or 37%, was consumed locally and the remains, or 63%, was exported. Owing to the price rise of oil, oil has become the highest foreign exchange earner since 1978, taking the place of cotton. In 1980, oil export revenues amounted to 3,000 million US$ accounting for 60% of the total export value.

d. Suez Canal Due

Suez canal was reopened in June 1975 after 8-year close. The reopening of the canal brought about great profits not only to Egypt as the most valuable foreign exchange earner but also to the world economy. When the canal was reopened, it was found to be too small to pass the new generation of tankers and container ships. And a two-stage reconstruction for enlargement was planned.

Initially the wet cross-section was increased to 3,200 m^2 with a draught of 16 m to allow passage of tankers up to 150,000 DWT. As a result of the completion, the canal revenue increased constantly: US$ 380 million in 1976, to US$ 900 million in 1980/81 and about US$ 1,200 million in 1981/82, as the number of ships increased and the toll was raised. The canal revenue constitutes an important foreign exchange earning source followed by oil and remittance revenues.

The second stage of enlargement is planned to increase its wet cross-section to 4,200 m^2 and to have the draught of 20 m for allowing passage of 260,000 DWT tankers.

e. Tourism Receipts

Tourism is a promising industry in Egypt where there are plenty of historical and religious monuments in a pleasant climate. The lack of adequate hotel accommodations had hampered the increase of tourrism revenue. However the recent increase of hotel accommodation capacity in the tourist areas caused tourism revenue increase, and the tourism industry has become one of the four prime sources of foreign exchange earning. Income from tourism increased from US$ 570 million in 1978 to US$ 770 million in 1979 and US$ 1,000 million in 1980. As long as the political situation in the area is stabilized as it is, the tourism may contribute more and more to the Egyptian economy in future.

Table 3-1 Economic Growth Rate by Sector

Sector/year	1976	1977	1978	1979	Proportion of 1979 (%)
Agriculture	1.5	-0.1	4.8	3.3	23.6
Petroleum		49.3	16.7	52.6	8.4
Manufacturing	14.0	9.0	8.2	9.0	17.2
Electricity	8.3	10.3	3.5	16.9	4.7
Construction	13.5	12.3	4.7	11.8	1.5
Transportation/ communication	67.5	15.3	-	-5.6	5.1
Suez canal			-	30.2	3.3
Commercial/finance	4.1	7.4	21.7	5.7	13.4
Housing	4.6	5.9	3.5	8.1	2.4
Public services	15.8	-	13.6	8.0	0.4
Other services	9.2	9.5	5.2	9.6	20.0
G.N.P.	10.2	8.5	9.0	9.8	100.0

Table 3-2 Balance of Payments

(Million US$)

Items	1977	1972	1979	1980	1981
Balance of Current Account	-826	-1,201	-1,225	-1,553	-490
Balance of Trade	-2,233	-2,130	-2,844	-3,589	-3,074
Export (FOB)	1,609	1,993	1,984	2,514	2,853
Import (CIF)	3,842	4,123	4,828	6,103	6,927
Balance of Invisible Trade	1,320	868	1,567	1,892	2,488
Balance of Transfer	87	61	52	54	96
Long Term Capital Balance	428	335	509	1,508	1,004
Short Term Capital Balance	-272	-1,040	-531	-121	79
Error	-636	8	180	190	71
Overall Balance	-1,306	-1,898	-1,067	24	664

Table 3-3 Major Economic Indicators

Indicators	1978	1979	1980	1981	1982
Official Foreign Exchange Reserve (Million US$)	481	529	1,088	688	734
Exchange Rate to US$	0.391	0.97	0.70	0.8325	0.8325
Official Rate	8%	9%	11%	12%	12%
Price Index (1975 = 100)					
Wholesale Price	133.6	140.8	186.0	188.6	213.8
Consumer's Price	138.1	151.8	183.2	202.3	239.2

Source: Monthly Bulletin of Statistics, October 1982
United Nations

3-2 OUTLINE OF ELECTRIC POWER SUPPLY SYSTEM IN EGYPT

3-2-1 History of Electric Power Industry

It was in 1893 that electricity was introduced for the first time into Egypt, when low voltage D.C current by diesel engine driven generators was supplied to private houses and street lighting on a limited scale. In 1932 the first power generating plant was erected at Shoubra-El-Kheima to supply general consumers and electrical traction in Cairo and Heliopolis district.

In 1965 all private and municipality-owned electric power companies were unified into General Electricity Corporation which was established by Decree No. 3716 for promotion of power development to secure stable supply of electricity under the control of the Ministry of Electric Power. In the same year, Authority for Rural Electrification was established for expansion of distribution networks in rural areas.

3-2-2 Present Situation of Electric Power Industry

1) Electric Power Development and UHV and HV Power Distribution

For the purpose of promoting the development of renewable energy resources, the Ministry of Electric Power was reorganized into the Ministry of Electricity and Energy in 1976 and, accordingly, General Electricity Corporation was reorganized into Egyptian Electricity Authority (EEA) by Decree No. 12, and Authority for Rural Electrification into Rural Electrification Authority (REA) by Decree No. 27 in the same year. Also in 1976, for promotion of studies, researches and development of renewable energy resources, Atomic Power Authority, Nuclear Plants Authority for Power Generation and Quattara Depression Hydro and Renewable Energy Authority were established by respective Presidential decrees.

Thus, there exist at present four authorities for power development and an authority for expansion of distribution systems in rural area as shown below. Of these authorities, EEA has the statutory duty to conduct generation, transmission and distribution of electricity to the ultra high voltage (220 kV and 132 kV - UHV) and high voltage (66 kV and 33 kV - HV) consumers. Wholesale supply of electricity to distribution companies is also carried out by EEA.

- Egyptian Electricity Authority (EEA) Decree No. 12 - 1976
- Rural Electrification Authority (REA) Decree No. 27 - 1976
- Atomic Power Authority Decree no. 13 - 1976
- Nuclear Plants Authority for Power Generation Decree No. 13 - 1976
- Quattara Depression Hydro and Renewable Energy Authority Decree No. 14 - 1976

2) MV and LV Power Distribution

Up to the end of 1978, power distribution at all voltage classes had been carried out by EEA. However, seven distribution companies were established in 1978 to supply energy to general consumers at medium voltage (11 kV - MV) and low voltage (380 V and 220 V - LV) in their respective distribution zones from the beginning of 1979. These distribution companies are as follows:

- Cairo Distribution Company Decree No. 220 - 1978
- Alexandria Distribution Company Decree No. 224 - 1978
- Canal Distribution Company Decree No. 225 - 1978
- Delta Distribution Company Decree No. 223 - 1978
- Behera Northern and Western Regions Distribution Company Decree No. 221 - 1978

- North Upper Egypt Distribution Company Decree No. 222 - 1978
- South Upper Egypt Distribution Company Decree No. 226 - 1978

3-2-3 Egyptian Electricity Authority (EEA)

As stated above, EEA was established in 1976 by Presidential Decree No. 12 of the same year. Its statutory duties, administrative organ and internal organization are as follows:

1) Statutory Duties by Presidential Decree No. 12

EEA's statutory duties are specified as follows:

a. Carrying out projects for generation, transmission and distribution of electricity all over the Republic.

b. Managing, operating and maintaining power stations and organizing loads in the main networks all over the Republic.

c. Distribution and sale of electric power all over the Republic. As described above, distribution is transferred to seven distribution companies from the beginning of 1979.

d. Performing studies and researches on matters relating to the EEA's activities.

e. Performing expertise work and executing projects within its scope of work - whether inside the Republic or abroad through abilities and expertise available to it or on its behalf.

2) EEA's Activities after Stated Decree in 1978

Since REA has a purpose of constructing distribution networks in rural area, power distribution itself is not included in its duty. Categorically, its duty is to construct transmission and distribution systems at 66 kV and below in the whole country except for Great Cairo (Cairo governorate and Giza governorate) and Alexandria. After construction, 66 kV and 33 kV transmission systems are transfered to EEA, and distribution systems at 11 kV and below to the distribution companies (DC). The duty of the distribution companies is to secure stable supply of electricity to general consumers fed on 11 kV and below.

The limit of EEA's activities is summarized as follows:

a. Construction
   - Construction of power plants
   - Construction of UHV and HV transmission lines and substations

b. Operation of power system

c. Power distribution
   - UHV power supply to:
     . KIMA (fertilizer)
     . SOMED (pipe-line)
     . Aluminium
   - HV power supply to:
     . Industries and Batra Broad Cast
     . Irrigation, drainage and land reclamation
   - Wholesale to the distribution companies

