UNCLASSIFIED

DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

Washington, D.C. 20523

Project Paper

EGYPT: SHOUBRAH EL KHEIMA THERMAL POWER PLANT

Project No. 263-0110

May 1979

UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

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7. PROJECT TITLE (Maximum 40 characters): Shoubrah Thermal Power Plant

8. ESTIMATED FY OF PROJECT COMPLETION: FY 86

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 79; B. QUARTER 2; C. FINAL FY 79 (Enter 1, 2, 3, or 4)

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 - 0,700 LE

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L. C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L. C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	100,000		100,000	100,000		100,000
(GRANT)	100,000		100,000	100,000		100,000
(LOAN)						
OTHER U.S. 1						
OTHER U.S. 2						
HOST COUNTRY		78,100	78,100		78,100	78,100
OTHER DONOR(S)	287,800		287,800	287,800		287,800
TOTALS	387,800	78,100	465,900	387,800	78,100	465,900

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY ___ F. GRANT	E. 1ST FY ___ G. LOAN	H. 2ND FY ___ I. GRANT	H. 2ND FY ___ J. LOAN	K. 3RD FY ___ L. GRANT	K. 3RD FY ___ M. LOAN
(1) SA	740B	825		100,000					
(2)									
(3)									
(4)									
TOTALS				100,000					

A. APPROPRIATION	N. 4TH FY ___ O. GRANT	N. 4TH FY ___ P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) SA					100,000	
(2)						
(3)						
(4)						
TOTALS					100,000	

12. IN-DEPTH EVALUATION SCHEDULED: MM 06 YY 82

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Kelly L. Stoltenberg

TITLE: Director, Office of Project Development

DATE SIGNED: MM 05 DD 31 YY 79

15. DATE DOCUMENT RECEIVED IN AID W OR FOR AID W DOCUMENTS, DATE OF DISTRIBUTION: MM 05 DD 09 YY 79

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EGYPT - SHOUBRAH EL KHEIMA
THERMAL POWER PLANT

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(As of January 1, 1979)

Currency Unit	= Egyptian Pound (EE)
Official Rate*	
LE 1 (or 1,000 milliemes)	= US$1.44
LE 1,000	= US$1,440
LE 1,000,000	= US$1.44 million
LE 0.69	= US$1.00

* Unless otherwise indicated all conversions of foreign currencies to Egyptian Pounds in this report are based on the Parallel Market Rate of Exchange of LE 1 = US$1.40 applicable before the recent fixing of the new official rate on January 1, 1979.

WEIGHTS AND MEASURES

1 kilowatt (kW)	= 1,000 watts (10^3W)
1 Megawatt (MW)	= 1,000 kilowatts (10^3kW)
1 kilowatt hour (kWh)	= 1,000 watt hours (10^3Wh)
1 Gigawatt hour (GWh)	= 1,000,000 kWh (10^6kWh)
1 kilometer (km)	= 1,000 meters (10^3m)
1 kilovolt ampere (kVA)	= 1,000 volt amperes (10^3VA)
1 megavolt ampere (MVA)	= 1,000 kilovolt amperes (10^3kVA)
1 microgram (ug)	= 1 x 10^{-6} grams

GLOSSARY OF ABBREVIATIONS

EEA	- Egyptian Electricity Authority
EEC	- European Economic Community
EIB	- European Investment Bank
EdF	- Electricite de France
IDA	- International Development Association
MEE	- Ministry of Electricity and Energy
OPEC	- Organization of Petroleum Exporting Countries
REA	- Rural Electrification Authority
S&P	- Sanderson & Porter, Inc.
SWECO	- Swedish State Power Board Consulting Services
USAID	- United States Agency for International Development
WASP	- Wien Automatic System Planning Program

EGYPTIAN ELECTRICITY AUTHORITY

FISCAL YEAR

January 1 to December 31

EGYPT - SHOUBRAH EL KHEIMA

THERMAL POWER PLANT

Summary and Recommendation

1. Grantee: The Government of the Arab Republic of Egypt (GOE)

2. Implementing Agency: The Egyptian Electricity Authority (EEA), a wholly owned Government corporation.

3. Grant Amount: U.S. $100,000,000 (one hundred million dollars). The grant amount will be passed on to the EEA as a grant contribution to EEA's equity capital.

4. Project Purpose: To augment the electricity generating capacity of the EEA to meet increasing energy requirements of consumers throughout Egypt.

5. Project Description: Engineering and construction of a new 600 MW thermal power plant, expandable to 900 MW, to be located in Cairo, together with necessary transmission linkages and technical assistance.

6. Total Project Cost: Total cost of the Project, both foreign exchange and local currency, is estimated at $465.9 million. The foreign exchange component is estimated at $387.8 million, of which $100.0 million will be financed by AID, $139.0 million by the World Bank Group, $35.0 million by the European Economic Community, $35.0 million by the European Investment Bank, $10.0 million by the Organization of Petroleum Exporting Countries (OPEC), $25.0 million by Japan's OECF, and $43.8 million by the GOE and/or other sources including international commercial banks. The local currency requirement, equivalent to $78.1 million, will be financed by the GOE.

7. Grant Application: The GOE has requested an AID grant of $100.0 million to assist in financing the foreign exchange costs of this Project. The application is attached as Annex A.

I. INTRODUCTION

1.01 The Government of the Arab Republic of Egypt (GOE) has requested AID assistance to finance the foreign exchange costs of engineering and construction of a 600 MW thermal power plant to be located at Shoubrah El Kheima in Cairo, Egypt. The project was evaluated, in part, by Sanderson & Porter, Inc. (S&P), a consulting engineering firm prominent in the electric power field. S&P's services were financed from funds made available from AID's Technical and Feasibility Studies Grant No. 263-0042. The feasibility study, completed by S&P in early 1979, forms the basis of the project analysis herein. Additionally, the project analyses and assessment prepared by the World Bank have been most useful in preparation of this paper.

1.02 The project will form part of the U.S. assistance program to Egypt which aims, inter alia, toward accelerating industrial development and improving the quality of life of rural and urban populations through the provision of an adequate energy infrastructure. One of the key elements in the success of the AID program is the availability of electric power. The 600 MW power plant to be financed with the assistance of this proposed grant will be a major generating facility ensuring the adequate availability of power in the mid-1980's. The power produced by this plant will flow into the Unified Power System (UPS), the national electricity grid, and be distributed to industrial, commercial, governmental and domestic consumers.

1.03 A large portion of AID's program in Egypt is focused on the electric power sector. In FY 75, a $30 million grant (No. 263-0001) was provided to finance power distribution equipment for rehabilitation and reconstruction of the Suez Canal area. In FY 76 and 77, a $141 million grant was provided for construction of a 300MW thermal plant at Ismailia in the Suez Canal area. A $69 million loan was also provided in FY 76 and 77 for supply of two gas turbine facilities having a joint capacity of over 300MW. AID provided under FY 76 and 78 loan financing of a $41 million National Energy Control Center, a modern computerized center for monitoring and controlling the UPS, and, in FY 77 and 78, loan financing of $46 million was extended for the rehabilitation of urban electrical distribution systems in Cairo, Alexandria and the provincial cities of Beni Suef and Shibin El-Kom.

8. Mission Views: USAID/Cairo has recommended authorization of the proposed Grant.

9. Source of U.S. Funds: Fiscal year 1979 Economic Support Fund.

10. Statutory Requirements: All statutory criteria have been satisfied; see Annex D.

11. Recommendation: Authorize a Grant in the amount of $100.0 million to the GOE on terms and conditions set forth in the grant authorization in Annex B.

12. Project Committees:

USAID/Cairo

Committee Chairman	:	Philip S. Lewis
Loan Officer	:	Thomas Johnson
Legal Advisor	:	James Phippard
Economist	:	James Norris
Program Officer	:	Charles Weden

AID/Washington

Chairman, NE/PD	:	Thomas Sterner
Loan Officer, NE/PD	:	Ron Redman
Engineer, NE/PD/ENGR	:	M. Kingery
Counsel, GC/NE	:	Gary Bisson
Environmentalist, NE/PD	:	Stephen Lintner
Economist, NE/PD	:	Leonard Rosenberg
NE/DP	:	Dale Pfeiffer
NE/EI/E	:	John Sperling

1.04 A.I.D. is also financing two major training programs under technical assistance grants. One program, costing $381,000, is being conducted in Egypt by the Overseas Advisory Associates, Inc., a non-profit company. A total of 200 upper level management personnel of the Ministry of Electricity have attended the four-week course, which is a very comprehensive review of modern management of electric utility companies. Additional course sessions will be offered to EEA staff in 1979. The other program is a participant training given by the National Rural Electric Cooperative in the United States. The course content is primarily technical and concentrates on operation of electric distribution systems, particularly rural systems.

1.05 The World Bank and the IDA are also active in assisting the Egyptian power sector. A power sector survey is being carried out by the consulting firm Sanderson & Porter, Inc., under UNDP-financing with the Bank acting as executing agency. Its objective is to integrate planning in the power sector with overall economic planning and to identify changes that are required in EEA's institutional and organizational structure, its operations and development program. Phase I of the Survey which was completed in November, 1976, recommended changes in energy policy, organization and management, accounting and financing system operation. Under Phase II, the consultants are assisting EEA in implementing the key recommendations. These include: (i) financial consultants to help EEA resolve the problems in its accounting and finance systems; (ii) a training component would help in manpower planning and in the rehabilitation of EEA's training centers; (iii) study of electricity tariffs; and (iv) a review of EEA's safety and inspection practices. The Bank, during June 1977, extended a $48 million loan to the EEA to finance a portion of the technical assistance required to implement the Phase II recommendations and to finance the foreign exchange costs needed to provide electric power to 13 rural cities and a number of rural zones.

1.06 The total foreign exchange cost of this project is estimated at $387.8 million. AID's portion of $100 million will be used to finance the dollar costs of consulting engineering services, for the design, engineering and supervision of construction of the project, and to finance major components of the power plant itself. The World Bank Group is committed to financing $139 million, with the remaining FX provided by other bilateral and multilateral donors. All local currency needs, estimated at $78.1 million, will be provided by the GOE. The A.I.D. $100 million dollar grant will be passed on to the EEA by the GOE as a contribution to EEA's equity capital, since our expectation is that even after assets are properly valued, EEA's debt to equity position will be less than satisfactory.

II THE POWER SECTOR

A. ORGANIZATION

2.01 Electric power was first introduced in Egypt in 1895 and developed thereafter by the installation of many small isolated generating units. The characteristics of these individual installations varied widely in frequency and voltage. The small systems were owned and operated by a large number of governmental, municipal, and private organizations.

2.02 In 1964 the Ministry of Electricity was founded, placing all of the electric generating facilities under the control of a single governmental agency. In 1965 the General Egyptian Electricity Corporation was founded to own and operate the Public Power System and to expand that system to insure electrical capacity to meet the needs of the nation. In 1971 the Rural Electrification Authority (REA) was formed to plan and supervise the construction of rural electrification projects. In 1976 the Egyptian Electricity Authority (EEA) was formed to replace the General Electricity Corporation and EEA now has the responsibility for the nation's electrical power supply, including operation of the facilities planned and constructed by the REA.

2.03 In 1976 two other authorities were established to study and develop specific sources of electric power. The Qattara Depression Authority was formed to study the power potential of that project and was given additional responsibilities in planning hydro developments. The Nuclear Power Plant Authority (NPPA) was established to develop nuclear power in Egypt. It is expected that any facilities developed by either of these authorities will be connected to the Unified Power System (UPS) and their output turned over to EEA.

2.04 The Ministry of Electricity and Energy (MEE) also has four separate companies for specialized construction work. They are the General Company for Electrical Projects (ELEGECT), the High Dam Company for Electrical and Mechanical Projects (HIDELCO), the Egyptian Electric Transformer Company (EL-MALCO) and the General Company for Mechanical and Electrical Projects (KHAROMICA).

2.05 The Higher Council for Electric Power has approved the formation of seven provincial electricity distribution companies. When these companies are organized they will own and operate the 11-KV lines and facilities of lower voltage and be responsible for distributing electric power.

2.06 MEE relations with the rest of the Government are regulated and coordinated by the Higher Council for Electric Power made up of the Minister of Agriculture and Irrigation, the Minister of Industry and Petroleum, in addition to the Ministry of Electricity and Energy. An organization chart of MEE is shown in Annex E.

Egyptian Electricity Authority (EEA)

2.07 The implementing agency for this project is EEA which is implementation, management, operation and maintenance of all electric power facilities in Egypt. It became financially autonomous from the GOE to the extent that it was able to prepare its own annual budget and five-year plan subject to GOE approval, retain any surplus revenues for its development and contract loans from both local and foreign sources. Bylaws have since been enacted prescribing such matters as personnel policy, salaries and wages, recruitment, and procurement procedures. In personnel, EEA has virtually no autonomy since it is required to conform strictly to Government policy in this area. One of the key aims of the reorganization in 1976 was to give the EEA more autonomy from Government and subsequently, following implementation of its by-laws, to increase efficiency. This move toward increased autonomy has been slow and is hampered by the traditions of the past and the cumbersome bureaucratic procedures still retained by Government. Another major modification to EEA's legal structure pertains to the impending transfer of all distribution activities to seven distrubtion companies created in 1978.

2.08 EEA is a Government-owned enterprise regulated by the Ministry of Electricity and Energy. It is managed by the Chairman of the Board of Directors assisted by two Deputy Chairmen,; one for System Operations, and the other for Financial and Administrative Affairs. The Board of Directors

includes the Heads of EEA's five regional offices; representatives of the Ministries of Electricity and Energy, Finance and Planning and the Chairman of the Rural Electrification Authority (REA). Annex F shows EEA's present organization chart.

2.09 Since 1976, the organizational structure of the EEA has been changed to include the seven distribution companies created as subsidiaries of EEA under a Cabinet Decree (No. 220 of 1978) signed by the Prime Minister on March 6, 1978. These companies are formed to take over distribution (at 11 KV and below) of electricity from the Cairo and Alexandria zones and from the municipalities in the other zones. EEA will continue to be responsible for generation and transmission through its 5 zones. Shares in the new companies are to be held 70% by EEA, 15% by the Governorates or municipalities and 15% by the public including employees of the companies. However, so far, only the EEA's shares have been issued in exchange for assets acquired from EEA. Each company will prepare its own budget for approval of EEA's Board of Directors and be able to retain any revenue surpluses, receive budget allocations from the Government and contract loans.

2.10 Apart from the formation of the distribution companies in 1978, EEA created a new position of Deputy Chairman, Finance and Administration. The other Deputy Chairman retained responsibility for operations and dispatch. The Presidents of the five zones and Directors of the Projects Administration, and Studies and Research Departments continue to report to the Chairman. These changes do little to reduce the centralized control exercised by EEA's top management. The administrative system remains cumbersome because there is little delegation of authority, and little coordination between technical and commercial staff. This position will not be rapidly changed but the Overseas Advisory Associates have carried out in 1978 and 1979 a series of training seminars for top level management under USAID financing which have been very well received by the participants from EEA. Follow-up courses are planned to include middle-level managers.

2.11 The EEA had about 48,000 employees at the end of 1977 compared with about 35,000 in 1973. Of the 48,000, about 30% were in the Upper Egypt zone, 25% in Lower Egypt, 30%

in Cairo (including Head Office) and the remainder were in the Alexandria and Canal zones. About 64% were classified as technical staff and the rest were in administrative, financial and services departments. The fundamental staffing problems identified earlier remain. There is still considerable overstaffing and a severe shortage of middle and top management level executives. Experienced and well qualified Egyptians continue to be attracted to neighboring oil-rich countries by higher salaries. EEA has been able to increase its salaries and bonuses about 20-30% in the last 2 years but not enough to be competitive with Egypt's wealthier neighbors. EEA has addressed the training needs of its top management through the Overseas Advisory Services courses and, as was mentioned, these may be extended to middle level staff in the next phase. EEA reports that it is no longer compelled to employ additional new graduates and ex-servicemen and has actually achieved some reduction in staff from the maximum number of budgeted employees for 1977 of 50,000. In the future, EEA plans to increase the productivity of its staff through retraining of existing employees. The first IBRD power loan provided for technical assistance, training materials and dormitory accommodation at EEA's two training centers near Cairo. EEA has signed an agreement with the International Labor Organization (ILO) for the services fo a high-caliber advisor to be financed under a World Bank loan. EEA is expected to follow up this appointment with two training specialists, one for Cairo North and the other for Cairo South training center.