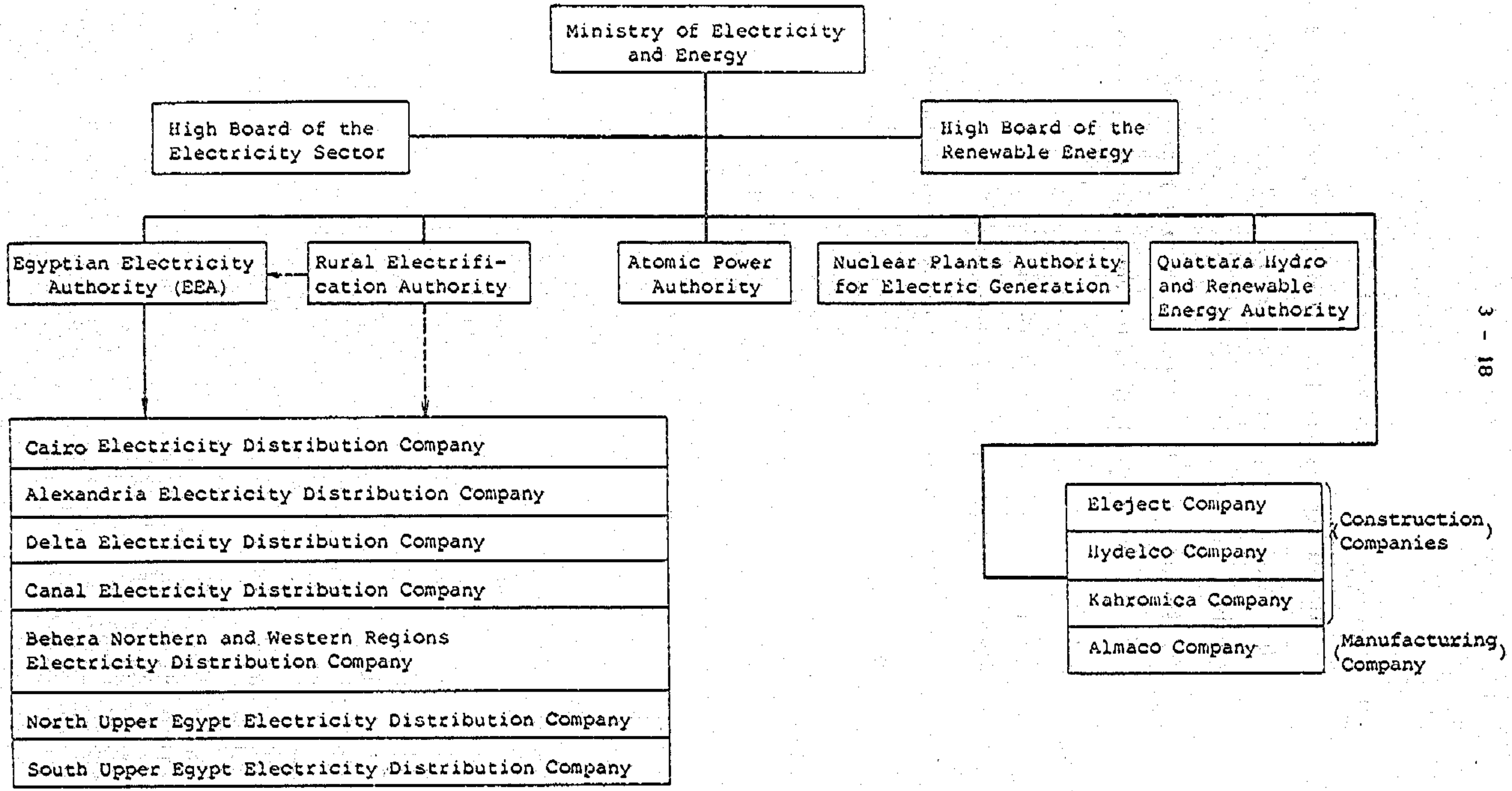
3) Control of Electric Power Industry

The electric power industry including EEA, REA, distribution companies and other authorities for new energy resources are under the general control by the Ministry of Electricity and Energy. For the effective control and administration by the Ministry, the following two advisory organs are established:

- High Board of the Electricity Sector
- High Board of the Renewable Energy

The organization chart of electric power industry is shown in Fig. 3-1.

Fig. 3-1 Organization Chart of Electric Power Industry



4) Organization of EEA

The Board of Directors is the supreme organ of EEA which decides operational and financial policies, development programs and other important affairs, and is formed of 21 members including Chairman of the Board. The Chairman of the Board (Chairman of EEA) is appointed by a Presidential decree. Other members of the Board are appointed by a decree from President of the Cabinet upon suggestion of the Ministry of Electricity and Energy.

a. General Service

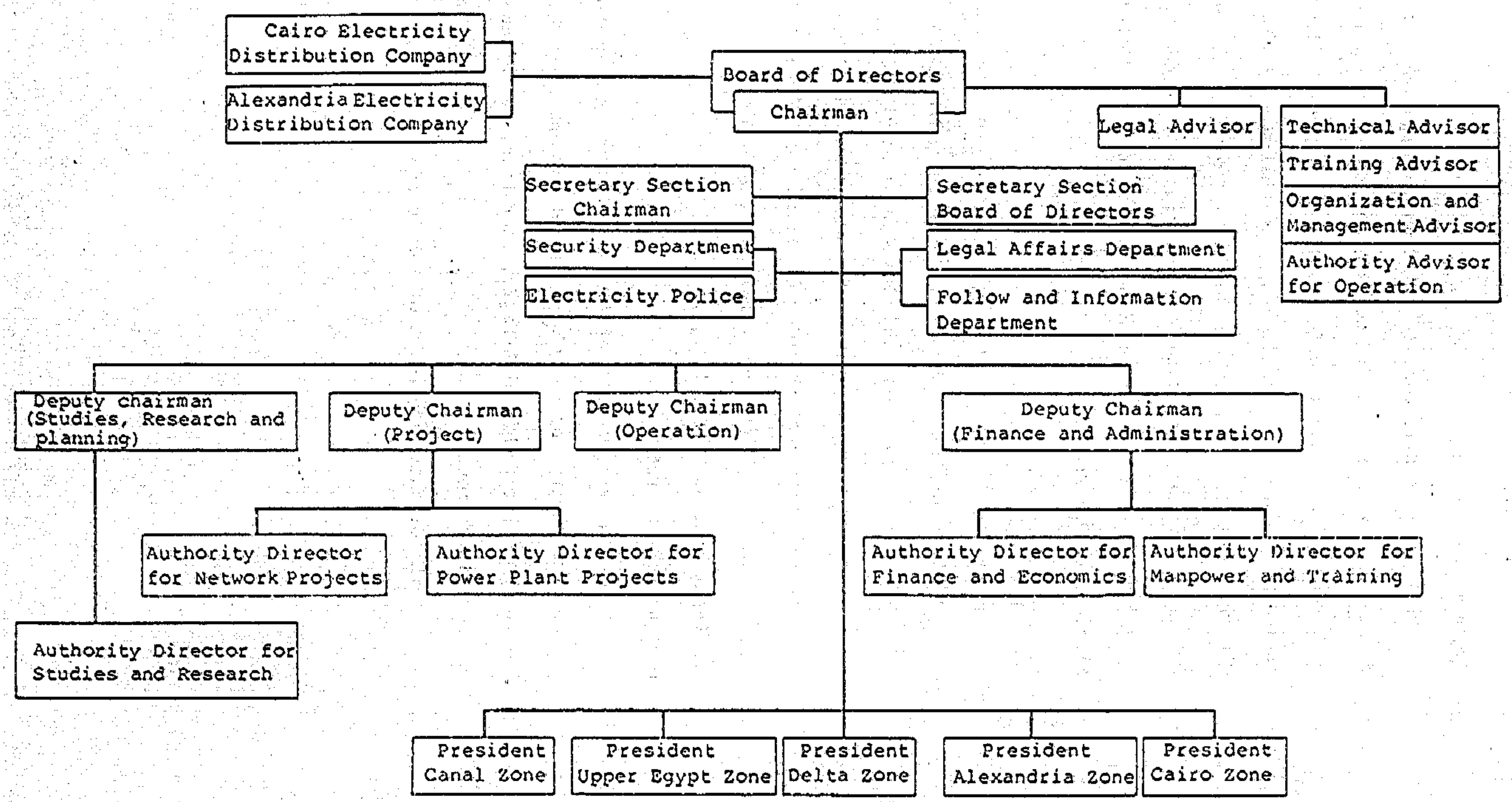
Staffs belonging to the Chairman and the Board of Directors are Legal Advisor, Technical Advisor, Training Advisor, Organization and Management Advisor. General service sections consist of Secretary Section (Chairman), Secretary Section (Board of Directors), Legal Affairs Department, Follow and Information Department, Security Department and Electricity Police.

b. Business Operation

Business operation of EEA are carried out under the general control by the Chairman and three Deputy-Chairmen in charge of Technical Affairs, Operation, and Finance and Administration.

The organization chart of EEA is shown in Fig. 3-2.

Fig. 3-2 Organization Chart of Egyptian Electricity Authority (EEA)



3-2-4 Power Supply System of EEA

1) Power Facilities

a. Power Stations

a) Installed Capacity and Peak Load

The total installed capacity of the EEA's power stations as of the end of 1982 is 5,132 MW, of which 2,445 MW is of hydro power stations consisting of 2,100 MW Aswan High Dam power station and 345 MW Aswan Dam power station, and the remaining 2,687 MW is of thermal power stations consisting of 1,675 MW steam power stations and 1,012 MW gas turbine power stations.

From 1970 to 1975 there had been no augmentation of capacity of thermal power stations because of the large generating capacity of Aswan High Dam power station which was put into operation in 1967, but for the period of 7 years from 1976 through 1982 the installed capacity of thermal power stations increased from 1,330 MW to 2,687 MW in order to meet growing power demand.

The peak load on the EEA's Unified Transmission System increased from 1,100 MW in 1970 to 3,900 MW in 1982.

The increases of installed capacity and peak load for the observation period are shown in Table 3-4.

Table 3-4 Installed Capacity and Peak Load

Unit: MW

Year	Installed Capacity: Thermal	Hydro	Total	Peak Load	Available Capacity
1970	1,330	2,445	3,775	1,100	
1975	1,330	2,445	3,775	1,733	
1976	1,344	2,445	3,789	1,909	
1977	1,415	2,445	3,860	2,284	
1978	1,460	2,445	3,905	2,564	
1979	1,784	2,445	4,229	2,829	
1980	2,286	2,445	4,731	3,239	
1981	2,469	2,445	4,914	3,553	
1982	2,687	2,445	5,132	3,900	4,077

b) Available Capacity

As stated above, the total installed capacity of 2,687 MW of thermal power stations consists of 1,675 MW steam power and 1,012 MW gas turbine capacities. All these gas turbine power stations are new, commissioned after 1976, except for 28 MW El Max.

As contrasted to this, more than two-third (1,366 MW) of steam power stations are very old. These power stations have been erected in 1950s and 1960s. The total installed capacity of new generating units of steam power stations is only 307.5 MW as shown below:

Cairo West No. 4 Units	87.5 MW (1979)
Kafr El Dawar No. 1 and No. 2 Units	220.0 MW (1979)
Total	307.5 MW

Therefore, it should be noted that the total available capacity of the existing steam power plants is only 1,225 MW as compared with the total installed capacity of 1,675 MW. This is due to their ages and the difficult circumstances of operation after the 3rd Middle-East War in 1967.

As for gas turbine power plants, their available capacity decreases necessarily according to rise of ambient temperature. Accordingly, the available capacity is estimated by EEA at 80 to 85% of ISO rating capacity in the climatic conditions of Egypt.

The actual hydro electric power output depends upon the available discharges allotted by the Ministry of Irrigation and also upon the dynamic and static stability of the 500 kV network, and it is estimated at 2,000 MW.

Thus, the total available capacity of the existing power stations including hydro, steam and gas turbines as of the end of 1982 is only 4,077 MW as indicated below:

Table 3-5 Installed and Available Capacities (1982)

Type of Power Plant	Installed Capacity (MW)	Available Capacity (MW)	
Hydro	2,445	2,000	(82%)
Thermal			
Steam	1,675	1,225	(75%)
Gas Turbine	1,012	852	(87%)
Sub-total	2,687	2,077	(77%)
Grand Total	5,132	4,077	(74.4%)

Therefore, Although the total installed capacity was 5,132 MW as of the end of 1982, the available capacity was only about 4,077 MW, which was not sufficient to give enough margin over the maximum power demand of 3,900 MW in the same year. The electric power facilities as of 1982 in Egypt are shown in Fig. 3-3.

Table 3-6 (1/2) General Characteristics of Power Stations

(As of the end of 1982)

Unit: kW

Power Station	Unit x Capacity	Total Installed Capacity	Total Available Capacity	Commissioning Year
A. Hydro P.S.				
Aswan High Dam	12 x 175	2,100	1,750	1967-70
Aswan Dam	7 x 46			
	2 x 11.5	345	250	1960
Total Hydro		2,445	2,000	
B. Steam P.S.				
Cairo West	3 x 87.5			1966
	1 x 87.5	350	245	1979
Cairo South	2 x 60			1957
	1 x 60			1955
	1 x 60	240	160	1965
Cairo North	2 x 10			1952
	2 x 30			1954
	1 x 20	100	75	1955
Talkha	3 x 13			1955
	3 x 30	129	126	1966
Damanhour	2 x 15			1960
	3 x 65	225	185	1968
El Suif	2 x 26			1961
	2 x 30	112	35	1969
Assuit	3 x 30	90	85	1966
El Tebine	3 x 15	45	44	1958
Karmauz	4 x 16	64	10	1946-56
Suez	4 x 25	100	75	1965
Kafr El Dawar	2 x 110	220	185	1979
Total Steam		1,675	1,225	

Table 3-6 (2/2) General Characteristics of Power Stations

(As of the end of 1982)

Unit: kW

Power Station	Unit x Capacity	Total Installed Capacity	Total Available Capacity	Commissioning Year
C. Gas Turbine P.S.				
Cairo North	1 x 20	20	15	1978
Talkha	6 x 24.2			1979
	2 x 24.2	193.6	186	1980
El Tebine	2 x 25	50	43	1980
Karmouz	2 x 12.5	25	10	1980
Suez	1 x 17	17	12	1976
El Max	2 x 14	28	24	1966
Ismailia	1 x 22	22	13	1977
Abu El Matamir	1 x 23	23	20	1978
Helwan	5 x 24.2	121	110	1980
Heliopolis	3 x 12.5	37.5	20	1980
Cairo East	2 x 25	50	42	1980
El Suif	1 x 26			1980
	1 x 33.3			1981
	2 x 33.3	126	110	1982
Mahmoudia	4 x 50	200	160	1981
El Shabab	3 x 33.3	100	87	1982
Total Gas Turbine		1,012	852	

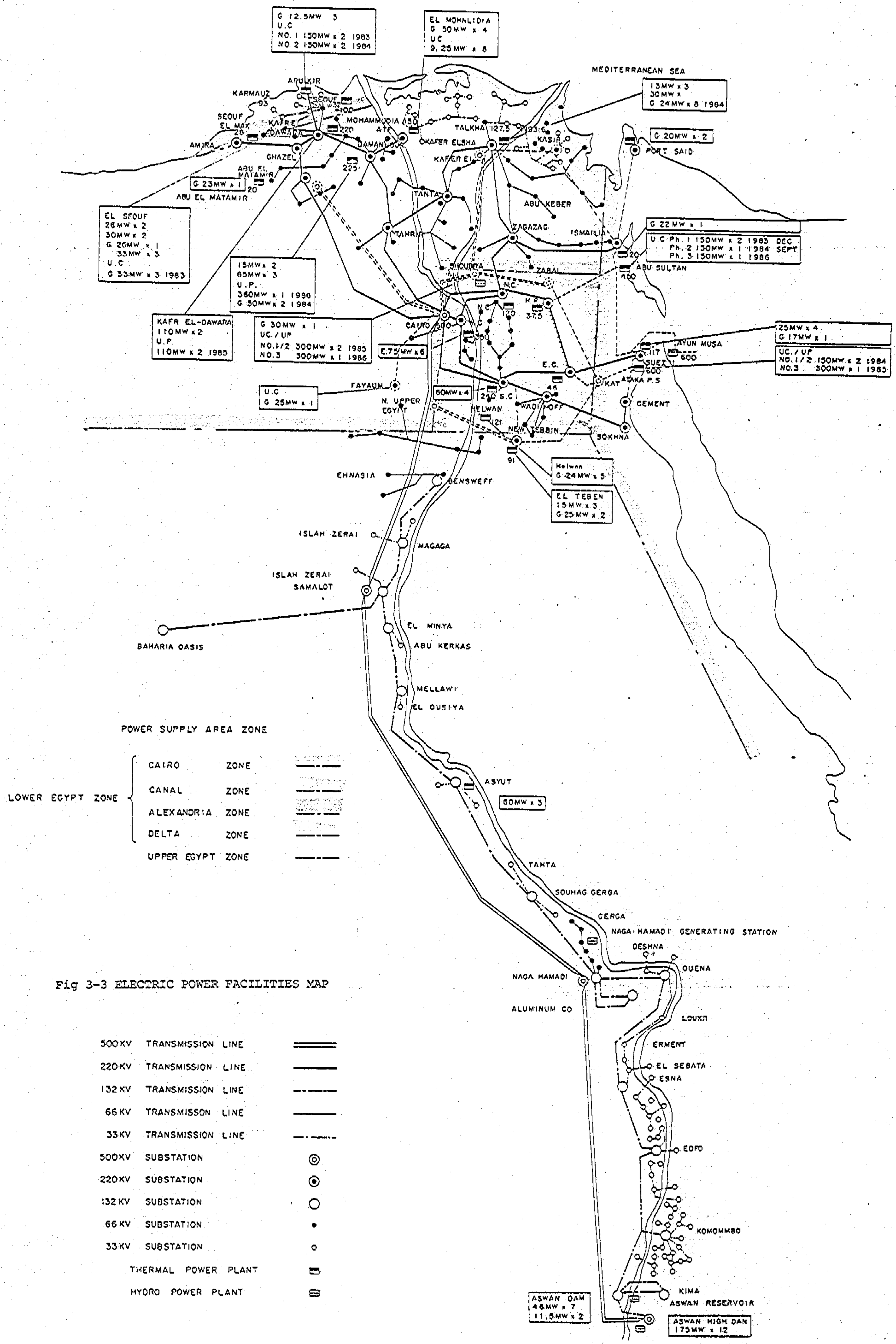


Fig 3-3 ELECTRIC POWER FACILITIES MAP

b. Transmission Lines and Substations

The voltage classes are 500 kV, 220 kV and 132 kV for ultra high voltage (UHV) transmission systems and 66 kV and 33 kV for high voltage (HV) transmission systems.

The importance of erection of the 500 kV transmission network appeared with the construction of Aswan High Dam power station which produces about 50% of the total power in Egypt (hydro power generation of 10,215.1 GWh against total energy generation of 20,747.5 GWh in 1981). In 1981, the 500 kV network transmitted an amount of energy equal to 4,458.1 GWh to feed loads in Delta, Alexandria, Suez and Cairo regions. The remaining 5,757.0 GWh was consumed in Upper Egypt to feed KIMA, Aluminium, etc.

The 132 kV transmission system is erected in parallel with the 500 kV system between Aswan High Dam power station and Beny Souef through Aswan Dam power station and Samalout. Another 132 kV branch line runs from Samalout to Beharia Oasis to feed loads by phosphate mines.

In Lower Egypt the 220 kV transmission network which starts from Cairo 500 kV substation connects all main cities such as Alexandria, Ismailia, Suez, Sokhna and other consumption centers in Delta.

Line routes of the trunk transmission systems are as follows:

a) Upper Egypt

<u>500 kV System</u>

° Aswan High Dam power station - Nag. Hammadi - Samalout - Cairo

132 kV System

- ° Aswan High Dam power station - Aswan Dam power station - Luxor - Nag. Hammadi - Samalout - Beny Souef
- ° Samalout - Beharia Oasis

b) Lower Egypt

220 kV System

- ° El Harm - Cairo South - Wadihoof - Wadihoof - Sokhna
- ° Cairo South - Cairo East - Suez
- ° Cairo South - El Harm - Cairo West
- ° Cairo 500kV - Cairo West - Cairo North - Heliopolis
- ° Cairo North - Zagazig - Ismailia (Manaif)
- ° Cairo 500kV - El Tahrir I - Damanhour - Kafr El Dawar - Alexandria I
- ° Cairo 500kV - El Tahrir II - Ameria (Alexandria II) - Somid
- ° El Tahrir I - Tanta - Talkha
- ° Damanhour - Mahmoudia - Kafr El Shikh - Talkha
- ° Manaif - Port Said
  - ° Manaif - Abu Sultan

The transmission line lengths and the substation capacities as of the end of 1981 are shown in Table 3-7 and Table 3-8 respectively.

Table 3-7 Transmission Line Lengths

(As of the end of 1981) Unit: km

	UHV			HV		
Region	500 kV	220 kV	132 kV	66 kV	33 kV	Total
Cairo		352		431		783
Alexandria		417		518	138	1,073
Canal		728		620		1,348
Delta		714		1,235	911	2,860
Upper Egypt	1,576		2,098	368	1,142	5,184
Total	1,576	2,211	2,098	3,172	2,191	11,248

Table 3-8 Transformer Capacities of Substations

(As of the end of 1981) Unit: MVA

	UHV			HV		
Region	500 kV	220 kV	132 kV	66 kV	33 kV	Total
Cairo		1,245		1,723		2,968
Alexandria		845		325	365	1,535
Canal		670		199		869
Delta		860		1,037	200	2,097
Upper Egypt	3,280		1,377	227	408	5,292
Total	3,280	3,620	1,377	3,511	973	12,761

2) Evolution of Power Demand and Supply

a. Annual Generation and Peak Load

For the period of 12 years from 1970 through 1982, the annual energy generation increased from 6,915.4 GWh to 23,350.0 GWh at an average rate of 10.7%, while the peak load increased from 1,100 MW to 3,900 MW at an average rate of 11.1% as shown in the following table. For this observation period, low growth rates of energy generation and peak load during the first 5 years from 1970 to 1975 (7.2% and 9.5% respectively) as contrasted with the high growth rates during the latter 7 years from 1975 to 1982 (13.2% and 12.3% respectively).