B. FACILITIES

2.12 EEA owns and operates ten steam electric generating stations, with four more committed for construction before 1984, five gas turbine generating stations with four more under construction and two hydro stations. Total capability of generating capacity in service as of early 1978 was 3031 MW as shown in Annex G; of this total 919 MW was in steam plants, 546 MW in gas turbine plants and 1566 MW in the hydro plants, with hydro plant capacity stated on the basis of peak carrying capability recognizing the limitation on water available in December.

2.13 The Unified Power System transmission facilities comprise a 500-KV transmission link connecting the hydro development in the upper Nile in southern Egypt with the loads and generation in northern Egypt. A 220-KV network serves the northern Egypt loads and a 132-KV system generally parallels the 500-KV transmission and serves the loads in the Nile Valley and nearby oases. A map of the system is shown in Annex H and a one-line diagram in Annex I.

2.14 The principal communications system used for operation and control of the Unified Power System uses power line carrier which is supplemented with wire line telephone circuits to serve local areas. In general, the public telephone system is not adequate to serve as a reliable substitute for the power line carrier equipment. Microwave communication facilities have not been used.

2.15 All power stations and transmission substations have full time operators, and remote control systems have not been used to any great extent. Generation control is accomplished by voice communication with minimal information display to the operator. Frequency control is accomplished manually at the High Dam Hydro Station. However, a new computerized control system is under construction, together with the necessary data for automatic control and monitoring of the system called The National Energy Control Center (AID Loan No. 263-K-037).

2.16 Because of the long transmission system from the hydro generation in the south to the principal load centers in northern Egypt, line outages sometimes result in separation of the system with excess generation on the southern portion and generation deficiency in the north. Frequency sensitive relays are used in northern Egypt to disconnect presecleted loads in order to maintain service to the remainder of the northern system loads in case of transmission faults causing such system disturbances.

2.17 General service facilities include a General Office Buiding in Abbassia, an AC Network Analyzer located in the building at Abbassia, a High Voltage Research Center, a Training Center, and various other facilities. The general office building is located in Abbassia and comprises a total of six floors with approximately 5000 square meters of usable space. The Executive Offices of EEA are located here together

with the principal administrative organizations. The building is occupied by EEA personnel and the Ministry of Electricity and Power.

2.18 The Network Analyzer is housed in the General Office Building and comprises some 15 generating units, 110 line units, 50 capacitor units and other units required to model the electric system with appropriate metering facilities. EEA also owns another building in the same area which has 12 floors and about 3000 square meters of usable floor space. It was built in 1972 and is fully occupied by EEA. The top two floors of this building are used for a microfilm filing system.

2.19 The Pyramids High Voltage Research Center was established in order to study problems peculiar to high voltage transmission in desert conditions and to develop parameters for the construction and operation of a reliable transmission system. The facilities include an extra high voltage cascade transformer capable of developing 2212 KV, a pollution and contamination testing area, corona test lines, provision for testing insulators and devices under actual weather conditions existing at the center, together with the necessary instrumentation.

2.20 In addition to these facilities, the EEA operates service centers in each zone to support the crew necessary for maintenance of the electric system and construction of new facilities.

2.21 The problems encountered in operation of the bulk power supply system result, in large part, from the nature of the system, with a large part of its generating capacity in a hydro generation complex 940 km from the principle load fluctuations at substations connected along the 500-KV transmission lines, system disturbances, and in some instances loss of service to some loads as a result of trip-outs in the 500-KV lines and a limitation on the amount of power and energy that can be used from the hydro project because of these transmission problems. There are also currently some problems resulting from the fact that lack of sufficient installed generating capacity makes it hard to schedule the maintenance outages required to keep generating equipment in good operating condition. This situation is further complicated by the difficulties experienced in obtaining an adequate supply of spare parts.

2.22 Several measures are presently being taken to improve the reliability of the 500-KV transmission system to alleviate related problems. these include a program of insulator washing and the installation of weights on insulator strings, where required, to prevent reduced clearance caused by high wind conditions. A techno-economical solution to the problem is being sought by a study now under way by the Swedish State Power Pool.

2.23 System development will also help alleviate these problems in that adding generation and load in the Cairo area will increase the transfer capability of the 500-KV system. similarily, development of additional loads and transmission facilities to serve those loads will help stabilize voltage along the line. Development of additional loads in Upper Egypt will also permit using the available water power without loading the circuit to northern Egypt so heavily. It is expected that implementation of the proposed project will provide sufficient energy generating capacity so that preventive maintenance can be scheduled, which will further alleviate the problems.

2.24 The project forms part of the proposed development program to meet the future demand for electricity on the EEA system. The past trend of demand on the system is shown in Annex J. Maximum demand rose from 872 MW in 1967 to 2,338 MW in 1977 (9.9% p.a.) and sales from 4,756 GWh to 11,429 GWh (9.2% p.a.). The average growth rates for the whole ten-year period conceal very divergent trends within the period. As shown by the detailed figures in Annex J, the annual growth rates followed a markedly downward trend in the first half of the period, declining from 10.1% in the 1968 to -0.8% in 1972 for sales, and from 6.7% to 1.4% for maximum demand, the average annual growth rates over the five-year period being 5.4% and 6.2% respectively. These low growth rates reflected the relatively lackluster performance of the economy in these years, during which the growth of GNP averaged only 4.3% p.a. Since 1972 there has been a sharp reversal of these trends, with economic growth of 7% p.a. and power demand growing at over 13% p.a.

2.25 The key factor in the much higher growth rate of power market over the last five years have been the demand of five

major industrial consumers, three of which began operations during this period. These together accounted for over 54% of total incremental sales between 1973 and 1977, during which period sales to these large industrial consumers grew at over 34%/a. Sales to other consumer categories grew much less rapidly, ranging from 17% p.a. for residential/commercial consumers to 1.4% p.a. for irrigation/agriculture. As a result, the share of industrial in total electricity sales rose from 54% to 63% as illustrated in Annex K. This high proportion of industrial sales also accounts for the relatively high system load factor (65% in 1977).

C. Load Forecast

2.26 Although the Shoubrah El Kheima plant is intended to meet load growth in 1985-87, the load forecast was not limited to this period since in power system planning it is necessary to ensure that proposed short- and medium-term expansion programs are consistent with optimum long-term system development. Consequently, EEA's consultants extended the forecast to the end of the century (1999), which was considered adequate for this purpose.

2.27 The method adopted by EEA and its consultants in projecting future demand was to make separate forecasts for each consumer category, as described below:

(a) Industry. In view of the importance of major consumers in industrial electricity consumption, this category was divided into subcategories, viz. "Industrial - Large Consumers" and "Industrial - General." The forecast for the first subcategory was based on the identification of individual major industrial consumers, existing or projected to 1985, for which specific information regarding their power requirements could be obtained either from the industries themselves (where they already existed), or from the agencies responsible for their construction (in the case of new industrial projects). This resulted in the identification of 36 major industrial consumers, as listed in Annex L, which shows their projected power requirements, based on the most up-to-date information available on the status

of the expansion plans of the industries concerned. It was further assumed that additional major industrial loads would emerge in the latter part of the period to 1985 such as to maintain the annual growth rate for this subcategory at the same level as that projected for "Industrial - General" (i.e., 9.5% p.a. - see below). Recent experience indicates that implementation of major industrial projects lags behind schedule, resulting in actual power demands less than those projected. Thus, in the last three years, actual annual sales to large industrial consumers have been between about 50% and 70% of forecast sales. For the purpose of the load forecast, therefore, the consultants assumed, as a measure of caution, that actual annual sales to large consumers in the period to 1985 would be only 60% of the industries' estimates of their requirement. For the period 1986-1999, it was assumed that growth rates for this subcategory would correspond to those for "Industrial - General." The resulting forecast for large industrial decline in the annual growth rate from the average of 34% p.a. in the period 1973-77, to 9.5% in 1983, 7.5% in 1986 and 7% in 1991.

For the "Industrial - General" subcategory the projection was based on an average growth rate of 11% p.a. in the number of industrial customers (excluding large consumers), and average use per customer declining at 1.2% p.a., through 1985. Thereafter, the number of customers was assumed to remain constant and the growth rate of sales per customer was assumed to be 7.5% p.a. through 1990 and 7% p.a. subsequently.

(b) Residential/Commercial. Forecast sales for this category assume continuance of the 1973-77 growth rate of 14% p.a. through 1985 and a subsequent decline to 12% p.a. through 1990 and 8% p.a. thereafter.

(c) Irrigation/Agricultural. The number of customers in this category remained constant at 200 in the period 1973-77 and, as shown in Annex M, the growth rate of sales was minimal, averaging only 1.4% p.a. However, there are plans to increase the acreage under irrigation and the total agricultural production by revision of irrigation methods, which is expected to lead to somewhat higher growth rates in the future. It was assumed, therefore, that sales in this category, after stagnating through 1980, would increase at 5% p.a. in subsequent years.

(d) Other Categories. The remaining categories comprise "General Purpose" and "Government Buildings". "General Purpose" sales were projected to grow at the average 1973-77 rate of 3.8% p.a. through 1985 and somewhat more slowly (3.5% p.a.) subsequently. It was assumed that the downward tendency in the "Government Buildings" category as a proportion of total sales (3.3% in 1973, 2.4% in 1977) would continue until it reached 2% in 1984 and that it would then remain at this level in subsequent years.

2.28 The resulting forecast of total sales, together with the corresponding estimates of net generation and maximum demand, are shown in Annex M and summarized below:

Table 1

Actual and Forecast Sales Summary

	1980		1985		1990		1999
Total EEA Sales, GWh	17,116		28,311		43,050		81.213
Average Growth Rate,% p.a.		10.6		8.7		7.3	
Net Generation, GWh	19,902		32,172		48,920		92,287
Average Growth Rat % p.a.		10.1		8.7		7.3	
Maximum Demand, MW	3,151		5,151		8,093		16,333
Average Growth Rate, % p.a.		10.3		9.5		8.1	

This was adopted as the most likely forecast for the economic evalution. It implies that by 1995 per capita consumption will be around the level reached by Portugal in 1976 (1,230 kWh). For

sensitivity testing, "low" and "high" forecasts were also made, as shown in Annex N. These assume annual incremental sales over the forecast period respectively 10% lower and 10% higher than in the probable forecast.

Losses

2.29 During the period 1973 through 1977, the system losses, excluding station auxiliaries, as a percentage of net generation varied from a high of 15.6% to a low of 9.9%, which were the losses in 1977 as shown in Annex J. It is expected that the high percentage of total energy delivered to large industrial customers at transmission voltages, especially considering that a large portion of this is delivered and used in southern Egypt thus avoiding losses on the 500-KV transmission system, will result in relatively low losses as compared with other systems. The fact that EEA is presently engaged in a program of rebuilding substantial parts of its distribution system should also lead to reductions in loss percentages. Therefore, losses are projected at 15% of net generation in 1978 with the percentage decreasing to 12% in 1984 and remaining at 12% thereafter.

D. FOREIGN-ASSISTANCE-TO-THE-SECTOR

2.30 AID has provided assistance to the electric power sector since resumption of the U.S. Assistance Program in Egypt in 1975. A brief description of these project activities, totalling over $327 million in loans and grants, is given in paragraphs 1.03 an 1.04. In addition, approximately $70.0 million has been provided to EEA and REA from AID's commodity import loans for the procurement of various types of electrical and support equipment and materials.

2.31 The World Bank has made one loan for power in Egypt ($48 million) in 1976 for regional electrification. The loan provided for rehabilitation and extension of all electric power facitilities serving a regional population for about 6 million people in 13 urban centers and 19 rural zones outside Cairo and Alexandria. The loan also included technical assistance for training and studies to strengthen organization and institutional aspects of EEA and REA. Construction is planned to start in the last quarter of 1979. In addition, the Bank

was Executing Agency for a UNDP-financed Power Sector Survey carried out in 1976-1978. Under Bank supervision this Survey identified areas needing immediate attention in relation to planning, operational, organizational, and institutional improvements in the Egyptian power subsector. Subsequently, the first power project provided for technical assistance in this connection. Although no loans have been made for oil and gas, a gas pipeline project to gather, treat and transport associated gas from the Gulf of Suez offshore oil fields to the Suez City area has been proposed and is now under appraisal by the Bank. Associated gas from this pipeline would be available to the Cairo area through existing pipeline facilities being modified under the Gulf of Suez Gas Project. Surplus gas could eventually be diverted from other power generation users to the Shoubrah El Kheima station.

III. THE PROJECT

A. PLANT FACILITIES

3.01 The Project consists of engineering and construction of a 600 MW thermal power plant to be located on a site at Shoubrah El Kheima in Cairo, Egypt. The plant will initially include two steam generating units each capable of producing 300 MW net, under normal operating conditions, together with the necessary auxiliary equipment including fuel storage, transmission linkage to the Unified Power System (UPS), and necessary communication and control equipment. The plant design will accommodate later installation of an additional 300 MW unit.

3.02 The throttle steam conditions will be 163 atmospheres, 538°C with reheat to 538°C. The turbine will be a double flow tandem compound, 3000 rpm unit with seven stages of feedwater heating. The electric generator will be rated at 427 MVA, with hydrogen cooling, 80% power factor, with the exciter on the shaft. The steam generator will be capable of producing approximately 1,040,000 kg of steam per hour continuously at the pressure and temperature required to provide the necessary throttle steam conditions. It will be designed to burn mazout but will be capable of being converted to gas if desirable. There will be three 60% capacity electri motor driven boiler fuel pumps to permit pump maintenance and still maintain a high load factor in the plant. A demineralizer is included to provide make-up water.

3.03 Condensing water will be taken from the Nile River through an intake structure and equipment designed to prevent trash from the river passing through the condensers. The temperature of this condensing water will be raised about 10°C, and it will be returned to the river downstream from the intake, without further treatment.

3.04 Plant wastewater will pass through a wastewater treatment plant before entering the river. The wastewater treatmen plant will be designed to provide an effluent of a quality equal to or better than the U.S. EPA requirements. No provision is included to collect runoff water since the rainfall is very low.

B. TRANSMISSION

3.05 Transmission system additions required to deliver the output of the proposed plant to the system loads comprise four 220-KV circuits with associated equipment. The plan is to loop the present double circuit from Cairo North to Cairo West through the proposed new plant. It is also proposed to loop this circuit through the Saptiah substation which is to be built to serve the increasing loads in the central part of Cairo. This loop to Saptiah, however, is required regardless of the source of power so it is not included in the project.

3.06 Project facilities will also include eight 220-KV circuit breakers and line terminal positions complete with circuit breakers, four in the Shoubrah substation to serve the new outgoing circuits and two at Cairo North. Also included are replacement of two circuit breakers and associated equipment of the Cairo North substation to provide sufficient current carrying capacity to handle the expected power flows.

C. FUEL SUPPLY

3.07 The primary fuel for the plant will be heavy fuel oil, called Mazout. Fuel requirements will be approximately 1.0 million tons per annun for the first two units, reaching 1.6 million tons per annum after installation of the third unit after 1986. A 14-day reserve storage supply will be provided to enable the plant to continue operations during interruption in the pipeline flow. This is considered a reasonable time allowance to locate and repair a line rupture.

3.08 Mazout will be supplied via pipeline by the Egyptian General Petroleum Company from a refinery at Suez. Current and anticipated levels of oil production and refining capacity indicate no problems in supplying the project's mazout requirements. However, existing pipeline capacity is not capable of handling the whole of Shoubrah El Kheima's fuel requirement. EGPC will eventually need to build additional pipeline capacity. At negotiations, AID will seek agreement from the Government to provide for building the additional pipeline facilities as they become necessary to assure adequate supplies of fuel for Shoubrah El Kheima in accordance with the plant's planned operation.