Table 3-9 Annual Generation and Peak Load

Year	Annual Generation (GWh)			Energy	Peak Load
	Thermal	Hydro	Total	Sold (GWh)	(MW)
1970	2,225.5	4,689.9	6,915.4	5,937.1	1,100
1975	3,009.3	6,790.3	9,799.6	8,307.6	1,733
1976	3,642.7	8,002.8	11,645.5	9,661.5	1,909
1977	4,478.1	9,037.5	13,516.6	11,488.9	2,284
1978	5,077.6	9,935.1	15,012.7	12,722.5	2,564
1979	6,750.7	9,608.3	16,359.0	14,549.0	2,829
1980	8,628.1	9,801.3	18,429.4	16,113.7	3,239
1981	10,532.4	10,215.1	20,747.5	17,940.1	3,553
1982	-	-	23,350.0	-	3,900
Annual Increase Rate					
1970 - 75			7.2%		9.5%
1975 - 82			13.2%		12.3%
1970 - 82			10.7%		11.1%

From the commissioning of Aswan High Dam power station in 1967, hydro energy had been the major source of electrical energy generation in Egypt up to the year 1980, representing 53.2% of the total energy generation in 1980. But, in 1981 the component ratio of hydro generation lowered to 49.2% of the total power.

The utilization of High Dam power station in generating hydro power using the available discharges determined to pass by the Ministry of Irrigation is continuously increasing. In 1981, it reached 99.5%, so now Aswan hydro power system is used up to the maximum of its power generating capability.

b. Component Ratios by Zone of Energy Sold and Peak Load

The annual energy sold by zone from 1979 to 1981 and the peak load by zone for the period from 1972 to 1979 are shown in Table 3-10 and Table 3-11 respectively. According to these tables, the component ratios of energy sold and peak load by zone for the recent years can be summarized as follows:

Zone	Energy Sold	Peak Load
Cairo	34%	37%
Alexandria	12%	12%
Delta	16%	25%
Canal	7%	
Lower Egypt	69%	74%
Upper Egypt	31%	26%
Total	100%	100%

The comparison of the above component ratios by zone between energy sold and peak load indicates that the load factor in Upper Egypt, where big industrial consumers such as KIMA, Aluminium, etc., concentrate, would be fairly higher than that in Lower Egypt.

Table 3-10 Energy Sold by EEA

Zone	Energy Sold (Gwh) 1979	1980	1981	Component Ratio (%) 1979	1980	1981
Cairo	4,957.3	5,608.1	5,902.8	34.0	34.8	32.9
Alexandria	1,833.8	1,923.9	2,088.2	12.5	12.0	11.6
Delta	2,258.5	2,552.0	3,065.1	15.6	15.8	7.1
Canal	925.5	1,069.2	1,265.4	6.4	6.6	7.1
Lower Egypt	9,975.1	11,153.2	12,321.5	68.5	69.2	68.7
Upper Egypt	4,573.9	4,976.6	5,618.6	31.5	30.8	31.3
Total	14,549.0	16,113.7	17,940.1	100.0	100.0	100.0

Table 3-11 Peak Load by Zone (Monthly Average)

Unit: MW

Maximum Load Month - Year	Cairo	Alexandria	Delta-Canal	L. Egypt Total	Upper Egypt	Total
November, 1972	507	173	225	905	270	1,123
December, 1973	549	193	237	979	264	1,198
September, 1974	565	222	263	1,050	350	1,335
December, 1975	671	235	348	1,254	447	1,691
December, 1976	761	250	408	1,419	486	1,836
December, 1977	872	297	492	1,661	637	2,238
December, 1978	884	286	645	1,815	683	2,449
December, 1979	1,055	349	699	2,103	716	2,742
Component Ratio in 1979	37.4%	12.3%	24.8%	74.5%	25.5%	100.0%

Source: Statistic Data provided by Planning Department (EEA)

c. Load Factor and Daily Load Curve

The annual maximum power demand has been recorded almost in December every year. The annual load factor was around 67% in average for the 4 years from 1975 to 1978 and 66% for the 4 years from 1979 to 1982 as shown below:

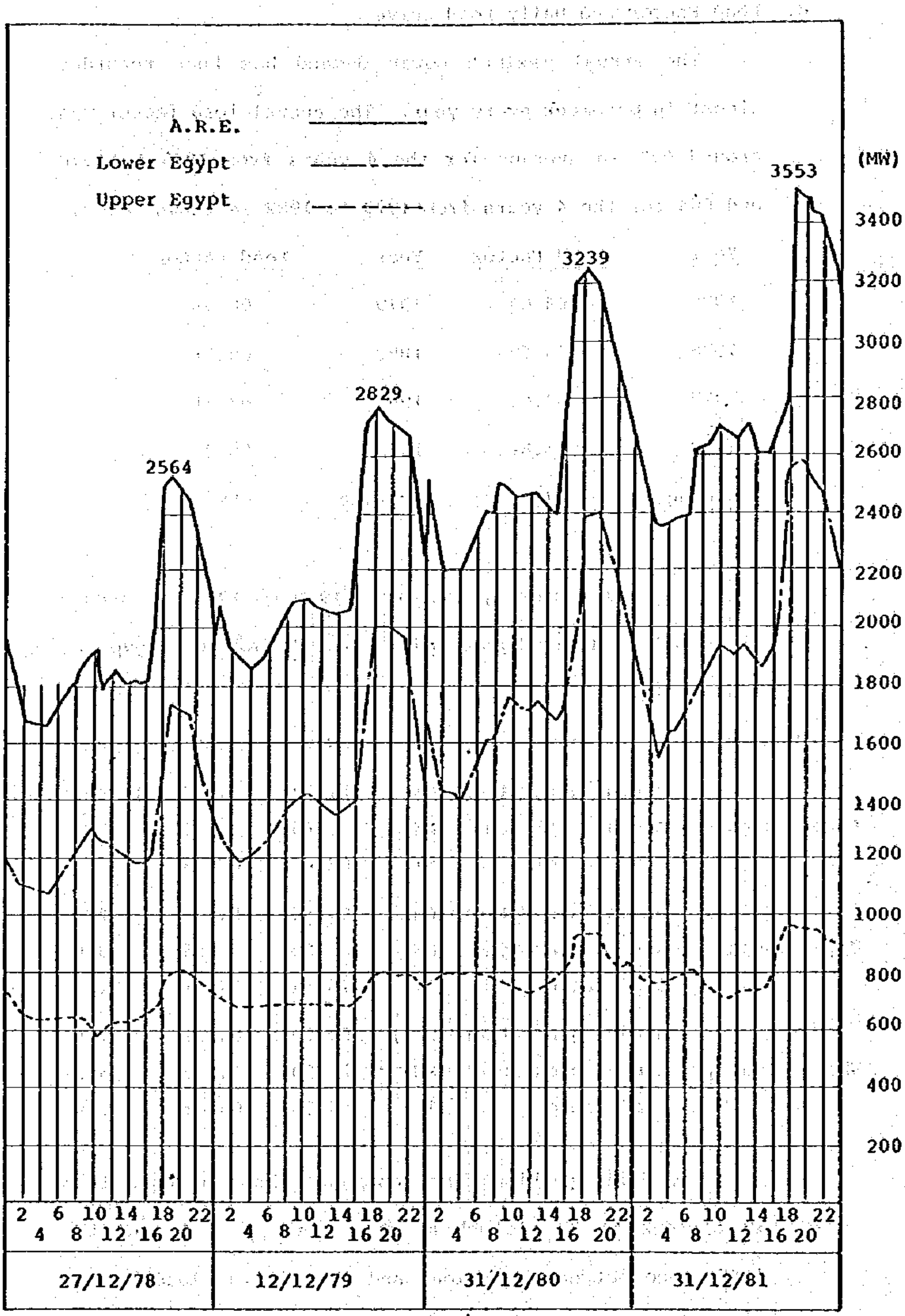
Year	Load Factor	Year	Load Factor
1975	64.6%	1979	66.0%
1976	69.6%	1980	65.0%
1977	67.6%	1981	66.7%
1978	66.8%	1982	68.3%
Average	67%	Average	66%

The load factor by zone from 1979 to 1981 was around 62 to 64% in Lower Egypt and 72 to 75% in Upper Egypt as shown below:

Zone	Item		1979	1980	1981
Lower Egypt	Annual generation	(GWh)	11,173	12,794	14,458
	Annual peak load	(MW)	2,044	2,350	2,567
	Load factor	(%)	62.4%	62.1%	64.3%
Upper Egypt	Annual generation	(GWh)	5,186	5,636	6,289
	Annual peak load	(MW)	785	889	986
	Load factor	(%)	75.4%	72.4%	72.8%
Whole country	Annual generation	(GWh)	16,359	18,429	20,748
	Annual peak load	(MW)	2,829	3,239	3,553
	Load factor	(%)	66.0%	65.0%	66.7%

The daily peaking time continues about 5 hours from 18 o'clock to 23 o'clock as shown in Fig. 3-4, and the difference between peak load and the minimum load in the mid-night was 1,200 MW on the annual peak day in 1981.

Fig. 3-4 Daily Load Curves on the Peak Days



d. System Loss Factor

The system loss factor in the EEA's power system which includes station service use and UHV and HV transmission losses is around 13%, but, the overall loss factor which includes the losses in EEA's power system and MV and LV distribution losses of energy supplied by the distribution companies is now about 21.5% as shown below:

Year	Gross Energy Generation (GWh)	Energy Sold EEA (GWh)	Energy Sold EEA + DC (GWh)	System Loss Factor EEA (%)	System Loss Factor EEA + DC (%)
1979	16,359.0	14,549.0	13,179.0	11.1	19.5
1980	18,429.4	16,113.7	14,289.8	12.6	22.5
1981	20,747.5	17,940.1	16,286.8	13.5	21.5
1982	23,350.0	20,267.8	18,306.4	13.2	21.6

Of the above system losses, the station service loss was 3.9% in 1980 and 3.3% in 1981. The station service loss in 1981 for steam power stations of which old and small scale generating units hold a major part was as high as 7.2%. However, for power plants as a whole, the station service loss was as low as 3.3% because of big proportions of energy generation by hydro power plants and gas turbines as shown below:

Power Plant	Gross Generation (GWh)	Net Generation (GWh)	Station Service Loss (%)
Steam P.P.	7,526.5	6,986.3	7.2
Gas Turbine	3,005.9	2,984.0	0.7
Hydro P.P.	10,215.1	10,090.6	1.2
Total	20,747.5	20,060.9	3.3

e. Energy Consumption by Category of Consumers

Up to the end of 1978 energy distribution at all voltage classes had been carried out by EEA. But, seven distribution companies were established in 1978 in order to supply electricity to general consumers fed on 11 kV and below in their respective distribution zones from the beginning of 1979. Therefore, the classification of consumers after 1979 is different from that of the preceding years.