D. AID FINANCING

3.09 The $100 million financing provided by AID will be utilized for the procurement of (1) U.S. consulting engineering services for the planning and engineering of all facilities; tendering and procurement of plant equipment, materials and related civil works construction services; supervision of installation, erection and civil works construction; acceptance testing and start up of plant; and assistance and training during initial commercial operations; and (2) design, supply and erection of a major equipment package, such as the turbine generator island or boiler island, from a U.S. manufacturing firm.

IV. TECHNICAL ANALYSIS

A. Project Selection

4.01 EEA owns and operates 17 generating stations with a total capability of 3,031 MW. Of these, 919 MW are in steam electric plants, 234 MW in combustion turbines and 1,566 MW in hydro. The figure for hydro capability reflects the limitations imposed by the December irrigation programs. A detailed plant-by-plant breakdown of system generating capacity is given in Annexes O and P. Generating capacity existing or under construction will suffice to meet the forecast requirements through 1983, but additional capacity will be needed to meet the projected peak demand on the system in December 1984. The technical options include hydropower and the various thermal possibilities viz nuclear conventional steam plant, combined cycle plant (i.e., a combination of combustion turbines and steam turbines) and combustion turbines.

4.02 Relative to hydro power, comprehensive studies and reports were made in recent years by two independent consultants: The Swedish firm of Vattensbyggnadsbyram (VBB) and the Soviet Institute "Hydroproject". The reports of these two firms contained similar recommendations for the installation of additional generating capacity at the lower Aswan dam and at new hydro stations in existing barrages on the Nile and in new barrages. Consideration was given to eleven separate sites where hydro power could be installed or increased. These sites are listed in the following table.

Table 2

HYDRO-POWER GENERATION SITES REVIEWED

Distance Below Aswan Dam per VBB (km)	Site	Proposed Additional Generating Capacity (MW)	Design Head (m)	Status of Dam or Barrage
0	Aswan Dam	160	20.0	Existing
74	Silsila	88	6.0	Proposed
167	Esna	89	6.3	Existing
266	Qift	75	5.2	Proposed
359	Nag-Hammadi	52.5	5.2	Existing
445	Sohag	85	8.2	Proposed
544	Assiut	48	5.6	Existing
608	Deirot	63	7.5	Proposed
692	Samalut	-	-	Proposed
775	Beha	-	-	Proposed
857	Kababat	-	-	Proposed
938	Delta	-	-	Existing

4.03 A thorough review was made by the feasibility study consultant, Sanderson & Porter, of all existing reports on the above listed hydro sites, supplemented by its own investigations and updated cost estimations and scheduling.

4.04 Relative to thermal power, EEA investigated a number of alternative locations for their suitability as plant sites. Preliminary evaluation of these resulted in the elimination of the least attractive of these locations, leaving five

specific sites for detailed evaluation. The five sites are located at: Ras Gharib - Ras Shukeir, Ain Shoukna, Suez, El Tabbin and Shoubrah El Kheima. A map showing the location of possible hydro and thermal sites is attached as Annex T. Each of these sites was studied in depth.

4.05 The study report concluded that, although there is scope for further hydropower development on the Nile, the hydro schemes could not be considered for the present requirement because of the long lead time for their construction (8-1/2 years). Similarly, a nuclear station could not constructed in time to meet the December 1984 peak demand. Of the remaining possibilities, experience with combined cycle plant is limited. And, due to the complex nature of the plant, many operational problems still exist, making it unsuitable for introduction into the EEA system at this stage, although it could be considered for later installation when more operational experience of this type of plant has been accumulated. The effective choice for meeting the projected 1984 and 1985 requirements, therefore, lies between conventional steam turbines and combustion turbines, or some combination of these.

4.06 Since the alternatives have different effects on the operation of the unified EEA system, they cannot be compared in isolation from the system. The comparison was therefore made using a computer model known as the Wien Automatic System Planning Computer Program (WASP), as described in Annex Q. This is designed to define the least-cost generation program in present worth terms for an electric power system, subject to any constraints, over a specified period, in this case 1978 and 1999. As a first step, the program was used to determine the appropriate size of unit to introduce in 1984 and 1985. As shown in Annex O, approximately 300 MW of additional thermal capacity is needed to meet the 1984 peak demand, and a further 600 MW in 1985, while still maintaining the required system reserve margin of 20%. Since the largest unit at present under construction or planned is 150 MW, this suggests 300 MW as the appropriate next choice of size. However, this was compared with the 450-MW size to establish whether the benefit of the scale effect would offset the additional cost of installing capacity in excess of system requirements. The comparison showed that the development program including three 300-MW units in 1984-85 rather than two 450-MW units had the lowest present worth of costs over the whole range of discount rates applied (8%-16%), and this result was found to be insensitive to variations in the main assumptions, thus confirming 300-MW as the economic choice of unit size.

4.07 Two generation expansion programs to meet the projected 1978-99 requirements were then compared, the first incorporating the proposed steam station (i.e. a 300-MW conventional steam unit in 1984, followed by two similar units at six-month intervals in 1985) and the second substituting 300 MW of combustion-turbine capacity for the 1984 steam unit. The program incorporating the Project was found to have the lowest present worth of total system costs up to a discount rate 17%. This result was found to be insensitive to variations in the base-case assumptions on capital costs, fuel costs, value of foreign exchange and load growth, the equalizing discount rate lying in the range of 15-19% for the cases considered.

4.08 It was finally necessary to compare the economics of four possible sites for the steam station, viz Ras Gharib (215 km south of Suez on the west bank of the Gulf of Suez), Ain Soukhna (also on the Gulf of Suez, 47 km south of Suez), Shoubrah El Kheima (located in Greater Cairo on the east bank of the Nile) and Suez itself. Ras Gharib was rejected at an early stage of the comparison when it was found to have the highest present worth of costs (capital plus operating - particularly transmission investment and losses) even when it was assumed that natural gas would be the fuel, despite the fact that it was the most favorably situated of all the sites in relation to the gas supply; as mazout is now assumed to be the fuel, for which Ras Gharib is less favorably situated, this rules it out from further consideration. Details of the estimated costs associated with the other three sites are shown in Annex R. The Shoubrah El Kheima site has the lowest present worth of costs up to a discount rate of at least 15% and is therefore the preferred location.

B. Project Site

4.09 The project location in Shoubrah El Kheima is at the site of an old abandoned steam-electric generating plant, north of the city proper, in the Governorate of Kallabia on the east bank of the Nile. The property, shown in Annex T, is occupied by two large powerhouses, each housing three turbine generator units varying in capacity from 10 MW to 13 MW, numerous boilers and auxiliary equipment. Both powerhouses, which appear structurally sound, are completely abandoned and are not used for any purpose. The site also contains many smaller buildings

and presently serves as a major storage depot and service center for EEA's distribution system. Eleven concrete underground fuel oil storage tanks are on the site, as well as an active 66 KV substation.

4.10 While the property is sufficiently large in area to accomodate the proposed plant, significant efforts must be expended in the demolition of present structures and the preparation of the site for new construction. Further, EEA's storage yards and warehousing activity must be relocated prior to initiation of site clearance.

4.11 The plant site is directly adjacent to the Nile River, separated from it only by a road under which circulating water intake and discharge pipelines must pass. The river appears to have adequate depth, minimal variations in stage, and sufficient current to present no problems in operation of a direct once-through condenser cooling water system. The temperature of this cooling water will be raised about 10 degrees centigrade. River water can be used as boiler make-up water after demineralization.

4.12 The plant structure will be founded on the alluvial deposits of the Nile river valley. The deposits of the flood-plain alluvium facies are represented by silty loam, sandy loam and clay. The deposits of fluvial alluvium facies are usually grey, fine sand strata with lenses of medium to coarse sand. The total thickness of the alluvial deposits is about 20 meters or less, and are underlain by strata of sand and gravel. The site is considered adequate for foundation support either pile or matraft type. The ground water table is about 3 to 4 meters below ground surface. This will create some difficulties if deep excavations are required and, as some soil layers have high sulphate content, ground water effect on buried steel and concrete structures must be given careful attention.

4.13 The site is located close to both the AbuRoach-North Sinai and the Red Sea - South Greece seismic belts. However, the region of the seismic belts near Cairo is characterized by earthquakes having low magnitudes, ranging from zero to about 1.9, but having a high frequency of occurrence. Plant design will include consideration of these seismic parameters.

4.14 The approach to the site is by way of a major city street followed by a short turn into a secondary, but also wide, city street before entering the main gate. All equipment, materials and personnel would use these busy city thoroughfares which, during the construction phase of the plant, may cause occasional delays. Aside from this minor inconvenience, no problems concerning access and transportation, even of the heaviest power plant components, are anticipated.

4.15 As the only viable site located in the greater Cairo area, no special requirements concerning procurement or accommodation of the construction personnel are expected for this site.

C. Plant Design

4.16 The ultimate project comprises three steam turbine generating units each capable of delivering 300 MW net, under normal operating conditions, together with the necessary auxiliary equipment including fuel storage, transmission to connect the plant to the Unified Power System, and necessary communication and control equipment. The throttle steam conditions will be 163 atmospheres, 538°C with reheat to 538°C. The turbine will be a double flow tandem compound, 3000 rpm unit with seven stages of feedwater heating. The electric generator will be rated at 427 MVA, with hydrogen cooling, 80% power factor, with the exciter on the shaft. The steam generator will be capable of producing approximately 1,0[illegible]0,000 kg of steam per hour continuously at the pressure and temperature required to provide the necessary throttle steam conditions. It will be designed to burn mazout but will be capable of being converted to gas if desirable. There will be three 60% capacity electric motor driven boiler fuel pumps to permit pump maintenance and still maintain a high load factor in the plant. A demineralizer is included to provide make-up water. The proposed physical arrangement of the plant on site is shown in the plan and related drawing of Annex U. A one line diagram of the plant's proposed electrical layout is presented in Annex V.

D. Fuel Supply

4.17 The primary fuel for Shoubrah El Kheima would be heavy fuel oil (mazout). Fuel requirements would amount to approximately 1.0 million tons/a for the first two units, reaching 1.6 million ton/a once the site is fully developed

(3X300 MW) after 1986. Mazout will be supplied via pipeline by the Egyptian General Petroleum Company from a refinery at Suez. Current and anticipated levels of oil production and refining capacity indicate no problems in supplying the Project's mazout requirements. However, existing pipeline capacity is not capable of handling the whole of Shoubra El Kheima's fuel requirement. EGPC will eventually need to build additional pipeline capacity. The GOE will be required to provide evidence that necessary actions will be taken to ensure ample fuel supply. A 14-day reserve storage supply will be provided at the plant site to enable the plant to continue operations during an interruption in pipeline flow. This is considered a reasonable time allowance for location and repair of line rupture.

E. Transmission

4.18 Transmission system additions required to deliver the output of the proposed plant to the system loads comprise four 220-kV circuits with associated equipment. The plan is to loop the present double circuit from Cairo North to Cairo West through the proposed new plant. It is also proposed to loop this circuit through the Saptiah substation which is to be built to serve the increasing loads in the central part of Cairo. In order to provide ample thermal capacity in the transmission facilities, it will be necessary to increase the conductivity of that portion of the existing circuit from the point where the new connection to the Shoubrah plant connects to the existing line to Cairo North. This is to be done by adding a second 400-mm(2) conductor per phase to the existing line. Project facilities will then comprise twelve 220-kV underground cables for a distance of 1 km from Shoubrah. At the end of these cables, the four circuits will go overhead for 2 km to a point where they meet the existing line. The existing line from that point to Cairo North, a distance of 5 km, will be strengthened by tower modifications and the addition of a second 400-mm(2) conductor per phase.

4.19 Project facilities will also include eight 220-kV circuit breakers and line terminal positions complete with circuit breakers, four in the Shoubrah substation to serve the new outgoing circuits and two at Cairo North. Also included are replacement of two circuit breakers and associated

equipment of the Cairo North substation to provide sufficient current carrying capacity to handle the expected power flows.

4.20 A power flow study shows that locating 900 MW of generating capacity at Shoubrah El Kheima also requires that the 220-kV transmission link from Cairo South to Wadi Hof be strengthened. This will be accomplished by construction of a double circuit 220-kV tower line from Cairo South to Wadi Hof, a distance of 3 km. Stability studies show that it will not be necessary to extend the 500-kV transmission system north from its present termination near Cairo.

F. Project Costs

4.21 A project cost estimate was prepared by the consultant during the feasibility study and subsequently adjusted to include escalation and contingencies. The table below presents a summary of costs. A detailed cost estimate is shown in Annex W.

Table 3

Summary Cost Estimate

	Million LE			US $ Million Equivalent		
	Local	Foreign	Total	Local	Foreign	Total
a) Thermal Power Station (2x300 MW), base cost/1	25.5	180.4	205.9	35.6	252.6	288.2
Contingencies						
Physical	1.9	13.5	15.4	2.7	18.9	21.6
Price	25.3	71.3	96.6	35.5	99.9	135.4
Subtotal	52.7	265.2	317.9	73.8	371.4	445.2
(b) Transmission (4 km, 220-kV loop plus a reinforcement of existing facilities base cost/1	0.9	6.5	7.4	1.2	9.2	10.4
Contingencies						
Physical	0.1	0.6	0.7	0.1	0.9	1.0
Price	1.0	2.7	3.7	1.4	3.8	5.2
Subtotal	2.0	9.8	11.8	2.7	13.9	16.6
(c) Technical Assistance (Studies, Research and Training) base cost/1	0.7	1.4	2.1	1.0	2.0	3.0
Contingencies						
Physical/2	-	-	-	-	-	-
Price	0.4	0.4	0.8	0.6	0.5	1.1
Subtotal	1.1	1.8	2.9	1.6	2.5	4.1
TOTAL ESTIMATED PROJECT COST	55.8	276.8	332.6	78.1	387.8	465.9

/1 At 1978 prices.
/2 Consolidated into price contingency figures for ease in rounding off.

G. Operation and Maintenance

4.22 The organization chart and table of organization of the required operation and maintenance staff for this project are shown in Annex X. The estimated personnel requirements are summarized in the following table.

Table 4

Estimated Personnel Requirements

	Units in Operation	
	1 & 2	1, 2, & 3
Plant superintendent	1	1
Assistant plant superintendent	1	1
Operation section	83	111
Maintenance section	63	77
Administration section	23	31
Total staff	171	221

4.23 The Plant Superintendent and his assistant are responsible for the safe and economic operation of the plant at its highest efficiency. He will be responsible to EEA's General Director of Power Stations. The Superintendent's staff will be divided into three principal functional groups: Operations, Maintenance and Administration. The Operations Department is responsible for the safe and efficient operation and control of generating facilities. Personnel will be assigned to four continuously rotating 8-hour shift crews, each headed by a Shift Supervisor. The Maintenance Department consists of three technical groups, each headed by a Maintenance Supervisor, responsible for mechanical, electrical and instrumentation maintenance, respectively. Most normal maintenance is performed during one daytime shift. Minimal maintenance crews are retained during the other two shifts. The Administration Department is responsible for all general office functions, such as personnel, procurement, accounting, correspondence and internal plant communications.

4.24 The number of employees per megawatt of installed capacity represented by the above totals is greater than might be expected for similar modern oil fired plants in the U.S. On

the other hand, the number of employees presently utilized at thermal power stations in Egypt far exceed these numbers. This is partly due to the smaller size of units found in the developing countries and the shortage of adequately trained personnel which is reflected by the need to add more trainees.

4.25 The level of skills required to operate and maintain the initial two 300 MW units is indicated in the following table.

Table 5

Skill Level Requirements

Experienced managers	8
Administrative assistants	4
Highly experienced skilled personnel	41
Experienced skilled personnel	61
Semi-skilled personnel	17
Professionals	2
Semi-professionals	4
Unskilled workers	34
Total	171

4.26 It is expected that most of the personnel needed will be drawn from the staffs of other existing power plants where professional and skill experience has been gained. However, between now and 1982, some 1600 MW of thermal generating capacity will be added to EEA's system. To meet its personnel needs, EEA plans to place greater emphasis on timely recruitment of new personnel and on strenghtening and upgrading its in-house training function. The project consultant's scope of work will include provision of initial operation management services to supervise and assist the operation staff for a period of twelve (12) months. The consultant will also be required to provide operation and maintenance training for the plant staff to assume a cadre of trained and skilled engineers, operators and other personnel for the proper operation and maintenance of the project.

V. FINANCIAL ANALYSIS

A. General

5.01 EEA is an operational organization within the Ministry of Electricity and Energy, and its finances form a part of, and are comingled with the Ministry's. As such, EEA's financial statements are essentially a listing of cash flow transactions that have occurred during one year, although it does own assets, has incurred liabilities and has a stated capital.

5.02 Since its formation in 1976, EEA has prepared its own annual budget and 5-year plans which are submitted through the Ministry of Electricity for approval by Parliament. With the formation of the seven new distribution companies, EEA's budget is prepared separately from those of the distribution companies; however, they will be consolidated for A.I.D.'s purposes. EEA's 5-year plan (the current one for 1979-83) is now updated each year by dropping off the current year and adding a year. Inclusion of a project in the 5-year plan represents the Government's approval and agreement to commit funds over the 5-year plan period without prescribing specific amounts for each year of the plan.

5.03 Although EEA planned to establish its own chart of accounts when it was formed, it still follows and is bound by the chart of accounts and the accounting principles described in the Government's "Standardized Accounting System". This system does not serve EEA's needs as a utility and is geared more to furnishing statistical information for the Government.

5.04 The deficiencies in the accounting system were pointed out in the 1976 UNDP Power Sector Survey report by Sanderson & Porter (S&P) Inc., New York. To remedy these deficiencies, EEA contracted with S&P for these financial management services. These services commenced in August 1977 but due to the preoccupation of the consultants with the asset revaluation exercise, little progress has been made in regard to modifications to EEA's accounting system.

5.05 S&P has also been developing the management information system (MIS) concept within EEA with the full support of EEA's management. However, with its contract expiring in August 1979, it is unlikely that a new system would be introduced by then. EEA has asked S&P to prepare specific recommendations for implementation of the MIS system and to outline the scope of work to be undertaken in the remaining period of its contract. IBRD's Loan Agreement will contain a covenant that the GOE/EEA agree to continue to employ consultants for modification of the existting accounting system and the establishment of a management information system. If requested by EEA, these services could be financed as part of this project. Further, AID's Grant Agreement will require the GOE/EEA to covenant that it will take appropriate measures to implement improvements in its accounting system.

5.06 Another study currently underway relates to determining the feasibility of computerizing various commercial operations of both REA and EEA. This Bank-financed study is being conducted by Harza Engineering Company International and is expected to be completed this year.

5.07 EEA's fixed assets have been valued at historical cost. Therefore, S&P was contracted by EEA to revalue its existing assets through establishment of an acceptable formula which reflected price changes in the costs of those assets. This study was completed in December 1978. S&P has recommended the valuation of EEA's gross fixed assets at about LE 601 million as of December 31, 1977 as against the historical cost of LE 492 million, which represents an increase of about 22% in the recorded values as of December 31, 1977. The valuation of LE 601 million (US $864 million) for a system with total effective generating capacity of 2,719 MW (919 MW in steam electric plants, 234 MW in combustion turbines and 1,566MW in hydro) along with associated transmission and distribution facilities appears rather modest and is significantly below S&P's own estimation of the replacement value of the system in November 1976 as US $4 billion. Since the attempt in the proposed revaluation exercise would not be to compute the replacement value of the assets, but rather to restate the historical cost to reflect the price level changes, a 22% increase need not necessarily be inadequate. Since many of the assets are new and the old ones have been retired, and the valuation is based on the consultants' in-depth study, the valuation would seem to be an acceptable starting point.

Furthermore, considering the magnitude of the assets that will be brought into service in future compared to the existing assets, establishment of appropriate principles for revaluation in future would be relatively more important than a precise determination of existing values.

5.08 In view of the difficulty of having a single index reflecting price inflation of all capital goods (both imported equipment as well as local construction), it would be appropriate to use two different indices for valuing foreign and local expenditures. The consultants have recommended that for revaluing the foreign cost component, the Handy-Whitman Index be used and that for revaluing the local cost component, the Construction Material Cost Index, as periodically issued by the Egyptian Center for Mobilization and Statistics be used. Although the recommendation for revaluing the local cost component would be generally acceptable, the use of the Handy-Whitman Index (US construction costs index) for revaluing the foreign cost, no matter how appropriate it might be for use in the USA, it might not correctly reflect the increase in prices of the equipment imported into Egypt. An alternative would be to use an index for the prices of machinery and equipment exported by developed countries, such as the one published by the United Nations. Pending agreement with the Egyptians on the principles of revaluation, the assets shown in the financial forecast in Annex Z have been revalued through 1986 using the valuation established by the consultants for the assets at the end of December 1977 and assuming an average annual price increase of 7.5%.

5.09 The income statements and balance sheets of EEA for the years 1976-1986 are given in Annexes Y and Z. In 1976, EEA's first year of operation as an independent electricity authority, it earned a modest profit of LE 3.6 million (Annex Y). The 1977 accounts show a further improvement in net income to LE 11.9 million, which may be reduced to about LE 5 million if a proposed provision for bad debts of LE 7 million is finally made. These results produced rates of return of 8.6% in 1976 and 10.0% in 1977 on unrevalued assets. In 1978, EEA is estimated to have earned a return of 4.7% on revalued assets. EEA's internal cash generation, which is a better measure of performance considering the valuation of its assets, was 11% of expansion requirements in 1976 and 2% in 1978 but none in 1977.

5.10 While the rates of return achieved appear to be very reasonable, they have been obtained in a period when EEA has reaped the benefits of cheap Aswan hydro power, and fuel oil of about $75 a ton. In addition, salaries and wages have been very low averaging about LE 380 per annum per employee (US $530 equivalent), although this advantage is offset by considerable overstaffing. With the growth in demand for electric energy to be met in the next 5-6 years from fossil-fueled plants, the possibility of Government reducing the fuel oil subsidy and the likelihood of large increases in salaries and wages (e.g., 1978 salary and wage increase of 30%), the future outlook is for much higher electricity rates. The last increase in electricity rates, namely, 20% in 1975, had met with strong resistance from the large Government-owned industrial consumers who use about 60% of all electricity sold, and it was only in January 1978 that the increase was ratified. (Domestic rates were unchanged.) Disputes over the legality of the increase helped increase the total unpaid electricity accounts to LE 59.8 million (US $84 million equivalent) as of March 31, 1978.

5.11 EEA has always had difficulties in collecting its electricity supply bills from entities in the public sector such as municipalities, public utilities, Government buildings and and Government industrial companies. In the case of the Governmen industrial companies, the failure to pay is often the result of a genuine lack of funds due to the prices of their goods and services being controlled by the Government at uneconomic levels. Although the Government and EEA have been taking action towards reducing its accounts receivables to not more than the equivalent of 6 months sales by March 31, 1978 and not more than 3 months sales by December 31, 1978, these targets were not achieved. In fact, the overdue accounts which amounted to about LE 51 million at the end of 1975 rose to about 60 million at the end of August 1978 while its electricity sales revenue for 1976 thru 1978 was about LE 289 million. Some progress has, however, been made since then. In January 1979, the Government agreed to a credit of about LE 10 million representing the arrears due from the Government industrial companies in 1975 and 1976. EEA hopes to obtain payment of a similar claim of about LE 5.3 million represent ing the 1977 consumption. Discussions are also under way between the Government and EEA for the settlement of a further sum of about LE 15 million on account of amounts due from muncipalities, Government buildings and public utilities.

If these expectations are fulfilled, EEA would clear about LE 30 million, or a half, of the overdue accounts. Discussions between the Government and EEA are continuing with a view to reducing the receivables to the level of 3 months sales as agreed. However, since this is likely to be a continuing problem with implications for EEA's liquidity position, A.I.D will require the Government to covenant that it will (i) cause its agencies to pay EEA all amounts owed to it by these agencies for electricity sales through 1977; (ii) agree on measures to reduce the outstandings to not more than the equivalent of 3 months' sales by September 30, 1979; and (iii) agree to cause its agencies in the future to pay EEA all amounts for electricity sales that are outstanding for more than 3 months.

5.12 In 1976 and 1977, EEA did not charge interest to construction but charged the total interest expense against revenues. However, EEA has now decided that, in future years, it will capitalize interest on funds borrowed for new investments. The IBRD loan agreements will require EEA to confirm that it will capitalize interest on loans for all new investments.

5.13 EEA's income statements have been prepared assuming that it is not liable to income taxes. However, the Government has claimed that EEA and the distribution companies should pay taxes on their profits. IBRD will seek to obtain a covenant from the Government and EEA that any income taxes which are held to be payable by EEA, would be included in operating expenses for determining EEA's rate of return under the proposed loan.

5.14 EEA's debt equity ratio improved marginally from 74/26 at 1976-end to 72/28 at 1977-end based on its historical balance sheet figures. With the revaluation of assets as of December 31, 1977 resulting in the creation of a revaluation reserve, the debt/equity ratio would have improved to 68/32 at the end of 1978. However, long-term (expressed in LE) debt has not been valued to reflect current rates of exchange. EEA has agreed to revalue its debt each year on the basis of current official exchange rates. This current value would be recorded in a foot note to its balance sheet. EEA's debt/equity ratio may be expected to strengthen further in the short-term as it makes use of grant funds from USAID and the Ministry of Housing and Reconstruction and revalues its gross fixed assets

and depreciation. The majority (90%) of EEA's existing long-term debt is owed to the Government and is repayable over 12 years subject to annual interest of 5%. The remaining 10%, or about LE 42 million, comprises LE 27 million repayable over the next 5 years on USSR loans for the Aswan project and LE 15 million in short-term supplier's credit.

5.15 EEA's debt service coverage in 1977 was only about 0.7 due mainly to the abnormally high repayments made on its loans to the Government. However, the debt service coverage for 1978 was estimated at 1.1 times the net revenues for that year. The current ratio which was 1.3 in 1977 fell to 1.0 in 1978 reflecting an increasingly tight liquidity position.

B. Financing Plan

5.16 The forecast of sources and applications of funds of EEA for the period 1978-86, assuming the tariff increases indicated in para 5.18, is given in Annex AA. A condensed version for the same period is given below:

Table 6

Sources and Application of Funds, 1978-1986

	1978-1986 Amount (Thousands) LE	US $	% of Capital Expenditu
Capital Expenditure Requirements (Including Interest during Construction)			
The Project	383,708	552,540	5
Other Construction	7,002,813	10,084,050	95
Total	7,386,521	10,636,590	100
Sources of Funds			
Internal Cash Generation	2,253,676	3,245,293	
Less: Debt Service	(753,813)	(1,085,490)	
	1,499,863	2,159,803	20
Less: Working Capital Increase	(718,743)	(1,034,990)	(9)
Net Internal Cash Generation	781,120	1,124,813	11
Grants			
USAID	88,734	127,777	1
Government	2,002,398	2,883,453	27
Total Grants	2,091,132	3,011,230	28
Borrowings			
Foreign - Proposed IBRD/IDA Loan/Credit	81,250	139,000	1
EIB	24,306	35,000	-
EEC	24,306	35,000	-
Others	3,891,863	5,582,284	53
Total Foreign	4,021,725	5,791,284	54
Local	488,011	702,736	7
Total Borrowings	4,509,736	6,494,020	61
Other Sources	4,533	6,527	-
Total Sources	7,386,521	10,636,590	10

5.17 It will be seen from the above table that EEA's investment program for 1978-86 will require about LE 7,387 million (US $10,637 million) which is expected to be financed 11% from net internal cash generation, 27% from Government grants, 1% from AID grants, and 61% from borrowing. After allowing for debt service, but not providing for working capital increase, the internal cash generation would be about 20%, which is appropriate considering that the annual cash generation during the period 1978-81 ranges from only 2% to 11% since only a gradual raising of tariffs is assumed in order to reach the required 9% return. We are recommending that the A.I.D. grant be passed on to EEA by the GOE as a contribution to EEA's equity capital since we believe that EEA's debt to equity position will still be less than satisfactory even after proper evaluation of its assets. We believe provision of the A.I.D. funds as a grant will be the best method of assisting EEA. Although firm financing arrangements are reasonably assured for the Project, it would be unrealistic to expect EEA to furnish a financing plan with assured funding for the total program at this stage. Since Egypt has in the past secured all financing necessary for its power sector investments, it is reasonable to expect that it will provide not only the local currency financing, but also will cover any shortfall in foreign exchange requirements. The GOE is, however, unlikely to need to provide any substantial portion of this foreign exchange gap from its own resources as the gap is likely to be closed from additional aid sources currently under consideration for the cofinancing of the project. In addition, various international commercial banks have expressed their readiness to participate in the cofinancing of this project.

5.18 On the Basis that the Government wished to establish EEA as a financially viable entity with a level of earnings which would provide some of its future expansion needs from internal resources after meeting its operating expenses and debt service obligations, AID Grant 263-0009 (Ismailia) contained a covenant which required EEA to set its tariff rates at a level which would allow EEA to earn a rate of return of at least 9% on average net fixed assets. There is a similar covenant in the loan agreement for the Helwan-Talkha combustion turbine project, Loan No. 263-K-032. A review of EEA's projected earnings during 1979 (see estimated income statements for 1979-1986 in Annex Y), and the assumptions underlying the financial statements in Annex BB shows that EEA cannot earn the required 9% immediately without a relatively large percent tariff increase (110% if effective July 1, 1979) because any tariff increase agreed upon could only take effect around the middle of the year with its impact, therefore, limited to only 6 months.

It is estimated that with a 40% average tariff increase effective July 1, 1979, EEA would achieve a rate of return of only 3.6% in 1979. Considering the environment in which EEA operates, it would be realistic to plan for reaching the required 9% return gradually over a period of time, intermediate targets being fixed for the interim for monitoring EEA's progress towards achieving the final objective of 9% return. The Bank is recommending a plan which requires EEA to implement a program which will lead to achievement of a minimum return of 5% in 1980, 6% in 1981,8% in 1982 and 9% in 1983 and thereafter. AID believes the plan is reasonable. These targets would require average tariff increases of 30% effective July 1, 1981, 25% effective January 1, 1982, 25% effective January 1, 1983 and additional adjustments as necessary thereafter. These returns would result in net internal cash generation of 3% in 1979, 4% in 1980, 11% in 1982 and 23-27% in 1983 through 1986, corresponding to a rate of return of 9% during this period. Over the total period of 1978-86, EEA's net internal cash generation would be around 20% excluding the requirements of working capital increase.

5.19 Assuming the tariff increases mentioned above, revaluation surpluses and the provision of LE 2,091 million as grants from both AID and Government during the period 1978-76, EEA's debt equity ratio would steadily improve from 68/32 at the end of 1978 to 42/58 at the end of 1983. Thereafter, it would rise to 49/51 at the end of 1986. The current ratio which is expected to be around 0.7 in 1979 reflecting an extremely tight liquidity position is expected to rise steadily to 1.4 in 1981, 1.5 in 1982, around 1.8 in 1983-85 and a comfortable 2.1 in 1986.

C. Section 611(a) Requirements

5.20 In view of the foregoing, it is the conclusion of the Project Committees that the requirements of Section 611(a) of the Foreign Assistance Act of 1961 as amended have been satisfied. The project is based upon sound engineering analysis and planning performed by Sanderson & Porter, Inc., and a reasonably firm cost estimate has also been prepared. The Mission has reviewed the plans and cost estimates and finds them reasonable and accurate.

VI. ECONOMIC ANALYSIS

A. General

6.01 The primary benefit of this project is the economic value of the electricity that will be generated by the 600 MW Shoubrah El Kheima thermal power plant. The true economic value of the Kwh of electric power should be based on an estimate of customer's willingness to pay, based in turn on the shape of direct demand curves for domestic users and prevailing market conditions for the products of commercial and industrial users. For Egypt such an analysis is not possible given the subsidies and controls that permeate all sectors of the economy. The GOE establishes tariff structures for electricity in Egypt. Tariffs for larger customers, such as producers of aluminum, iron, and steel, and fertilizer, are negotiated on an individual basis, while special rates are charged for other purposes, such as irrigation. Rates, therefore, are based on the GOE's desires to subsidize the user.