The EEA's energy sold by category of consumers from 1979 to 1981 is shown in Table 3-12, and the overall energy sold by both EEA and the distribution companies for 1980/81 and 1981/ 82 is given in Table 3-13. From this table, the component ratios of various consumers can be summarized as follows:

Industrial	55.9%
Residential/Commercial	25.4%
Public Utilities	7.7%
Agricultural/Irrigation	5.0%
Governmental Buildings	3.9%
Others	2.1%
Total	100.0%

Table 3-12 Energy Sold by EEA and Its Average Rate

Category	Energy Sold (GWh)			Average rate (mill./kWh)		
	1979	1980	1981	1979	1980	1981
A. 220 kV and 132 kV						
KIMA	1,534.3	1,453.5	1,451.8	3.4	3.4	3.4
Aluminium	1,831.8	2,096.4	2,407.5	2.6	2.8	2.9
SOMED	280.6	275.1	327.1	5.3	5.1	5.1
B. 66 kV and 33 kV						
Egypt Chemical	95.1	104.5	85.4	6.5	6.5	6.5
NASR Petroleum	81.5	94.2	101.8	5.0	5.0	4.9
Abu Qir Fertilizer	12.1	8.3	9.9	6.4	7.2	6.5
Talkha Fertilizer	233.1	222.3	306.9	6.5	6.5	6.5
ARSENAL	10.9	10.0	10.8	6.7	6.4	6.5
MEHALLA EL KORBA	44.9	34.4	81.3	7.0	7.0	6.8
Alex. Petroleum	-	-	21.3	-	-	5.7
Alex. Cement	-	-	100.0	-	-	6.5
Total Industries	4,124.3	4,298.7	4,903.8	3.5	3.5	3.7
Irrigation/Drainage	213.1	453.1	489.4	6.9	6.9	6.4
Land Reclamation	-	24.6	8.6	-	8.3	8.3
Total Agriculture	213.1	477.7	498.0	6.9	7.0	6.5
BATRA Broad Cast	21.2	18.9	18.6	8.3	7.5	6.5
C. Wholesale to D.C.	10,187.5	11,318.4	12,519.7	9.0	9.0	9.0
Total EEA	14,546.1	16,113.7	17,940.1	7.41	7.47	7.47

Table 3-13 Energy Sold by EEA and DC and Component Ratios

Category	1980/81 (GWh)	1981/82 (GWh)	Component ratio (%)
EEA (UHV and HV)			
Industries	4,907.7	4,793.5	27.9
Agriculture/Irrigation	440.7	512.5	3.0
BATRA Broadcast	20.0	20.0	0.1
Sub-Total	5,368.4	5,326.0	31.0
Wholesale to D.C.	11,867.1	13,687.3	
Total EEA	17,235.5	19,013.3	
Distribution Companies (MV and LV)			
Industries	4,278.0	4,799.6	28.0
Agriculture	335.9	323.0	2.0
Housing Companies	258.8	337.0	2.0
Public Utilities	1,153.9	1,324.4	7.7
Residential/Commercial	3,583.1	4,372.9	25.4
Governmental Buildings	612.5	682.6	3.9
Total D.C.	10,222.2	11,839.5	69.0
Total Energy Sold (EEA+DC)	15,590.6	17,165.5	100.0

f. Proposed New Tariff System

a) Preparation of New Tariff System and Its Philosophy

On the occasion of financing Shoubra power plant project which is now in progress, the International Bank for Reconstruction and Development (IBRD) recommended EEA in 1979 to take necessary measures to raise up by step its rate of return (ratio of net income to working assets) from 5% to 9%. In order to improve the financial situations, EEA prepared a new tariff structure for lighting and residential in April, 1980, and also requested SOFRELEC, France, to study a new tariff system. The studies made by SOFRELEC were compiled in a series of reports and submitted to EEA in 1981 and 1982.

EEA, based on the above studies, has elaborated in 1982 and 1983 amendments to the present tariff system. In 1983, a comprehensive draft for the tariff system was proposed by EEA and submitted to the authorities concerned for approval.

Structure and philosophy of the proposed new tariff system are as follows:

i. The proposed tariff system is established on the marginal cost theory. In this connection, it is to be noted that as far as the development programs are carried out in a optimum manner the development costs (marginal costs) should theoretically coincide with total average costs.

ii. The proposed tariff structure consists of the demand charge and the energy charges. But, for the purpose of simplification, the agricultural use fed on medium voltage (11 kV) and the commercial and governmental uses, etc., fed on low voltage are of the energy charges only.

iii. The proposed tariff is considered as per subsidized price of fuel (7.5 LE/ton for Mazout and 35 LE/ton for Sollar).

iv. As a target of revenues requirements, the proposed tariff system adopts the larger one of the following two:

- Revenues to be obtained when self-financing ratio on the debt service (interest and instalments of the next year) is 1.5.
- Revenues to be obtained when rate of return on the net fixed assets in service is 5% to 9%.

And, as a result of calculation, it was obvious that the ratio concerning the return on the net fixed assets in service as recommended by IBRD is fully satisfied when the ratio on the debt service is respected (but not the reverse). Therefore, the 1.5 ratio on the debt service is adopted in the proposed new tariff system.

b) Average Rates Per Unit Sold in the Proposed Tariff System

The overall average rate per unit sold (EEA and Distribution companies) in the new proposed tariff is as follows:

Year	Average rate (mill./kWh)
1983/84	15.666
1984/85	19.226
1985/86	23.109
1986/87	26.709
1987/88	28.846 (8% escalation)
1988/89	31.154 (8% escalation)
1989/90	33.646 (8% escalation)

3-3 LOAD FORECAST

The load forecast which constitutes the basis of the power development program for the current 5-year Plan (1982/83 - 1986/87 was formulated by Department of Planning and Economical Studies in April, 1981, taking the years 1981 to 2000 as a prediction period.

The methodology adopted in the forecast is to extrapolate the past demand trend in conjuction with planned large loads. Needless to say that this long-range power demand forecast should be revised at least every 5 years, since new large loads are planned by each 5-Year Plan.

The new bulk consumers of electricity included in the new 5-Year Plan are indicated in the following table.

Table 3-14 New Large Industrial loads (UNIT:MW)

Industry	Zone	1982	1983	1984	1985	1986
Cement and various New industries	Cairo, Alexandria	100	145	325	460	600
Ferro-Silicon	Upper Egypt	-	80	80	80	80
Abu Tartour Phosphate	Upper Egypt	-	90	90	90	90
Aluminium 5th Expansion	Upper Egypt	-	80	80	80	80
Under ground railway	Cairo	10	10	10	10	60
El Dekhela Iron-Steel	Alexandria	-	-	-	-	90
	Total	110	405	585	720	1,000

According to the Ministry of Planning, perspective of finance is secured for all of the above bulk consumers except for El Dekhela.

EEA's load forecast including these new large loads is shown in Tables 3-16 and 3-17, Figs. 3-5 and 3-6.

1) Methodology for Load Forecast

The demand function for electricity is different by category of consumers such as residential, commercial, industrial, agricultural, etc. Therefore, if data are available of average rates per unit sold for categorical consumers and their respective incomes represented by GDP, it is desirable for analysis to be carried out for each of these categorical consumers. However, data of categorical GDP which correspond strictly to these categorical consumers are not available. Further, the classification of analysis between power demand, economic growth and electricity pricing for EEA's power system has been conducted for only aggregated power demand as described below:

In general, demand function for a given commodity consists of prices and income specified as follows:

$$Di = f(Pi, Pw, Y)$$

where, Di: Demand for the i th commodity

Pi: Price of the i th commodity

Pw: Prices of other commodities represented by integrated general prices index

Y : Income of the consumer

Since demand functions are homogenous of degree zero in terms of income and prices, the above equation can be rewritten as follows:

$$Di = f(Pi/Pw, Y/Pw)$$

This means that the demand for the i th commodity is a function of the relative price of commodity and of the income in real term. The demand function for electricity will take the same form.

For the observation period from 1970 through 1981, indices of power consumption, deflated GDP and also deflated average rate per unit sold of electricity which take 1975 as a base year (= 100) are as shown in Table 3-15. From respective change patterns of these three series of indices, it is possible to assume that there exists a linear relation between power demand and GDP but that such relation depends on a linear valuation of average rate per unit sold of electricity. From this, the demand function for electricity (y) is expressed in the form of the following multiple regression equation:

$$y = a + b_1x_1 + b_2x_2$$

where, x_1: GDP

x_2: Average rate per unit sold

In the case that there exist more than three kinds of samples of each total number of n as follows:

$$(y_1, x_{1i}, x_{21}), (y_2, x_{12}, x_{22}), \ldots\ldots (y_n, x_{1n}, x_{2n})$$

the regression coefficients b_1 and b_2 can be obtained from the following simultaneous equations using the least square method.