B. Economic Cost Comparison

6.02 Once the need for additional power is established, as is the case for Egypt, the power must be produced internally--it cannot be imported. The economic analysis must initially determe the least cost method of obtaining the new generation. As noted earlier, hydroelectric generation offers few possibilities in Egypt. The building of barrages on the Nile and transferring water from the Mediterranean Sea to the Quattara Depression in Western Egypt are future possibilities that require additional and lengthy study. The second alternative nuclear power, is being considered by EEA but, at present, implementation is constrained by financial and political factors. This leaves EEA two alternatives - gas turbine generators and conventional fossil fueled thermal plants. The least cost analysis for this comparison is presented in Annex CC.

6.03 The assumptions underlying the least cost comparison are carefully outlined on pp 1-2 of Annex CC. Both alternatives provide identical electric power output. In both instances the net export price to the Egyptian economy determined the

fuel price included in that analysis. Unskilled labor used in the alternatives (in construction and operations and maintenance) was taken at 50% of marked price and the foreign exchange rate of LE 1 = 7.40. The relevant cost streams are presented on pg. 3 of 4 of Annex CC. The discount rate necessary to equalize both cost streams, that will bring the higher total cost of the combustion turbine into line with the conventional steam generating plant, is 17.4 percent. The sensitivity analysis on pg. 3 of 4 of Annex CC indicates that the equalizing discount rate will remain substantially above the assumed 9-11 percent opportunity cost of capital given the movement in variables included in that table. The minimum shown is 15.1 percent.

C. Economic Rate of Return

6.04 The Project includes only two of the three 300-MW units to be built at Shoubrah El Kheima and enough transmission materials to interconnect the plant with the system. It does not include associated system transmission and distribution facilities needed to make the station's output available to consumers. However, the justification of the Project cannot be considered in isolation from the whole Shoubrah development (including associated system transmission and distribution), of which it forms an integral part. It was necessary, therefore, to calculate the economic rate of return on the complete Shoubrah scheme rather than on the Project alone. This is the discount rate which equates the present worths of the streams of costs and benefits associated with Shoubrah. For the purpose of the calculation, the attributable financial costs were adjusted for taxes, internal transfers and for any differences between the money costs of inputs and their opportunity costs to the economy. The benefits comprise the incremental revenue from sales of electricity to consumers attributable to Shoubrah, plus other quantifiable incremental benefits.

6.05 The details of the calculation, and the technical and economic assumptions used are given in Annex EE. The main adjustment to the financial costs relate to the fuel (mazout). Many of the other adjustments were noted in para 6.03 above. The internal price payable by EEA is controlled by the Government and has remained unchanged for over 20 years at LE 7.50/ton, which compares with its opportunity cost at the time of appraisal,

based on the export value of mazout, of LE 55/ton. The incremental electricity sales attributable to Shoubrah were valued at the average prices derived from the financial projections for EEA (Annex Y). Additional benefits comprise fuel savings through substitution of electricity from Shoubrah for fuels with higher opportunity costs, plus extra tax revenues, radio receivers license fees and connection charges payable by residential consumers. The resulting economic rate of return is about 8%. This is below the opportunity cost of capital, estimated to be in the range of 9%-11%, indicating that the tariff projections in the financial forecast (Annex Y), though adequate from a financial point of view, do not adequately reflect the long-run marginal cost of electricity supply if fuel is valued at its opportunity cost rather than the low domestic price paid by EEA. Sensitivity tests indicated (pg.7 of Annex EE) that the rate of return would vary in the range 5.5%-10% for variations in the assumptions on capital costs, fuel costs, revenues for electricity sales, load growth and value of foreign exchange.

VII. SOCIAL ANALYSIS

7.01 The construction and operation of the Shoubrah El Kheima Thermal Power Plant will have a number of direct and indirect social benefits which can be viewed as significant outputs of the Project.

7.02 First, there will be an important element of employment generation, mostly in the non-skilled and semi-skilled areas, during the entire construction and erection period of approximately four and one-half years. The total number of construction workers will peak at over one thousand during a two-year period as the first two 300 MW units are installed. Depending on the timing of third unit installation, this figure could climb to 1500 workers. It is presently estimated that about 70 percent of the above noted work force will be Egyptian nationals with about one-third of this group being common laborers. The remaining force of roughly 450 workers will be semi-skilled tradesmen and laborers who will receive intensive on-the-job training from expatriate personnel in the fields of welding, piping installation, electrical and mechanical installation, conduit installation cable and wire hookup, instrumentation work and sheet metal trades. Following construction of the plant, people having experience in these fields will be easily assimilated by the Egyptian job market on a long-term basis.

7.03 Second, operation and maintenance of the completed 600 MW plant will require a permanent work force, including professional and technical personnel, of about 171 people. When the third unit of generation is added, the work force will grow to about 221 people. Although a number of these people will be transferred for other operating thermal plants, they will be replaced by less experienced personnel and/or trainees in at least equal numbers.

7.04 Third, undoubtably the most significant social impact of this project will result from the longer term effects that adequate electric power availability will have on the Egyptian economy. Present power demand projections indicate that, without this project, power shortages would begin to develop in the mid-1980's, thus constraining public and private industrial and commercial development. The new industrial development and the

increases in production made possible by having reliable power available are expected to result in increased employment and increased availability of goods on the Egyptian economy.

7.05 If present industrialization and urbanization trends in Egypt continue, most secondary employment generation resulting from this project could occur in presently heavily urbanized areas. This could possibly result in negative social benefits with respect to deterioration of the human environment in Egyptian cities. Countering this, AID programs and those activities of other donors are directed toward upgrading the social services and the sanitary infrastructure (potable water and sewage systems) of the major cities in Egypt. It is intended that these programs will be expanded to cover additional urban centers in the future. Further, AID is supporting a study of national urban growth policies which is expected to result in governmental actions designed to modify present industrialization and urbanization trends, hopefully moving toward patterns which will minimize negative social benefits.

VIII. ENVIRONMENTAL ANALYSIS

8.01 Although an Initial Environmental Examination (IEE) of the project was not formally prepared, it was recognized by the Mission that an Environmental Assessment of the project was, by the basic nature of the project, required. The scope of services, therefore, of the feasibility study consultant, Sanderson & Porter, Inc., included the requirement of preparing such an assessment. An Environmental Assessment was so prepared by S&P and submitted as Appendix I of the Feasibility Study Report. The findings and conclusions of that assessment are summarized below.

A. Land Use

8.02 The project site lies in the Nile River valley on the east bank of the river, some 10 kilometers north of the main business district of Cairo. A site plan is shown in Annex T. There are no known archaeological or cultural items on or in the immediate vicinity of the proposed site. However, if during the course of site preparation excavations such items are discovered, immediate notification will be given to the appropriate GOE officials to permit investigation and proper disposition.

8.03 The land area in the immediate vicinity of the site is presently used for a combination of light industries, commercial and residential uses. Although presently abandoned, the proposed site has for many years been the site of electric power generatting facilities. This project, therefore, will return the site to its previous usage. Other EEA activites presently on site, equipment and material storage and worker housing, will be relocated by EEA.

8.04 Adverse effects during the construction period will include some fugitive dust from traffic and construction activities, temporary and acceptable noise levels, and some traffic congestion in the area caused by delivery of project commodities. Dust can be reduced by appropriate palliative methods and traffic congestion can be minimized to a great extent by special traffic control procedures and the scheduling of commodity deliveries during off-peak periods.

8.05 The power plant's sanitary wastes will be disposed of through connections with existing city sewage collectors. As rainfall is minimal, no special site drainage facilities will be necessary.

8.06 The power plant will have three systems which are potential sources for oil spills.

a. The lubricating oil system is an integral part of each turbo generator unit, and consists of an oil tank, pumps, strainers, coolers, gages and associated piping. Oil spill prevention techniques for lube oil tanks include check values on discharge lines to prevent flow reversal. Instrumentation will provide adequate warning of excessive conditions in the system which might produce spills. Control techniques to counter spills will consist of concrete dikes to retain all tank volume and sumps with level-actuated pumps to transfer oil to portable tanks for reclamation.

b. The fuel oil system is composed of fuel oil storage tanks, day tanks and their related piping. A concrete dike will surround each tank to catch the total amount of storage volume. Pumps will return spilled oil to the tanks.

B. Water Quality

8.07 The condenser discharge into the Nile River would form a thermal plume with a surface temperature 3°C or more above the ambient water temperature over about 1600 square meters, although water temperature at the discharge would be some 10°C above the ambient water temperature. Due to the effect of the plume mixing with the river water, the 3°C rise plume area at a depth of 3 meters below the surface of the river is only 311 m^2. At a depth of 6 meters below the surface of the river, the plume area is insignificant. The depth of the river adjoining the proposed site is about 10 meters. In order to bring the discharge temperature down to the 5°C limit in the World Bank Guidelines, an oversize condenser would be required together with oversized facilities on the rest of the circulating water system. For the 900 MW plant this would add about $10,000,000 to the capital cost of the plant and $250,000 per year to the operating cost. The consultant was advised by the Director of Fishery Projects of the Department of Aquatic Life in the Ministry of Agriculture

that there would be no adverse effect to river fish life if the raising of the temperature of the river were limited to a 10°C rise above ambient. Since the thermal plume to be expected comprises only a small volume of the total volume and depth of the Nile River at the subject site and since the maximum thermal impact would be only a 3°C temperature rise, additional substantial expenditures to construct a plant with effluent restricted to a 5°C rise is not considered warranted.

C. Noise

8.08 The medical profession has described hearing impairment as an average hearing threshold level greater than 25 dB at various frequencies, and limits have been established to prevent a hearing loss in excess of this value. When employees are subjected to sound levels exceeding those listed in the following table, administrative and engineering measures must be taken.

Table 7

Threshold Noise Exposure Levels

Duration (hours per day)	Sound Level dBa (slow response)
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

8.09 Typical sound pressure levels produced by major equipment in a power station will be approximately 90 to 100 dBa. Noise levels inside the station should meet the criteria listed in the above table. The procurement specifications for the various plant equipment items, such as turbine generator, pumps, fans and other noise source items, will specify that protective treatment, such as acoustical insulation, be used to meet the noise criteria established.

D. Air Quality

8.10 The major air pollutant emissions from the power station when operating with mazout fuel oil will be particulates, nitrogen dioxide, and sulphur dioxide. The average mazout fuel oil presently being supplied to EEA contains about 2.8 percent by weight of sulphur. Cleaner fuels are available in Egypt in limited quantities; however, they command a premium price.

8.11 The consultant examined the extent of these pollutants against two principal criteria: the maximum annual average degradation of air quality, and the maximum 24-hour average resultant ambient concentrations. His findings indicate that, relative to annual average degradation, all plant configurations studied yield expected values which compare favorably with EPA, Egyptian and World Bank standards. However, relative to 24-hour concentrations, plant configuration is a significant factor and the more strict standards of EPA and the COE cannot be met in every case.

8.12 The following table indicates 24-hour average ambient air quality limits and standards for the three major pollutants as established by the U.S. Environmental Protection Agency (EPA) the Egyptian Ministry of Health and The World Bank.

Table 8

EPA Ambient Air Quality Standards
(ug/M^3)

Pollutant	U.S. EPA Limit	Egyptian Standard	World Bank Guideline
Suspended Particulates	150	150	500
Nitrogen Dioxide	not spec.	200	not spec.
Sulphur Dioxide	365	200	1,000

8.13 Utilizing meteorological data for Cairo for a ten-year period (1965 - 1974) and derived diffusion climatology, the consultant calculated expected ground-level concentrations of pollutants resulting from the plant emissions (burning mazout) for a range of plant configurations. The results of this mathematical modeling are shown in the following table. The figures represent the existing ambient concentrations plus the degradation caused by the plant, thus indicating the resultant ambient conditions. (Stack heights are in meters.)

Table 9

Maximum Resultant Ambient Air Quality for 24-Hour Average (ug/M^3)

Plant Type	Three Stacks 900 MW			Two Stacks 600 MW			One Stack 900 MW		
Stack Height	100	200	300	100	200	300	100	200	30
Item									
Suspended Particulates	258	228	209	258	228	209	244	225	21
Nitrogen Dioxide	196	124	79	196	124	79	-	-	-
Sulphur Dioxide	1233	808	539	844	561	382	708	536	39

8.14 Inspection of the table indicates that, relative to suspended particulates, the resultant ambient concentrations are less than the World Bank guideline but exceed both EPA and Egyptian standards for all of the plant configurations examined. Relative to nitrogen dioxide concentrations, the air quality degradation caused by all plant configurations studied is less than the Egyptian (ambient) standard. Relative to sulphur dioxide concentrations, in all but one case (three stacks 900 MW, 100 meter stack height) the World Bank guideline can be met; however, in no case can the EPA or Egyptian standards be satisfied.

8.15 Further investigations by the consultant have indicated that the installation of air pollution control equipment together with certain plant configurations would reduce emission and groundlevel concentrations so as to satisfy EPA standards. However, the capital costs of such equipment for the (ultimate) 900 MW plant were estimated at about $145 million and annual operation and maintenance costs would be increased by about $9.5 million. Preliminary site layout studies indicate that the area of the present site could accommodate the control equipment.

8.16 Given the above described situation, it is expected that the GOE and EEA will elect to accept World Bank guidelines regarding air quality. In view of Egypt's state of development and available resources, USAID believes that acceptance of the World Bank guidelines in this case is appropriate. Special note is given to the fact that the consultant's feasibility study does not represent final design. Decisions on final design parameters and plant configuration, particularly with reference to stack arrangements and air quality control, will be made in response to the Preliminary Design Report to be prepared by the U.S. engineering consultant selected to design and supervise construction of the plant. The preparation of this report will be the first task assigned to EEA's engineer.

8.17 It is the intention of AID, the World Bank and other cofinanciers that, in preparing the Preliminary Design Report, the engineer give particular attention to methods of reducing air pollution and making explicit the trade-offs between improved air quality and project costs in order to set such alternatives before EEA for informed decision-making. Further, it is the intention of the cofinanciers, including AID, to reach agreement with EEA regarding installation of appropriate air quality measuring equipment to monitor ground-level sulphur dioxide concentrations resulting from project operation. Such monitoring would enable EEA, under adverse atmospheric conditions, to temporarily modify, restrict or curtail plant operations in order not to exceed established standards.

IX. PROJECT IMPLEMENTATION

A. Implementing Agency

Egyptian Electric Authority

9.01 Prime responsibility for the overall management of project implementation will be the Egyptian Electric Authority (EEA). The EEA will establish, by July 1, 1979, a special project team, reporting directly to the Chairman of EEA, having full authority to approve all contracts, change orders, and payments to contractors and to make final decisions on all project-related matters. This unit shall consist of a project director, electrical engineer, civil engineer, accountant, financial analyst, contract specialist and legal counsel. This special project team shall be supported, as required, by the full organizational resources of EEA and the Ministry of Power and Energy.

Cooperating Agencies

9.02 Timely and economic implementation of this project depends primarily on EEA. However, the cooperation of a number of other agencies of the GOE is essential to the implementation process. For example, the cooperation of the Customs Department of the Ministry of Finance is needed to ensure that project commodities and equipment are afforded timely clearance through the Port of Alexandria; the General Organization for Sewerage and Sanitary Drainage (GOSSD) and the General Organization Greater Cairo Water Supply (GOGCWS) must cooperate with EEA in providing the site with adequate water and sewage services; the Governorate at Cairo must provide assistance to EEA in the movement of project commodities through the crowded Cairo streets to the project site; and the Egyptian General Petroleum Company (EGPC) must coordinate with EEA relative to timely provision of fuel pipelines, storage and supply.

B. Implementation Plan

Current Status

9.03 On October 30, 1978, AID had published in the Commerce Business Daily a notice requesting expressions of interest and

submission of prequalifying data from experienced and qualified U.S. consulting firms relative to provision of engineering and management services for implementation of this project; the due date for submissions was November 27, 1978. A short-list of six prequalified firms was selected by EEA utilizing an evaluation procedure agreed upon with USAID; this short-list was approved by USAID. On March 7, 1979, a Request for Proposals (RFP) including the scope of work, was provided to the short-listed firms with technical proposals due on April 21, 1979. Utilizing evaluation procedures agreed upon by USAID, EEA is expected to have selected, by the end of May 1979, the first ranked firm with whom to initiate contract negotiations. It is expected that a contract will be executed by EEA and approved by USAID in July 1979.