$$S_{11}b_1 + S_{12}b_2 = S_{1y}$$

$$S_{12}b_1 + S_{22}b_2 = S_{2y}$$

where,

$$S_{11} = \sum_{i=1}^{n} (x_{1i} - \bar{x}_1)^2 \qquad \bar{x}_1 = \frac{1}{n}\sum x_{1i}$$

$$S_{22} = \sum_{i=1}^{n} (x_{2i} - \bar{x}_2)^2 \qquad \bar{x}_2 = \frac{1}{n} \quad x_{2i}$$

$$S_{12} = \sum_{i=1}^{n} (x_{1i} - \bar{x}_1)(x_{2i} - \bar{x}_2)$$

$$S_{1y} = \sum_{i=1}^{n} (x_{1i} - \bar{x}_1)(y_i - \bar{y}_2)$$

$$S_{2y} = \sum_{i=1}^{n} (x_{2i} - \bar{x}_2)(y_i - \bar{y})$$

The multiple regression equation is specified as follows:

$$y = \bar{y} + b_1(x_1 - \bar{x}_1) + b_2(x_2 - \bar{x}_2)$$

The degree of conformity of the above multiple regression equation is measured by the following multiple correlation coefficient:

$$R^2 = \frac{b_1 S_{1y} + b_2 S_{2y}}{S_{yy}}$$

where,

$$S_{yy} = \sum_{i=1}^{n} (y_i - \bar{y})^2$$

The degree of deviation of the actual figures of (y) from figures (y') calculated by the above equation is measured by the following standard error of regression:

$$s = \sqrt{\frac{1}{n} (y - y')^2}$$

2) Result of Calculation

Using the above equations and time-series data given by Table 3-15, the following result is obtained:

$$S_{11}b_1 + S_{12}b_2 = S_{1y}$$

$$44,485,677\ b_1 - 29,348\ b_2 = 80,761,612 \quad \ldots\ldots (1)$$

$$S_{12}b_1 + S_{22}b_2 = S_{2y}$$

$$-29,348\ b_1 + 22.28\ b_2 = -54,676 \qquad \ldots\ldots (2)$$

From (1) and (2), the regression coefficients b_1 and b_2 are calculated as follows:

$$b_1 = 1.5$$

$$b_2 = -478.4$$

Therefore, the demand function for electricity is expressed by the following formula:

$$y = \bar{y} + b_1(x_1 - \bar{x}_1) + b_2(x_2 - \bar{x}_2)$$

$$= 9,778 + 1.5(x_1 - 6,116) - 478.4(x_2 - 7.75)$$

Thus: $\underline{y = 4,312 + 1.5\ x_1 - 478.4\ x_2}$ ..... (Formula)

The multiple correlation coefficient of the above formula is:

$$R^2 = \frac{b_1S_{1y} + b_2S_{2y}}{S_{yy}}$$

$$= \frac{(1.5 \times 80,761,612) + (478.4 \times 54,676)}{149,590,379}$$

$$= 0.985$$

The above coefficient which is fairly high and near to 1 means that the obtained formula would be very appropriate to specify the correlation between power demand, GDP and electricity charges.

Deviations of the actual figures of power consumption given by Table 3-18 from figures calculated by the above formula are translated into the following standard error of regression:

$$s = \sqrt{\frac{1}{n}\overrightarrow{(y - y')^2}} = \sqrt{\frac{2,503,929}{12}} = 457\ \text{(GWh)}$$

3) Power Demand Forecast Obtained from Multiple Regression

It is appropriate for power demand forecast for the coming several years to be made in a micro economic framework, taking into account authorized development programs for industry, agriculture, land reclamation, rural electrification, etc. On the other hand, for a long-range period, the power demand forecast is generally made in a macroscopic manner, using general economic parameters such as anticipated inflationary trend, growth rates of GDP and population, etc.

In the new 5-Year Plan for the period from 1982/83 to 1986/87, it is anticipated that GDP in real terms will grow at an average rate of 8.6% per annum. However, the present power demand forecast was established based on a high growth rate of 12.3% per annum, which was recorded for the past 5 years from 1975 to 1980, because the power development program should be able to meet any unforeseen rapid increase of power demand. And, for the period from 1987 to 1995, a rate of growth of 8.8% per annum was assumed for GDP, which is slightly higher than the targeted growth rate in the current 5-Year Plan. Thus, the conditions applied for the present power demand forecast are summed up as follows:

- Forecast period: 1982/83 - 1994/95
- Price escalation indexes:
  - From 1982/83 to 1986/87 6.7% per annum (average)
  - From 1987/88 to 1994/95 6% per annum
- GDP growth rate:
  - From 1982/83 to 1986/87 Average 12.3%
  - From 1986/87 to 1994/95 Average 8.8%

- System loss factor: 21.5% (Actual figure for 1981/82)
- Load factor: 66% (Average for the recent 3 years)
- Electricity pricing:

  Present tariff system will still be effective without amendment.

For the calculation, GDP and average rate per unit sold expressed in the current values have been deflated by price escalation indexes taking 1975 as a base year (= 100). Based on the above-stated conditions, forecast of energy sold and peak load have been obtained as shown in Table 3-16.

Result of macro load forcast derived from multiple regression equation is shown in Table 3-16. In comparison with the result of load forecast obtained by Planning and Economical studies Department-EEA, the above is almost the same. Peak load forecast obtained by both methods is shown in the following table. In this load forecast, the development program is planned by use of the load forecast obtained by Planning and Economical studies Department-EEA, and the results are shown in Table 3-17.

Year	Multiple Regression Method	EEA Forecast
1982	3,899	3,900
1983	4,340	4,320
1984	4,853	4,815
1985	5,456	5,455
1986	6,097	6,100
1987	6,732	6,735
1988	7,363	7,360
1989	8,020	8,000
1990	8,736	8,720
1991	9,552	9,505
1992	10,327	10,360
1993	11,097	11,085
1994	11,875	11,860
1995	12,748	12,695

Table 3-15 Basic Economic Data

Year	Energy Sold (GWh)	Wholesale Price Indexes	GDP (Million LE) Current Value	Deflated Value	Rate per Unit Sold Current (Mil/kWh)	Deflated (Mil/kWh)
1970	5,937	75.0	2,971	3,961	6.54	8.72
1971	6,218	75.1	3,146	4,189	6.93	9.23
1972	6,169	76.1	3,417	4,490	7.38	9.70
1973	6,178	81.3	3,663	4,506	7.49	9.21
1974	6,895	93.0	4,197	4,513	7.27	7.82
1975	8,308	100.0	4,886	4,886	8.94	8.94
1976	9,662	107.8	6,276	5,822	8.62	8.00
1977	11,489	117.8	8,210	6,969	8.01	6.80
1978	12,723	135.2	9,782	7,235	8.67	6.41
1979	13,179	148.4	12,475	8,406	9.65	6.50
1980	14,290	180.6	15,808	8,753	10.86	6.01
1981	16,287	189.6	18,312	9,658	10.69	5.64
Total	117,335			73,388		92.98
Average:						
1970-81	$\bar{y}$=9,778			$\bar{x}_1$=6,116		$\bar{x}_2$=7.75
Annual Growth rate:						
1970-80	9.6%	9.2%		8.3%		-3.7%
1970-75	7.0%	5.9%		4.3%		0.5%
1975-80	12.2%	12.9%		12.3%		-7.6%

Source: Wholesale price indexes and GDP ... IMF annual report 1982

Energy consumption and average rate per unit sold ... EEA

Table 3-16 Long Range Load Forecast

Fiscal Year	A. Whole sale Price Indexes (1975=100)	B. GDP (1000 LE)		C. Tariff (Mil/kWH)		D. Energy sold $Y = 4,312 + 1.5X_1 - 478.4X_2$ (GWh)	E. Generation at P/S Tr. end $E = Y/(1-0.215)$ (GWh)	F. Load Factor	G. Peak Load E/8.76.F (MW)	Comparison between Macro Multiple Regression Method and Another Solution by computer system				
		X_1 Deflated Value (1975 base) X_1'/A	X_1' Current Value	X_2 Deflated Value (1975 base) X_2'/A	X_2' Current Value					Calender Year	Macro Multiple regression Method: Generation at P/S Tr. End (GWh)	Macro Multiple regression Method: Peak Load (MW)	EEA Forecast: Generation at P/S Tr. End (GWh)	EEA Forecast: Peak Load (MW)
1981/1982	207.6	10,479	21,754	5.66	11.76	17,323	22,068	0.683	3,688	1982	22,915	3,899	23,350	3,900
1982/1983	224.3	11,232	25,193	5.24	11.76	18,653	23,762	0.66	4,110	1983	25,093	4,340	25,107	4,320
1983/1984	239.6	12,519	29,995	4.91	11.76	26,742	26,423	0.66	4,570	1984	28,056	4,853	27,984	4,815
1984/1985	255.4	14,129	36,213	4.60	11.76	23,305	29,688	0.66	5,135	1985	31,547	5,456	31,376	5,455
1985/1986	271.8	15,985	43,447	4.32	11.76	26,223	33,405	0.66	5,778	1986	35,207	6,097	35,862	6,100
1986/1987	288.8	17,839	51,545	4.07	11.76	29,123	37,009	0.66	6,417	1987	38,876	6,732	39,246	6,735
1987/1988	306.1	19,672	60,244	3.84	11.76	31,983	40,743	0.66	7,047	1988	42,573	7,363	42,991	7,360
1988/1989	324.5	21,517	69,823	3.62	11.76	34,856	44,403	0.66	7,680	1989	46,368	8,020	45,856	8,000
1989/1990	343.9	23,510	80,851	3.42	11.76	37,941	48,332	0.66	8,360	1990	50,506	8,736	51,074	8,720
1990/1991	364.6	25,725	93,826	3.23	11.76	41,354	52,680	0.66	9,112	1991	55,052	9,522	55,671	9,505
1991/1992	386.5	28,146	108,819	3.04	11.76	45,077	57,423	0.66	9,932	1992	59,707	10,327	60,679	10,360
1992/1993	409.7	30,482	124,922	2.87	11.76	48,662	61,990	0.66	10,722	1993	64,159	11,097	64,925	11,085
1993/1994	434.3	32,701	142,020	2.71	11.76	52,067	66,327	0.66	11,472	1994	68,652	11,875	69,464	11,860
1994/1995	460.3	35,085	161,538	2.55	11.76	55,720	70,981	0.66	12,277	1995	73,705	12,748	73,735	12,695

Table 3-17 Long-Range Load Forecast by EEA

Year	Ultimate Consumption (GWh)	Generation Demand at S/S End (GWh)	Generation Demand at P/S Tr. End (GWh)	Load Factor (%)	Peak Demand (MW)
1982	18,330	20,268	23,350	68.3	3,900
1983	19,709	21,792	25,107	66.35	4,320
1984	21,967	24,290	27,984	66.35	4,815
1985	24,630	27,234	31,376	65.66	5,455
1986	27,759	30,694	35,362	66.18	6,100
1987	30,808	34,065	39,246	66.52	6,735
1988	33,748	37,316	42,991	66.86	7,360
1989	36,782	35,463	46,856	66.86	8,000
1990	40,093	44,332	51,074	66.86	8,720
1991	43,701	48,322	55,671	66.86	9,505
1992	47,633	52,669	60,679	66.86	10,360
1993	50,966	56,355	64,925	66.86	11,085
1994	54,529	60,295	69,464	66.86	11,860
1995	58,667	64,870	74,735	67.2	12,695

Source: Figures of peak load and generation were taken from data provided by Department of Planning and Economical Studies.

Energy sold by EEA and ultimate consumption are based on the system loss factors in 1981/82 (13.2% for energy supplied by EEA and 21.5% for ultimate consumption including UHV, HV, MV and LV). Estimated peak load (MW) readjusted EEA's newest estimation issued by EEA on February, 1983.

3-4 POWER DEVELOPMENT PROGRAM

3-4-1 Basic Aspects of Power Development Plan

The long-range power development program which was established based on the above-mentioned long-range load forecast shows that it is necessary to add a total capacity of 25,500 MW to EEA power system during the period from 1986 to 2005. Principles of this long-range program are as follows:

- The most capacity of Aswan High Dam power station will be used for daily peak load shaving.
- Aswan Dam power station and the efficient new thermal units will be operated as nearly constant base load units.
- In order to save fuel oil for export as a precious indigenous energy resource with increasing value, construction of oil-fired thermal power stations will be limited to around 3,600 MW.
- Construction of coal-fired thermal power stations should be accelerated. Scale of its development will be about 5,700 MW.
- From the early stage of the years 1990s, a series of nuclear power stations should be constructed to free fuel oil for export. Anticipated scale of development is around 12,000 MW.
- In parallel with construction of nuclear power stations, Quattra hydro power station and a series of hydro pumped storage power stations will be constructed with a total capacity of 4,200 MW, of which 1,800 MW for Quattra project and 2,400 MW for hydro pumped storage projects.

The above projects are long-term targeted projects, so detailed technical characteristics, time schedule of implementation of each individual project will be determined in the future 5-Year power development programs of EEA.

The current 5-year power development program for the period from 1982 to 1986 is shown in Table 3-18.

Table 3-18 Current 5-Year Power Development Program

Project	1983	1984	1985	1986
Thermal				
Abu Qir	2 x 150	2 x 150		
Ismailia (Abu Sultan)	2 x 150	1 x 150		1 x 150
Kafr El Dawar			2 x 110	
El Suez (Ataka)		2 x 150	1 x 300	
Shoubra El-Kheima			2 x 300	1 x 300
Damanhour				1 x 300
Sub-total	600	750	1,120	750
Gas Turbine				
El Shabab				
El Suif	3 x 33.3			
El Mahmoudia	8 x 25			
Wady Houf		3 x 33.5		
Damanhour		4 x 25		
Sub-total	300	200	0	0
Total Installed	900	950	1,120	750

Source: EEA - Department of Planning and Economical Studies

3-4-2 Power Supply Plan

The proposed capacities and commissioning years of the projects included in the long-term power development program are shown in Table 3-19.

Table 3-19 Long Term Development Program

Year	Project			Total Installed Capacity (MW)
1986	(Hydro)	4 x 75	(Aswan II)	300
1988	Coal	1 x 300	) or 600 MW x 1	300
1989	Coal	1 x 300		
	Oil	2 x 300		900
		or 1 x 600		
1990	Coal	2 x 300	or 600 MW x 1	
	Oil	2 x 300		1,200
		or 1 x 600		
1991	Coal	2 x 300	or 600 MW x 1	1,500
	Nuclear	1 x 900		
1992	Coal	2 x 300	or 600 MW x 1	1,500
	Nuclear	1 x 900		

In connection with the acting reserve capacity to be taken into account in the planning, it is to be noted that a method generally adopted for developing countries is to reserve larger one of the following two:

- Total of the largest and the next largest capacities in the power system
- Capacity equivalent to 15 to 20% of the peak load.

Taking into account the scale of EEA's power system and its component ratio of power sources, a capacity equivalent to 15% of the peak load has been taken as an acting reserve capacity in the above table.

3-5 NECESSITY OF THE PROJECT

3-5-1 Necessity of Power Development

As described in Section 3-4, Load Forecast and following section 3-5-3, Power Development Program, since power demand-supply balance as of 1987 will be very severe, reserve capacity of the system at the peak load will be 15.6% as shown in Table 3-20, Fig. 3-5 and 3-6. If no power development will be planned, the power demand will exceed the power supply capacity at the beginning of 1989, and when the power plant with big capacity will need to be overhauled, or will be tripped due to accident, lack of power supply will be resulted in 1988. Therefore, new power development project is needed for solution of the above situation. To cope with the growing power demand, construction program of 600 MW power generating facilities as first stage, and 600 MW power generating facilities as second stage, total capacity of 1,200 MW in Ayun Musa, Sinai Peninsula, are planned.

After Sinai Peninsula was returned from Israel in 1979, the Arab Republic of Egypt has promoted industrial development in Sinai as fast as possible. This project is one of the industrial development projects. As for electrification program in Sinai, EEA established a committee to promote the program.

According to the report issued by EEA in 1982, power demand in North Sinai (around El-Arish) and Maghara Coal Mine would be forecast to be 44,000 kW, and 2,000 kW in 1987, respectively. And the power demand in South Sinai would be 31,400 kW in 1987 including 20,000 kW consumed by Manganese Company in Abuzenima. Power supply to these load centers up to 1987 will be performed by independent small capacity gas turbine and diesel power plants locally installed. These independent power plants are planned to be interconnected with 220 kV main trunk transmission line running in the direction of north to south of Sinai after commissioning of the project.

This project will contribute to promotion of local industries in Sinai and also of development of settlement for inhabitants, therefore, prompt realization of this project is expected.

3-5-2 Selection of Coal-Fired Thermal Power Plant

Since oil shock in 1973, remarkable attention to coal resource has been considered as a substitute fuel world-wide and almost all of countries in the world has changed the energy policy to meet the situation. In Egypt, the government has promoted the energy policy and studied the effective utilization of solar and wind power energy. In accordance with the energy policy, construction program of coal-fired thermal power plant which utilizes domestic coal produced from Maghara Coal Mine in northern portion of Sinai Peninsula and imported coal from foreign countries is settled by EEA. The development of coal-fired thermal power plant project is first in Egypt and contributes much to the policy.

Egypt is oil production country, and the oil production amounted to 29,800,000 tons in 1980; domestic consumption was 11,000,000 tons and the remaining was exported.

Generating cost of coal-fired thermal power plant is lower than that of oil-fired thermal power plant as shown in Table 10-1. Instead of utilization of domestic crude oil, utilization of domestic coal and imported coal as fuel of coal-fired thermal power plant will contributes to promotion of oil exports and economic policy in Egypt.

For the purpose of stable, continuous electric power supply to load centers and promotion of local industrial development, domestic heavy oil can be utilized for power generation even in the event of decrease in or unstable coal supply due to unexpected situation in related countries, therefore, dual type boiler will be applied to this Project.

3-5-3 Power Development Program

The scale of power development program for the long-range demand forecast (1983 - 1995) including the system reserve capacities, as described in Section 3-4 and the unit capacities based on the system stability were studied, and the power development program has been formulated as shown in Table 3-20 and Fig. 3-5 and Fig. 3-6.

As seen in Table 3-20, 300 MW x 2 Sinai Coal-fired Power Plant under the present project and 600 MW x 1 El Kurimat Power Plant, or a total of 1,156 MW (including retirement of 44 MW at El Tebine) will be installed for the peak demand of 7,360 MW and 8,000 MW in 1988 and 1989 respectively, but in consideration of the demand and supply balance, the reserve capacities of 9.27% in 1988 and 11.78% in 1989 are lower than 15% of the standard, and therefore, it is absolutely necessary to complete the above two projects in time for 1988 and 1989 without fail.

Table 3-20 Development Plan and Demand-Supply Balance

Year	Project	A. Installed Capacity (MW) Hydro	A. Thermal	A. Gas T.	A. Total	B. Available Capacity (MW) Hydro	B. Thermal	B. Gas T.	B. Total	C. Peak Demand at P/S Tr. End G/(8,760xF)	D. Reserve Margin B - C	E. Margin Rate (%) D/C	F. Load Factor (%)	G. Annual Required Generation at P/S Tr. End (GWh)	H. Available Generation at P/S Tr. End Bx8,760x0.7 (GWh)	I. Balance H - G (GWh)
1982	Existing	2,445	1,675	1,012	5,132	2,000	1,225	852	4,077	3,900	177	4.54	68.3	23,350	25,000	1,650
1983	Abu Quir (150x2) Abu Sultan (150x2) El Suif (33x3) El Mahmoudia (25x8)		+300 +300	+100 +200	6,032		+300 +300	+100 +200	4,977	4,320	657	15.21	66.35	25,107	30,519	5,412
1984	Abu Quir (150x2) Abu Sultan (150x1) Ataka (150x3) Wadi Houf (33x3) Damanhour (50x2)		+300 +150 +300	+100 +100	6,982		+300 +150 +300	+100 +100	5,927	4,815	1,112	23.09	66.35	27,984	36,344	8,360
1985	Kafr El Dawar (110x2) Ataka (300x1) Shoubra El-Kheima (300x2) *Cairo North *Talkha		+220 +300 +600 -100 -39		7,963		+220 +300 +600 -75 -36		6,936	5,455	1,481	27.15	65.66	31,376	42,532	11,156
1986	Abu Sultan (150x1) Shoubra El-Kheima (300x1) Damanhour (300x1) *Karmauz		+150 +300 +300 -64		8,649		+150 +300 +300 -10		7,676	6,100	1,576	25.84	66.18	35,362	47,069	11,707
1987	Aswan II (75x4) *Cairo South	+300	-180		8,769	+230	-120		7,786	6,735	1,051	15.60	66.52	39,246	47,744	8,498
1988	Sinai (1st Stage) (300x1) *El Tebine		+300 -45		9,024		+300 -44		8,042	7,360	682	9.27	66.86	42,991	49,314	6,323
1989	Sinai (1st Stage) (300x1) El Kurimat		+300 +600		9,924		+300 +600		8,942	8,000	942	11.78	66.86	46,856	54,832	7,976
1990	Sinai (2nd Stage) (300x2) El Kurimat (600x1) *Damanhour		+600 +600 -30		11,094		+600 +600 -24		10,118	8,720	1,398	16.03	66.86	51,074	62,044	10,970
1991	Sidi Kerier (300x2) El Dabhaa (900x1) (Nuclear) *El Suif		+600 +900 -52		12,542		+600 +900 -16		11,602	9,505	2,097	22.06	66.86	55,671	71,144	15,473
1992	Sidi Kerier (300x2) --- (Nuclear)		+600 +900		14,042		+600 +900		13,102	10,360	2,742	26.47	66.86	60,679	80,341	19,622
1993	-				14,042				13,102	11,085	2,017	18.20	66.86	64,925	80,341	15,416
1994	-				14,042				13,102	11,860	1,242	10.47	66.86	69,464	80,341	10,877
1995	*Cairo South *Suez		-60 -100		13,882		-40 -75		12,987	12,695	292	2.30	67.20	74,735	79,636	4,901