Consulting Services

9.04 The proposed contract between EEA and the Consultant shall include a scope of services similar to the scope of work set forth in the RFP. The Consultant shall be responsible for: preparation of a preliminary design report, schedule and cost estimates; final design and engineering; full procurement services; construction management; performance and acceptance testing; management of initial commercial operations, O & M training and establishment of an adequate spare parts system.

9.05 At the request of EEA, the dollar portion of costs of the Consultant's engineering services contract will be funded under this project; all local currency requirements for the Consultant's support and for the services of associated Egyptian engineering firms will be for the account of the EEA. It is anticipated that a cost-plus-fixed-fee type contract will be negotiated between the EEA and Consultant. Contract terms and conditions shall be in accordance with guidelines set forth in AID Handbook 11, Chapter 1.

9.06 If, as expected, the services of the Consultant are required prior to the date of effectiveness of the AID project grant provided hereunder, with the approval of the Ministry of Economy and Economic Cooperation, initial services may be funded under a letter of credit and/or commitment financed from AID Grant No. 263-0042, Technical and Feasibility Studies.

Implementation Procedure

9.07 The EEA has made application to multiple agencies for loans and grants for financing of this project (see the Financial Plan, in Section V), including AID, the World Bank Group, and other bilateral and/or multilateral agencies. Procurement of all equipment, commodities, construction and erection services, etc., shall be made in accordance with applicable lender/donor regulations and guidelines. All AID funded procurement shall be in accordance with AID Handbook 11, Country Contracting.

9.08 Because of the multiple funding sources, project equipment and services will be procured under a number of separate but related tenders. Final decisions on the assignment of specific bid packages to specific funding sources shall be made after receipt of the preliminary design report, to be prepared by the Consultant, in which the Consultant's recommendations regarding such assignments shall be set forth. EEA decisions on these assignments shall be subject to the approval of the lenders/donors. A preliminary schedule of funding assignments is, for illustrative purposes, attached hereto as Annex FF. However, agreement in principle has been reached among the cofinanciers, reflective of AID's desire to fund a major, highly visible plant component, to the effect that one of the major equipment islands (i.e. boiler or turbine generator) will be funded by AID under AID procurement regulations. During the discussions regarding project procurement it was concluded that one possible solution would be to have the first major tender (for either the boiler island or T-G island) open to international competition; if awarded to a U.S. firm, the procurement would be financed from the AID grant. (Any possible financing shortfall relative to this procurement will be covered by World Bank or other untied funds.) If this first major tender is not awarded to a U.S. firm, the second major tender (for either the T-G island or boiler island) will be limited to competition among U.S. suppliers only, and the resulting procurement will be financed from the AID grant. It should be understood that this procurement procedure is illustrative and will not be part of the Agreement.

9.09 The demolition of existing site structures and site preparation will be accomplished by a local Egyptian general contractor. Procurement of equipment and commodities will be principally from foreign suppliers; major bid packages will include the boiler island, turbine generator island, electrical equipment, substation and switch yard, auxillary mechanical equipment, transmission tie lines and fuel tank farm. The prime civil construction contract will be tendered internationally

and awarded to a foreign firm or a joint venture of a foreign firm and a local Egyptian firm; it is expected that other local construction firms will be engaged for non-critical plant civil works, such as auxiliary buildings. Erection services will be provided by the respective suppliers of major equipment packages. Miscellaneous erection/installation services will be provided under separate contract(s), under the direct supervision of the Consultant, for non-major items.

C. Implementation Schedule

9.10 The final implementation schedule will be included in the preliminary design report to be prepared by the Consultant and submitted to EEA approximately six weeks after start of work. However, based on the general planning accomplished during the feasibility study of this project, an approximate schedule for implementation is set forth in Annex GG. attached hereto. Principal or milestone dates of this schedule include:

Table 10

Implementation Schedule

Consulting Engineer's Contract Signed	July 1979
Engineer Starts Work	August 1979
Preliminary Design Report Completed	October 1979
Turbine Generator Island Tendered	April 1980
Turbine Generator Island Awarded	October 1980
Boiler Island Tendered	June 1980
Site Preparation Contract Awarded	July 1980
Boiler Island Awarded	December 1980
Civil Works Contract Awarded	June 1981
Mechanical/Electrical Package Awarded	July 1981
Switchyard/Transmission Package Awarded	August 1981
Preliminary Operation Unit No. 1	March 1985
Commercial Operation Unit No. 1	June 1985
Preliminary Operation Unit No. 2	September 1985
Commercial Operation Unit No. 2	December 1985

D. Terminal Dates

Conditions Precedent

9.11 The terminal date for meeting the initial Conditions Precedent to Disbursement, relative to consulting engineering services, will be 60 days from the date of grant signing. The

terminal date for meeting the second set of Conditions Precedent to Disbursement will be 180 days from the date of grant signing, being the date when funds will be needed to finance project equipment procurement contracts.

Letters of Commitment

9.12 The terminal date for opening of Letters of Commitment or amendments thereof will be Dec. 1, 1984, six months prior to initial commercial operation.

Project Assistance Completion Date

9.13 The project assistance completion date (PACD) will be December 1, 1985, the date of initial commercial operation of the second 300 MW unit.

Disbursement

9.14 The terminal date for Disbursements will be Dec. 31, 1986, twelve months after initial commercial operation to allow for final payments after all guaranty tests have been completed.

E. Control and Monitoring

9.15 Upon signing of the Grant Agreement, USAID will issue an Implementation Letter which, inter alia, will contain the necessary guidance details on the types of reports, i.e., progress, financial, shipping, etc., and reporting formats and schedules to be followed. As one of his first tasks under the proposed scope of work, the Consultant will prepare, as a part of the preliminary design report, a revised, updated project implementation plan, schedule and cost estimate. This plan and schedule shall, upon approval by EEA, and subject to subsequent refinements, become the basis for project control and monitoring. The EEA, through the Consultant, shall be required to submit to the lenders/donors (including USAID) a monthly progress report covering all significant aspects of the project, measuring progress in terms of the approved implementation plan and schedule.

9.16 Throughout the life of the project, the U.S. Consultant will monitor the project, bringing all routine problems, together with recommended solutions, to the attention of EEA and USAID in the form of the monthly progress report. More serious problems, those requiring immediate action, will be

USAID Project Officers, including both an electrical engineer and a loan officer, through frequent and timely periodic visits to the project site, meetings with EEA principals and site personnel, U.S. consultant staff and others. Regular reviews, usually bi-monthly, of progress will also be conducted by the USAID Project Committee responsible for the project, which in addition to the engineer and loan officer, also includes a program officer, legal counsel, a member of the controller's staff and an economist. Regular bi-monthly reviews of progress will also be conducted by the USAID Mission's top management staff. Such reviews, when required, will be followed by substantive meetings on project problems with EEA management staff and with responsible representatives of other lenders/ donors.

F. Evaluation

9.17 USAID will conduct annual evaluations of this project beginning twelve months after award of the prime civil works construction/erection contract, or approximately June 1982. These evaluations will be primarily based on routine monitoring procedures, including monthly reports, disbursement records, and normal site visit reports.

9.18 Upon completion of construction/erection and initiation of commercial operation of the first two 300 MW units, a more comprehensive, detailed evaluation will be performed which will summarize how actual project performance parameters compare to those projected or estimated, i.e., was the project completed in accordance with the technical criteria and plans originally formulated, was the project completed within the projected schedule, was the project completed within the estimated budgets. Where significant discrepancies are apparent between the actual and planned parameters, the evaluation shall attempt to establish the reasons for such differences, and to set forth those lessons to be learned from this project which may be applicable to subsequent projects.

9.19 One year after completion of construction and initial commercial operation, a second comprehensive project evaluation will be conducted to assess the management, performance and maintenance functions relative to the plant. This evaluation

will include evaluation of the annual kilowatt production of the plant with respect to the load demands existing during the operational year, the actual staffing of the plant's organizational structure by EEA during the year, the costs of operation and maintenance compared with similar projected or expected costs, etc. As necessary, and as resources permit, this final evaluation of this project will be conducted by an independent AID task force, composed of individuals not previously involved in project management, or by an independent consulting firm.

X. RECOMMENDATIONS, CONDITIONS AND COVENANTS

A. Recommendation

10.01 Subject to the conditions and convenants listed below, we recommend that AID authorize a grant to the Government of Egypt (GOE) in the amount of $100,0 million for the construction of a 600 MW thermal power plant in the city of Cairo, district of Shoubrah El Kheima; and that the grant be passed on by the GOE to the Egyptian Electricity Authority (EEA) as a grant contribution to EEA's equity capital.

B. Conditions Precedent to Disbursement

10.02 Prior to the first disbursement or to the issuance of the first Letter of Commitment under this grant, the GOE shall furnish to AID in form and substance satisfactory to AID:

1. An Opinion of the Minister of Justice or of other counsel acceptable to AID that this Grant Agreement has been duly authorized and/or ratified by, and executed on behalf of, the Grantee and that it constitutes a valid and legally binding obligation of the Grantee in accordance with all its terms.

2. A statement of the names of the persons authorized to represent the Grantee and EEA as specified in Section 8.02, and a specimen signature of each person.

3. An acceptable Contract for consulting engineering services for the Project with an organization acceptable to AID.

4. Evidence that the proceeds of the grant will be made available to EEA as a grant contribution to its equity capital.

5. Evidence from the appropriate GOE entity that utilization of World Bank air quality guidelines as project criteria is acceptable to the GOE and will not constitute violation of Egyptian law.

10.03 Prior to any disbursement or to the issuance of any Letter of Commitment under this Grant for any purpose other than to finance the services of the consulting engineer, the GOE shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

1. Evidence of firm commitments from U.S., international, and foreign lending institutions for provision of not less than seventy (70) percent of all foreign exchange funds required for the project, aside from those funds provided by the AID grant, on acceptable terms.

2. Evidence that local currency financing for the Project has been budgeted by the Grantee and will be available for expenditure by EEA through establishment of a special fund (to be replenished monthly) adequate to meet at least three months' expenditures on the Project, pursuant to a cost estimate made by the Consulting Engineer and approved by EEA.

3. Evidence that satisfactory arrangements have been made by Governmental Agencies involved in the Project to carry out, operate, and maintain the Project as planned, including evidence of the ownership or availability of the plant site on Shoubrah El Kheimah, or some other site acceptable to AID, for the purposes intended.

4. Evidence that the GOE has taken all steps necessary to ensure that adequate supplies of fuel for the power plant to be built under this Project will be made available on a continuing and timely basis; and that the GOE shall provide for the building of additional fuel pipeline facilities as and when they become necessary for Project purposes.

5. Evidence that the Project has been designed and shall be built and operated in a manner which shall ensure that ultimate sulphur dioxide concentration levels resulting from the Project do not exceed 1,000 ug/m^3 24-hour peak and 100 ug/m^3 annual average.

6. Evidence that the GOE has formulated and is prepared to implement a firm plan, including but not limited to tariff increases, which will allow EEA to meet the required minimum rates of return of 5 percent in 1980, 6 percent in 1981, 8 percent in 1982, and 9 percent in 1983 and thereafter, and that such plan will evidence that these rates of return shall not be achieved by increasing the fuel input subsidy.

C. Covenants

10.04 The GOE will be required to covenant as follows:

1. The Grantee and EEA shall cooperate fully with AID and other lenders/donors to assure that the purpose of the Grant will be accomplished. To this end, they shall from time to time, at the request of either party, exchange views through their representatives with regard to the progress of the Project, the performance by the EEA of its obligations under this Agreement, the performance of the the consultants, contractors and suppliers engaged on the Project, and other matters relating to the Project .

2. The EEA shall provide qualified and experienced management for the Project, and it should train such staff as may be appropriate for the maintenance and operation of the Project.

3. The Parties agree to establish an evaluation program as part of the Project. Except as the Parties otherwise agree in writing, the program will include, during the implementation of the Project and at one or more points thereafter: (a) evaluation of progress toward attainment of the objectives of the Project; (b) indentification and evaluation of problem areas or constraints which may inhibit such attainment; (c) assessment of how such information may be used to help overcome such problems; and (d) evaluation, to the degree feasible, of the overall development impact of the Project.

4. The Grantee and EEA covenant that, except as AID shall otherwise agree in writing,

   a. EEA shall promptly take all such action as shall be required to provide in any fiscal year after 1982 an annual return on the average of the current net value of the fixed assets of EEA in service at the beginning and end of the fiscal year concerned at a rate of not less than nine percent (9%).

b. In order to achieve the desired nine percent (9%) rate of return by 1983 and thereafter, EEA agrees to implement a program necessary to achieve a minimum five percent (5%) rate of return in 1980, six percent (6%) in 1981, eight percent (8%) in 1982 and nine percent (9%) in 1983 and thereafter. Grantee further agrees that these rates of return shall not be achieved by increasing the fuel input subsidy. It is further agreed that any increase in fuel costs shall be immediately reflected by commensurate increase in tariff areas.

c. Grantee shall assure adequate long-term financing for EEA's expansion program which has been authorized and modifications and additions to such program. Within two years from the date of this Agreement, the financing so provided will be divided between equity contributions and loans in such a manner that after the completion of loan transactions the debt to equity ratio will be no greater than 1.5:1.

d. Grantee shall (i) cause its agencies to pay EEA all amounts owed to it by these agencies for electricity sales through 1977; (ii) agree on measures to reduce the outstandings to not more than the equivalent of 3 months' sales by September 30, 1979; and (iii) agree to cause its agencies in the future to pay EEA all amounts for electricity sales that are outstanding for more than 3 months.

5. The GOE agrees to hold periodic consultations with A.I.D. concerning fuel pricing as it relates to the power rate.

6. The Grantee shall provide evidence of a plan relating to the distribution of shares in the seven distribution companies of the EEA.

7. The EEA shall take appropriate steps to implement modifications and improvements in its existing accou.. ing system. Such improvements shall be based, at least in part, on recommendations of the consulting firm under contract to study EEA's accounting system.

8. EEA covenants to prepare and to submit to AID by November 1 of each year, a provisional forecast of operating revenues, operating expenses and rate of return for the next succeeding year, a statement of the tariffs and assumptions underlying the forecasts, an aging report of accounts receivable from major accounts, and a statement of the measures proposed, if any, to produce the annual return provided for above, and to furnish to AID all such detail as AID may reasonably request.

   For the purpose of this section

   a. the annual return specified above shall be calculated in respect of each fiscal year, by using as the denominator the average current net value of the fixed assets of EEA in service at the beginning and at the end of each such year, and as numerator the net operating income of EEA for the same year;

   b. the term "current net value of the fixed assets of the EEA in service" means the gross value of EEA's fixed assets in service less the amount of accumulated depreciation, both as valued from time to time in accordance with consistently applied appropriate methods of valuation or revaluation acceptable to AID; and

   c. the term "net operating income" means gross revenues from all sources less all operating expenditures, including expenses of administration, adequate maintenance and taxes, or any payment in lieu of taxes, and adequate provision for depreciation, but excluding interest and other charges on debt.

5[illegible]61

BEST AVAILABLE COPY

ANNEX A

MINISTRY OF ECONOMY
AND ECONOMIC COOPERATION

Economic Cooperation

CON
REDS DLR/DD
Date 6/6

Mr. D. S. Brown,
AID Director,
U.S. Embassy,
C A I R O

Cairo May, 1979

Dear Mr. Brown,

The Government of the Arab Republic of Egypt is planning to construct a 600 MW thermal power plant in Shoubrah El Kheima to provide by 1985 adequate electric power to assist meet the projected demands of new and expanded industrial activity and domestic load growth, and required reserve capacity.

The U.S. consulting engineer, Sanderson & Porter, Inc., has prepared a feasibility study of the project, including a reasonably firm cost estimate. Total project costs are estimated to be $ 465.9 million, of which $ 387.8 million are foreign exchange costs. We are hereby requesting the Agency for International Development to provide a $ 100 million grant to assist finance the foreign exchange costs of the project. It is anticipated that other lenders and donors, including the World Bank Group, will provide assistance in financing the remaining foreign exchange costs. Any shortfalls in foreign exchange financing and all local currency financing required will be provided by the Government of Egypt.