Remarks;

*Retired Plant

*Available Capacities for Gas Turbine Project are Assumed on the Condition in Winter Season

*Utilization Factor is Assumed as Average of 70% Considering Whole Power Plants in Egypt

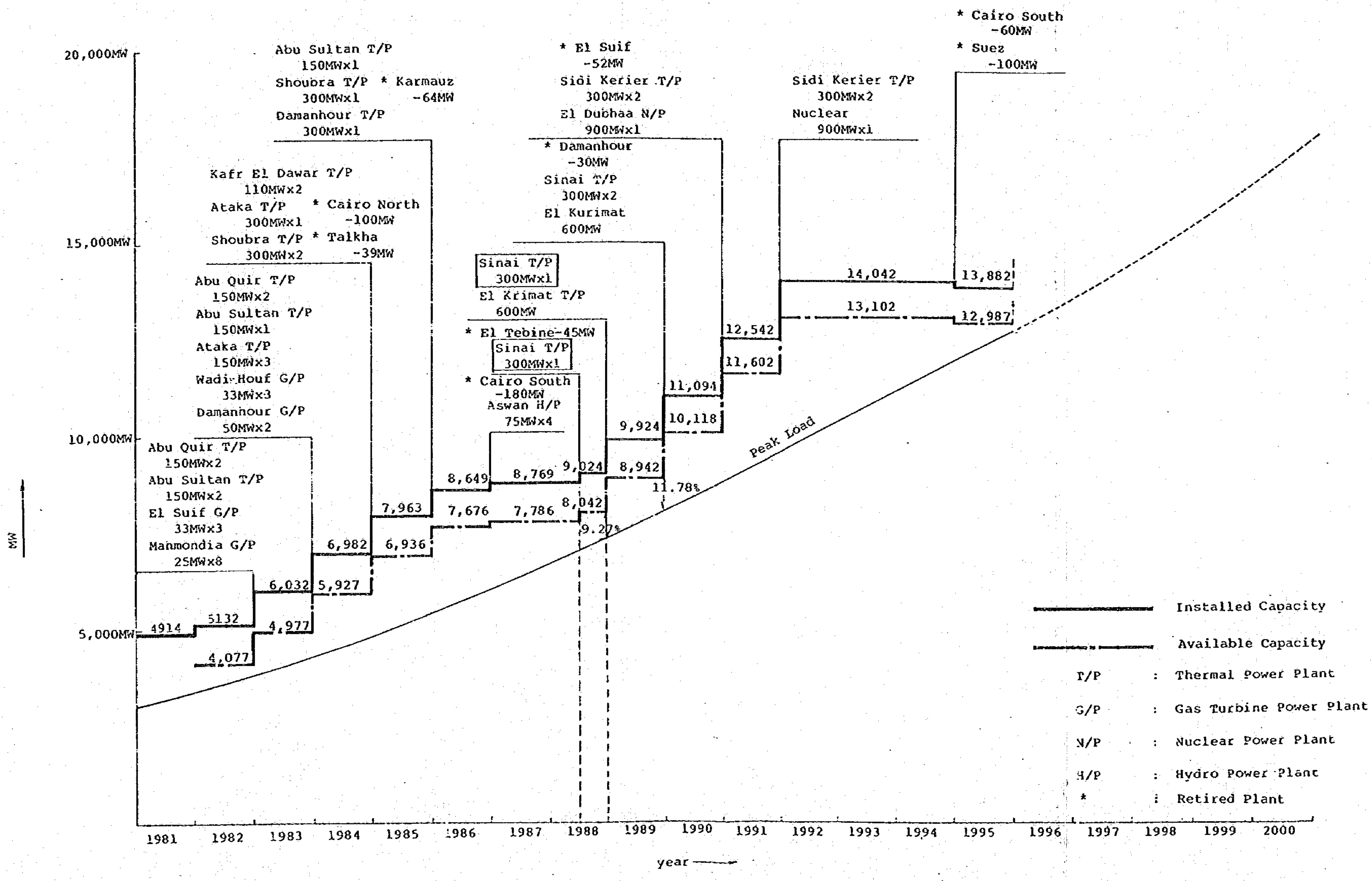


Fig. 3-5 Power demand and Supply Balance

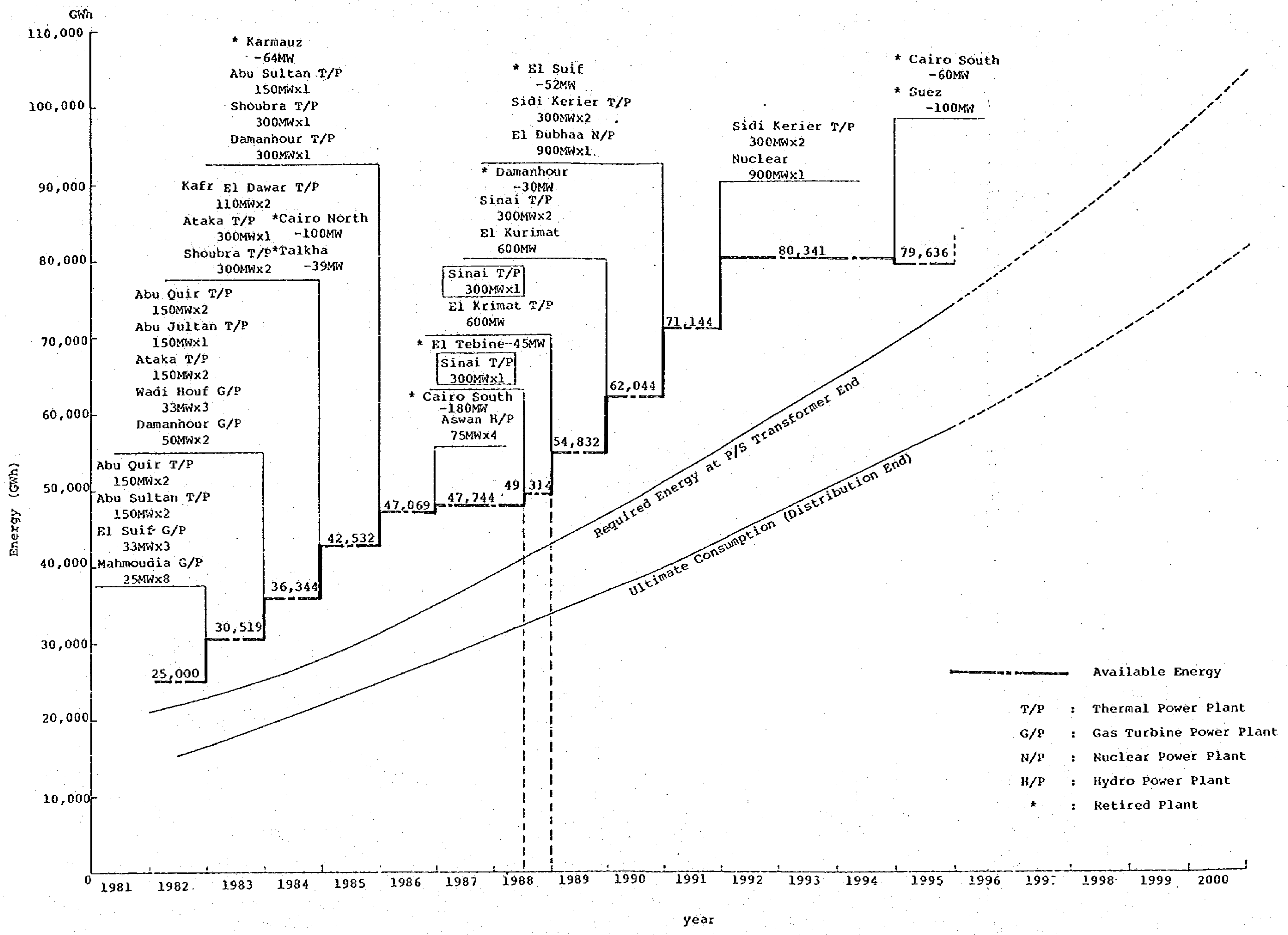


Fig. 3-6 Energy Demand and Supply Balance

CHAPTER 4

DEVELOPMENT PROGRAM FOR THE PROJECT

(1st Stage 300 MW x 2 Units)

CHAPTER 4 DEVELOPMENT PROGRAM FOR THE PROJECT

4-1 FUEL PLAN

The fuel plan for thermal power plants in Egypt adopts, as the national policy, the dual type fuel plan so that a stable supply of fuel, irrespective of imported coal or domestic coal, may be maintained for uninterrupted generation. In this dual type plan, two different types of fuel will be stored for ready use. Thus, the fuel storage facilities, boilers and other related facilities will have to be prepared for firing two types of fuel.

This project is the first coal fired thermal power plant project intended to use the Maghara coal from Sinai Peninsula as a means of effective utilization of substitute fuel in order to suppress the domestic consumption of petroleum which tends to increase recently, in spite of the fact that it is an important export supporting the national economy.

Therefore, for the fuel plan for this Project will be considered the coal as the main fuel, together with heavy oil or gas as the standby fuel.

With respect to the fuel for the coal fired thermal power plant to be built on Sinai Peninsula, the domestic coal from Maghara Mine to be re-developed as aforementioned, the blended coal made of the domestic coal to supplement the shortage of the domestic coal and the imported coal, heavy oil, gas and light oil are described in the following.