Sincerely yours,

ABDEL AZIZ [illegible]
Under Secretary of State
For Economic Cooperation

CAPITAL DEV. PROJECT

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

ANNEX 3
1 of 7

OFFICE OF
THE ADMINISTRATOR

PROJECT AUTHORIZATION
AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

Name of Country: Arab Republic of Egypt Name of Project: Shoubrah El Kheima Thermal Power Plant

Number of Project: 263-0110

Pursuant to Part II, Chapter 4, Section 532, of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to the Arab Republic of Egypt (the "Cooperating Country") of not to exceed One Hundred Million Dollars ($100,000,000) (the "Authorized Amount"), to assist in financing the foreign exchange costs of goods and services required for the project as described in the following paragraph.

The project consists of the engineering, design and construction of a 600 megawatt thermal power plant at Shoubrah El Kheima in Cairo, Egypt (hereinafter referred to as the "Project"). The funds authorized herein will be made available to the Egyptian Electricity Authority (EEA) to carry out the project.

The entire amount of the A.I.D. financing herein authorized for the Project will be obligated when the Project Agreement is executed.

I hereby authorize the initiation and negotiation of the Project Agreement by the officer to whom such authority has been delegated in accordance with A.I.D. regulations and Delegations of Authority subject to the following terms and covenants and major conditions; together with such other terms and conditions as A.I.D. may deem appropriate:

a. Source, Origin and Nationality

The source and origin of goods and the nationality of suppliers of goods and services shall be the United States, except as A.I.D. may otherwise agree in writing.

b. Conditions Precedent to Disbursement

(1) Prior to the first disbursement or to the issuance of any commitment documents under the Project Agreement, the Cooperating Country shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) An Opinion of the Minister of Justice or of other counsel acceptable to AID that the Grant Project Agreement has been duly authorized and/or ratified by, and executed on behalf of, the Cooperating Country and that it constitutes a valid and legally binding obligation of the Cooperating Country in accordance with all its terms.

(b) A statement of the names of the persons authorized to represent the Cooperating Country and EEA, and a specimen signature of each person.

(c) An acceptable Contract for consulting engineering services for the Project with an organization acceptable to AID.

(d) Evidence that the proceeds of the Grant will be made available to EEA as a grant contribution to its equity capital.

(e) Evidence from the appropriate Cooperating Country entity that utilization of World Bank air quality guidelines as project criteria is acceptable to the Cooperating Country and will not constitute violation of Egyptian law.

(2) Prior to any disbursement or to the issuance of any commitment documents under the Project Agreement for any purpose other than to finance the services of the consulting engineer, the Cooperating Country shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) Evidence of firm commitments from U.S., international, and foreign lending institutions for provision of not less than seventy (70) percent of all foreign exchange funds required for the project, aside from those funds provided by the AID loan, on acceptable terms.

(b) Evidence that local currency financing for the Project has been budgeted by the Cooperating Country and will be available for expenditure by EEA through establishment of a special fund (to be replenished monthly) adequate to meet at least three months' expenditures on the Project, pursuant to a cost estimate made by the Consulting Engineer and approved by EEA.

(c) Evidence that satisfactory arrangements have been made by Governmental Agencies involved in the Project to carry out, operate, and maintain the Project as planned, including evidence of the ownership of availability of the plant site on Shoubrah El Kheima, or some other site acceptable to AID, for the purposes intended.

(d) Evidence that the Cooperating Country has taken all steps necessary to ensure that adequate supplies of fuel for the power plant to be built under this Project will be made available on a continuing and timely basis; and that the Cooperating Country shall provide for the building of additional fuel pipeline facilities as and when they become necessary for Project purposes.

(e) Evidence that the Project has been designed and shall be built and operated in a manner which shall ensure that ultimate sulphur dioxide concentration levels resulting from the Project do not exceed 1,000 ug/m^3 24-hour peak and 100 ug/m^3 annual average.

(f) Evidence that the Cooperating Country has formulated and is prepared to implement a firm plan, including but not limited to tariff increases, which will allow EEA to meet the required minimum rates of return of 5 percent in 1980, 6 percent in 1981, 8 percent in 1982 and 9 percent in 1983 and thereafter, and that such a plan will evidence that these rates of return shall not be achieved by increasing the fuel input subsidy.

c. Covenants

The Cooperating Country will be required to covenant as follows:

(1) The Cooperating Country and EEA shall cooperate fully with AID and other lenders/donors to assure that the purpose of the Project will be accomplished. To this end, the Cooperating Country shall from time to time, at the request of either party, exchange views through their representatives with regard to the progress of the Project, the performance by the EEA of its obligations under the Project Agreement, the performance of the consultants, contractors and suppliers engaged on the Project, and other matters relating to the Project.

(2) The EEA shall be required to provide qualified and experienced management for the Project, and shall train such staff as may be appropriate for the maintenance and operation of the Project.

(3) The Cooperating Country and AID agree to establish an evaluation program as part of the Project. Except as the Cooperating Country and AID otherwise agree in writing, the program will include, during the implementation of the Project and at one or more points thereafter: (i) evaluation of progress toward attainment of the objectives of the Project; (ii) identification and evaluation of problem areas or constraints which may inhibit such attainment; (iii) assessment of how such information may be used to help overcome such problems; and (iv) evaluation, to the degree feasible, of the overall development impact of the Project.

(4) Except as AID shall otherwise agree in writing:

(a) The Cooperating Country shall ensure that EEA will promptly take all such action as shall be required to provide in any fiscal year after 1982 an annual return on the average of the current net value of the fixed assets of EEA in service at the beginning and end of the fiscal year concerned at a rate of not less than nine percent (9%).

(b) In order to achieve the desired nine percent (9%) rate of return by 1983 and thereafter, the Cooperating Country shall ensure that EEA agrees to take prompt action, including but not limited to adjustment of tariffs, if necessary, as shall be required to achieve a minimum five percent (5%) rate of return in 1980, six percent (6%) in 1981, eight percent (8%) in 1982 and nine percent (9%) in 1983 and thereafter. The Cooperating Country further agrees that these rates of return shall not be achieved by increasing the fuel input subsidy. It is further agreed that any increase in fuel costs shall be immediately reflected by commensurate increase in tariff areas.

(c) The Cooperating Country shall assure adequate long-term financing for EEA's expansion program, which has been authorized and for modification and additions to such program. Within two years from the date of the Project Agreement, the financing so provided will be divided between equity contributions and loans in such a manner that after the completion of loan transactions the debt to equity ratio will be no greater than 1:5:1.

(5) The Cooperating Country shall hold periodic consultations with A.I.D. concerning fuel pricing as it relates to the power rate.

(6) The Cooperating Country shall provide evidence of a plan relating to the distribution of shares in the seven distribution companies of the EEA.

(7) The Cooperating Country shall ensure that EEA takes appropriate steps to implement modifications and improvements in its existing accounting system. Such improvements shall be based, at least in part, on recommendations of the consulting firm under contract to study EEA's accounting system.

(8) The Cooperating Country shall ensure that EEA prepares and submits to AID by November 1 of each year, a provisional forecast of operating revenues, operating expenses and rate of return for the next succeeding year, a statement of the tariffs and assumptions underlying the forecasts, an aging report of accounts receivable from major accounts, and a statement of the measures proposed, if any, to produce the annual return provided for above, and to furnish to AID all such detail as AID may reasonably request.

For the purpose of this covenant (8):

(a) The annual return specified above shall be calculated in respect of each fiscal year, by using as the denominator the average current net value of the fixed assets of EEA in service at the beginning and at the end of each such year, and as numerator the net operating income of EEA for the same year;

(b) the term "current net value of the fixed assets of the EEA in service" means the gross value of EEA's fixed assets in service less the amount of accumulated depreciation, both as valued from time to time in accordance with consistently applied appropriate methods of valuation or revaluation acceptable to AID; and

(c) the term "net operating income" means gross revenues from all sources less all operating expenditures, including expenses of administration, adequate maintenance and taxes or any payment in lieu of taxes and adequate maintenance provision for depreciation but excluding interest and other charges on debt.

d. Other Terms and Conditions

The Project Agreement will be subject to such other terms and conditions as A.I.D. shall deem appropriate.

Alexander Shakow
Acting Deputy Administrator

9/15/78
Date

ANNEX C

CERTIFICATION PURSUANT TO

SECTION 611(e) OF THE

FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

I, Donald S. Brown, the Director for the Agency for International Development in Egypt, having taken into account, among other things, the maintenance and utilization of projects in Egypt previously financed or assisted by the United States and technical assistance and training planned under this Project, do hereby certify that in my judgment Egypt has both the financial capability and human resources capability effectively to maintain and utilize the capital assistance to be provided for the engineering and construction of a 600 MW Thermal Power Plant at Shoubuah El Kheima in the city of Cairo, Egypt.

Donald S. Brown
Director

May 25, 1979
Date

CAIRO

SHOUBRAH 600 MW POWER PLANT - PROJECT NO. 263-0110

SC(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A.	**Procurement**	
1.	FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed?	Due to large single procurement contemplated, it is not deemed practical to make use of small business procedures.
2.	FAA Sec. 604(a). Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes.
3.	FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed?	Yes.
4.	FAA Sec. 604(e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?	There will be no such procurement.
5.	FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?	Consideration will be given to use of excess property when practical.
6.	FAA Sec. 603. (a) Compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.	Yes.
7.	FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities	Technical assistance will be on contract basis with U.S. private enterprise.

of other Federal agencies will be
they particularly suitable, not co
private enterprise, and made avail
undue interference with domestic p

8. International Air Transport. Fair Practices Act. 1974. If air trans persons or property is financed or will provision be made that U.S.-fl will be utilized to the extent suc available? — Yes.

9. FY 79 App. Act Sec. 105. Does the procurement contain a provision au termination of such contract for t of the United States? — Contract will so provide.

B. Construction

1. FAA Sec. 601(d). If a capital (e. project, are engineering and profe of U.S. firms and their affiliates the maximum extent consistent with interest? — Yes.

2. FAA Sec. 611(c). If contracts for are to be financed, will they be l tive basis to maximum extent pract — Yes.

3. FAA Sec. 620(k). If for construct enterprise, will aggregate value o be furnished by the U.S. not exce — Yes.

C. Other Restrictions

1. FAA Sec. 122(e). If development l rate at least 3% per annum during and at least 3% per annum thereaft — Not applicable.

2. FAA Sec. 301(d). If fund is estab by U.S. contributions and administ international organization, does C General have audit rights? — Not applicable.

3. FAA Sec. 620(h). Do arrangements or assisting the foreign aid progra of Communist-bloc countries, contr interests of the U.S.? — The Agreement shall so stipulate.

4. FAA Sec. 636(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S., or guaranty of such transaction? Yes.

5. Will arrangements preclude use of financing:

a. FAA Sec. 104(f). To pay for performance of abortions or to motivate or coerce persons to practice abortions, to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to undergo sterilization? Yes.

b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property? Yes.

c. FAA Sec. 660. To finance police training or other law enforcement assistance, except for narcotics programs? Yes.

d. FAA Sec. 662. For CIA activities? Yes.

e. FY 79 App. Act Sec. 104. To pay pensions, a for military personnel? Yes.

f. FY 79 App. Act Sec. 106. To pay U.N. assess Yes.

g. FY 79 App. Act Sec. 107. To carry out provi of FAA sections 209(d) and 251(h)? (Transfer o FAA funds to multilateral organizations for lar Yes.

h. FY 79 App. Act Sec. 112. To finance the e of nuclear equipment, fuel, or technology or to train foreign nations in nuclear fields? Yes.

i. FY 79 App. Act Sec. 601. To be used for p on propaganda purposes within U.S. not authoriz by Congress? Yes.

CAIRO

SHOUBRAH 600 MW POWER PLANT - PROJECT NO. 263-0110

[illegible] - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual fund sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Fund.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT

1. FY 79 Appn. Act Unnumbered; FAA Sec. 653(b); Sec. 634A. (a) Describe how committees on appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure)?

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $500,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

4. FAA Sec. 611(b); FY 79 Appn. Act Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?

6. FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.

(a) An "Advice of Program Change" will be transmitted to the appropriate committee of Congress. Obligations under this change will not be made prior to 15 days after date of delivery of this notification.

(b) The intended obligation is within the level of funds appropriated for Egypt for FY 1979.

2. (a) Yes.
(b) Yes.

3. Change in Egyptian law may be required to allow exception to application of existing GOE environmental standard. Project Agreement will require , as a condition precedent to disbursement of funds, evidence that utilization of World Bank air quality guidelines for project is acceptable to GOE and will not violate Egyptian law.

4. Not applicable.

5. yes.

6. This project is not susceptible of such execution.

7. FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

The project is intended to enhance Egypt's electricity generating capacity, enabling sale of adequate power to any and all industrial, commercial and domestic consumers. It will, therefore, directly affect (e) and indirectly affect (a) and (b).

8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

All goods and services to be procured under the Grant will be U.S. source and origin. U.S. private industry will also be eligible to compete with international firms for project goods and services being funded by the IBRD and other untied funds.

9. FAA Sec. 611(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.

The Agreement will so provide.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?

Yes, however, no local cost financing to be provided under this project.

11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?

Yes.

12. FY 79 App. Act Sec. 608. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?

Not applicable.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b); 111; 113; 281a. Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate

1. Development assistance project criteria not applicable.

technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers;

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research.

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development;

(4) [106] does technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

(i) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

(ii) to help alleviate energy problems;

(iii) research into, and evaluation of, economic development processes and techniques;

(iv) reconstruction after natural or manmade disaster;

(v) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(vi) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

c. [107] Is appropriate effort placed on use of appropriate technology?

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)?

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?

f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.

f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects.

b. FAA Sec. 122(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Project Criteria Solely for Economic Support Fund

a. FAA Sec. 531(a). Will this assistance support promote economic or political stability? To the extent possible, does it reflect the policy directions of section 102?
531(c).

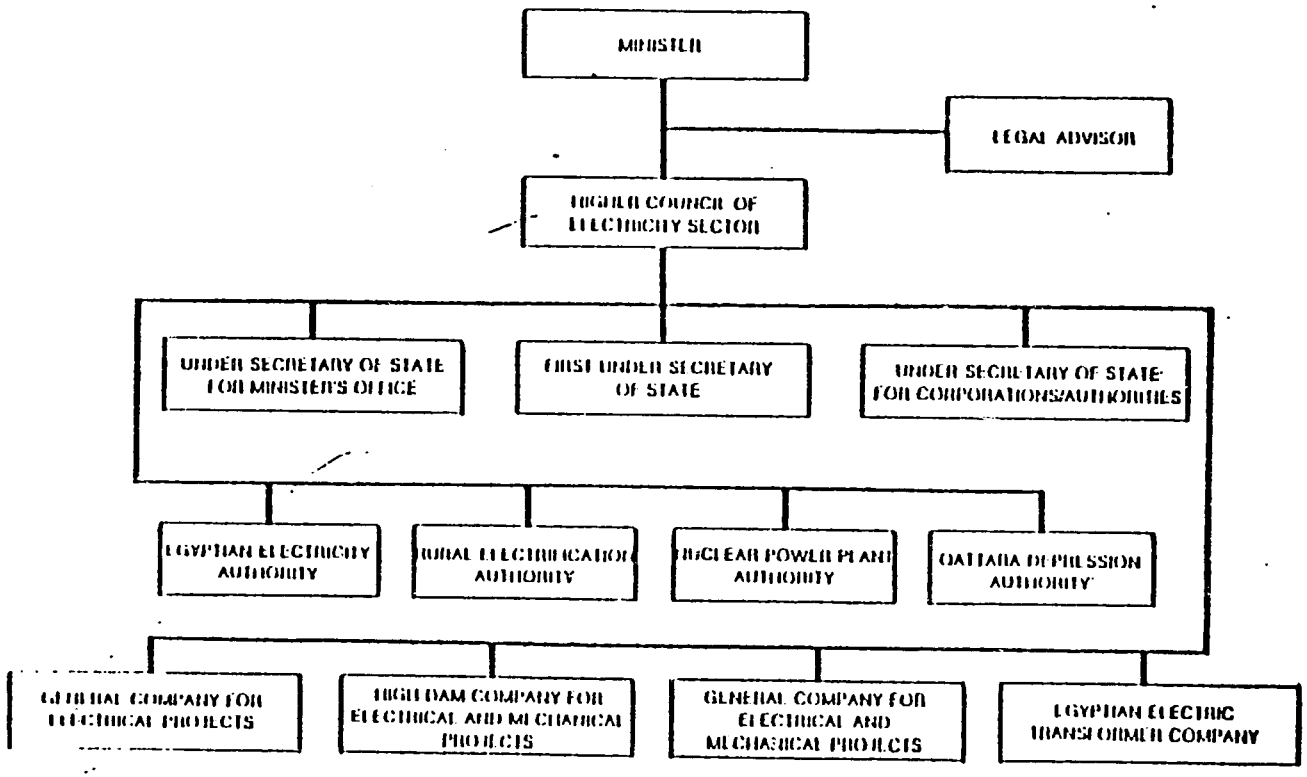
b. FAA Sec. 660. Will assistance under this chapter be used for military, or paramilitary activities?

Development Assistance project criteria (Loans only). Not applicable.

Investment in the power sector will enhance ability of GOE to sustain economic growth and recovery which in turn will have positive political results. Policy directions of section 102 reflected to extent that rural areas will be served.

No.

EGYPT
MINISTRY OF ELECTRICITY AND ENERGY
ORGANIZATION CHART

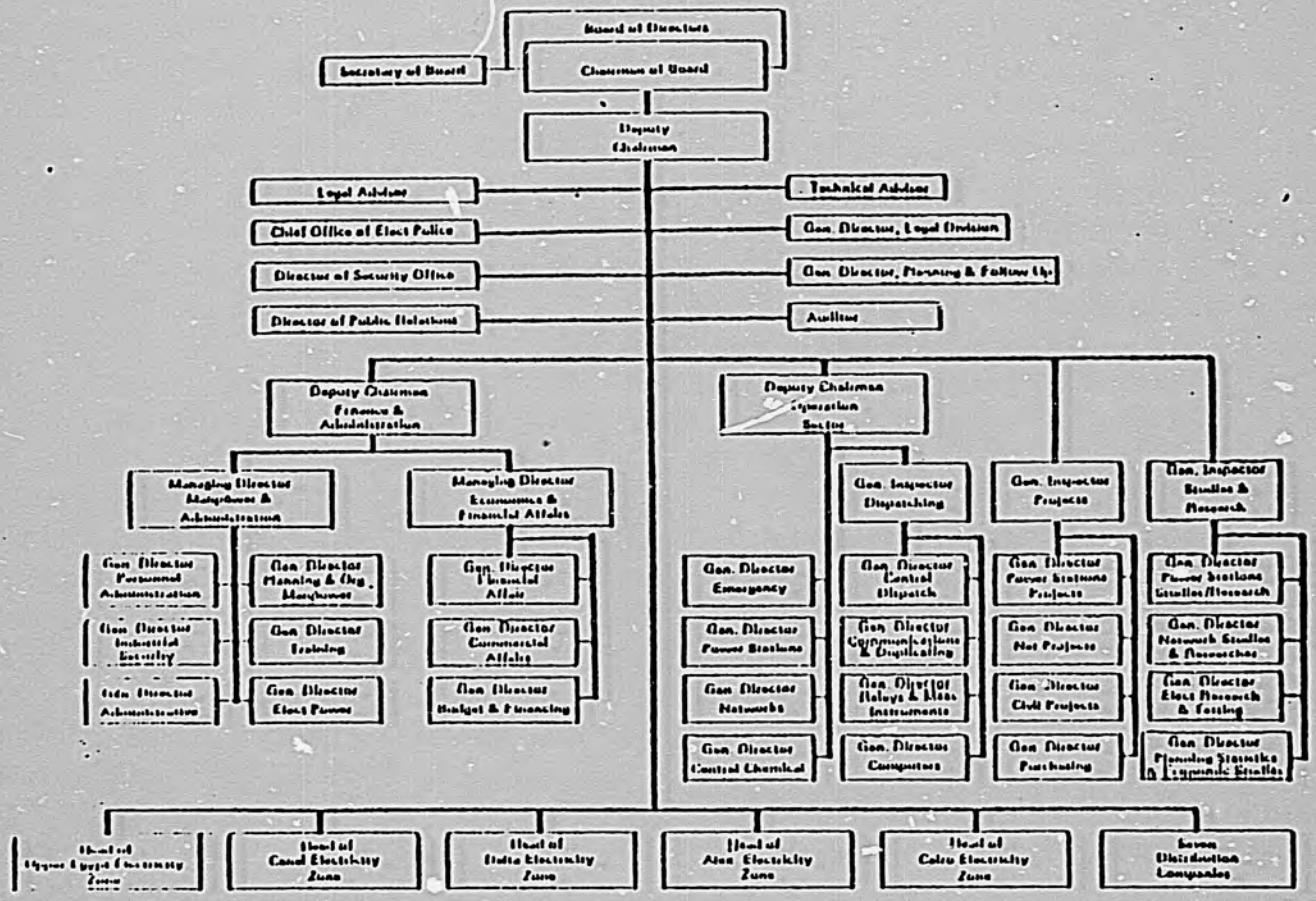


World Bank – 16802

ANNEX 1

BEST AVAILABLE COPY

EGYPT
EGYPTIAN ELECTRICITY AUTHORITY
ORGANIZATION CHART



March 1979

World Bank - 20021

GENERATING STATIONS IN SERVICE
1978 & 1983

Station	Number & Nominal Size of Units (MW)	Net Capability at End of Year (MW)	
		1978	1983
Steam			
Cairo West	3 x 87	165	261
Cairo South	4 x 60	150	240
Cairo North	2 x 30 + 1 x 20 + 2 x 10	64	36
El Tebbin	3 x 15	33	45
Talka	3 x 12.5 + 3 x 30	117	117
Demarhour	2 x 15 + 3 x 65	200	225
Karmouz	4 x 16	22	0
El Siouf	2 x 26.5 + 2 x 30	45	113
Assiut	3 x 30	78	90
Suez (old)	4 x 25	45	100
Kafr El Dawar	3 x 110	-	110
Cairo West	1 x 87	-	87
Abu Qir	4 x 150	-	600
Ismailia	2 x 150	-	300
Suez (new)	2 x 150	-	300
Total Steam		919	2884
Combustion Turbines			
El Max	2 x 14	22	22
Suez	1 x 17	17	17
Ismailia	1 x 22	22	22
Cairo North	1 x 22	22	22
Port Said	2 x 23	44	44
Fay Um	1 x 22	22	22
Helwan	——	120	120
Talkha	——	192	192
Tahrir Matamir	1 x 23	23	22
Heliopolis	3 x 12.5	37	37
Karmouz	2 x 12.5	25	25
El Tebbin	2 x 25	-	50
Cairo East	2 x 25	-	50
Total Combustion Turbines		546	645
Hydro			
High Dam (1)	12 x 175	1383	1581
Aswan Dam (2)	7 x 46 + 2 x 11.5	183	183
Total Hydro		1566	1764
Total System		3031	5253

Notes:

(1) Based on usable capability at time of system peak load considering water availability.

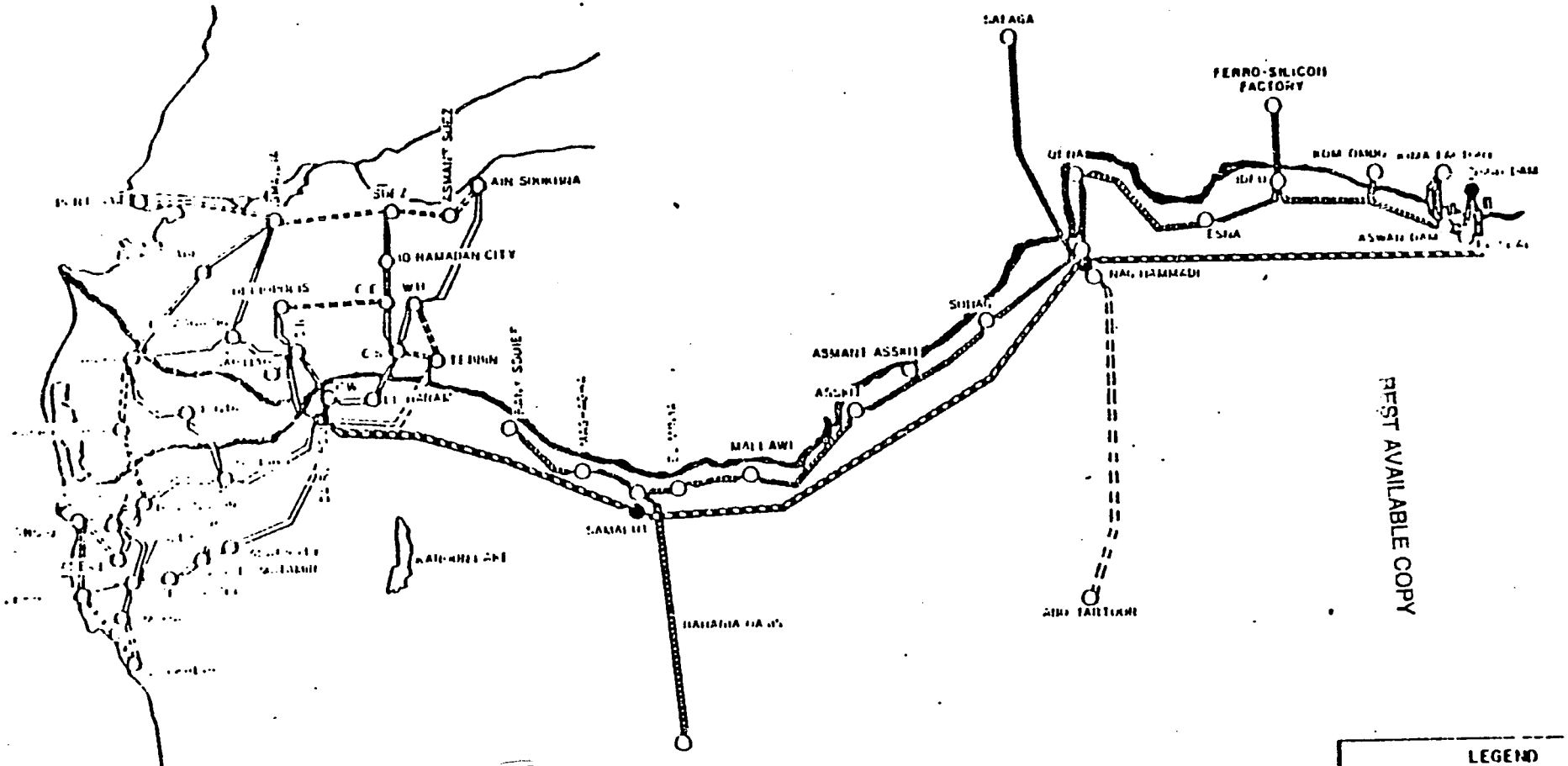
(2) Based on minimum water availability and requirement to regulate river flow.

RETIREMENT SCHEDULE

Year	Identification	Capability		
		No. of Units	Nominal MW/Unit	Total
1985	Cairo North	2	18	36
1986	Talkha	3	27	81
1988	Tebbin	3	15	45
1990	Damanhour	2	15	30
1991	Siouf	2	27	53
1995	Suez (old)	4	25	100
1995	Cairo South	4	60	240
1996	Max GT	2	14	24
1997	Talkha	3	12	36
1997	Assiut	3	30	90
1998	Cairo West	3	87	261
1998	Damanhour	3	65	195
1998	Suez GT	1	17	17
1998	GE Gas Turbines	6	22	132
1999	Siouf	2	30	60
1999	Helwan GT	5	24	120
1999	Talkha GT	8	24	192
1999	Swedish GT	5	12.5	69
1999	Alsthom GT	4	25	100
	Total	65		1872

GT: Gas Turbine

UNIFIED POWER SYSTEM
TRANSMISSION NETWORK
SYSTEM MAP

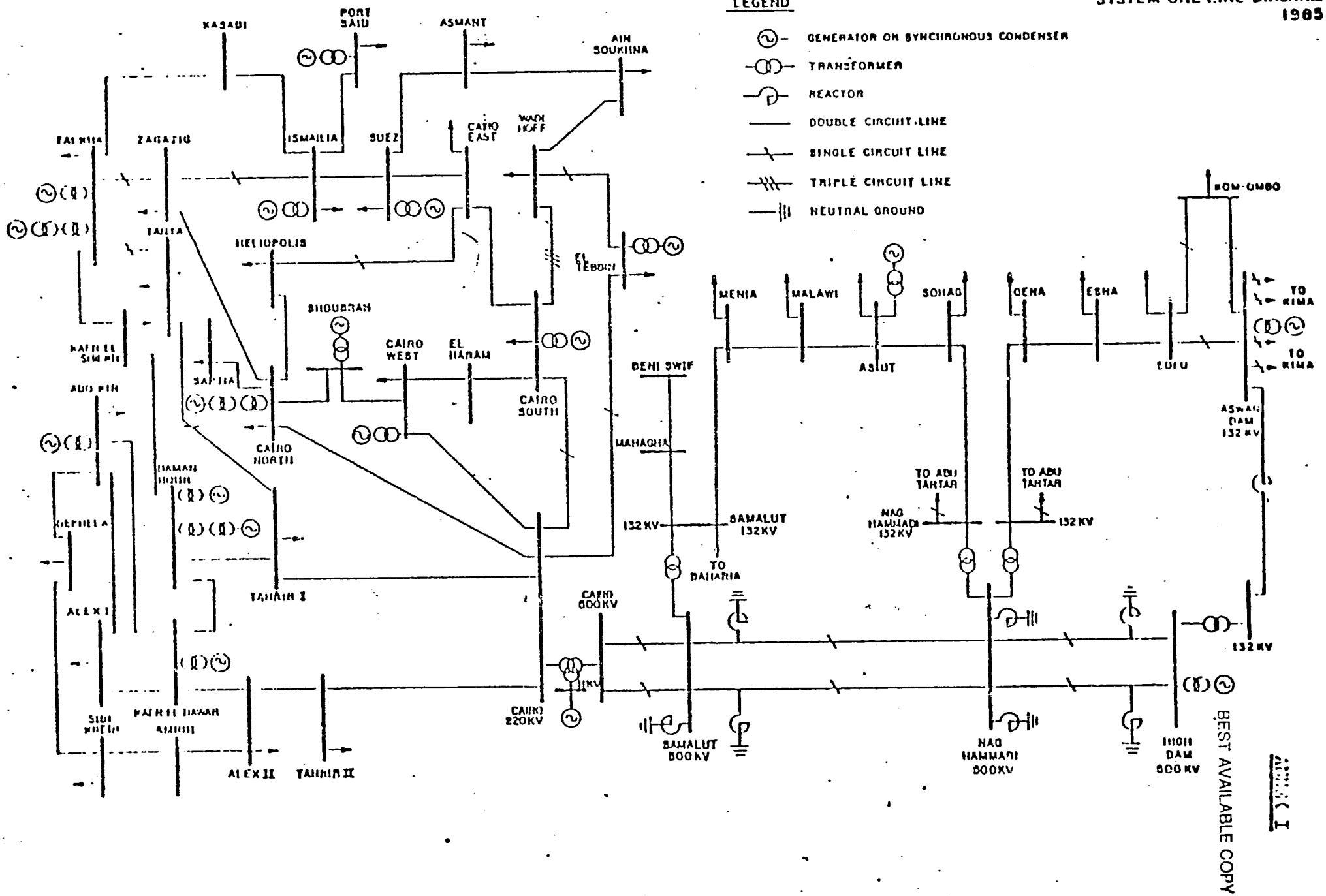


LEGEND	
500KV TRANSMISSION LINE	
220KV TRANSMISSION LINE	
132KV TRANSMISSION LINE	
500KV POWER STATION	●
220KV POWER STATION	O
132 KV POWER STATION	O
ESTABLISHED TRANSMISSION LINE	
PROPOSED TRANSMISSION LINE	

EGYPTIAN ELECTRICITY AUTHORITY

SYSTEM ONE LINE DIAGRAM

1985



ANNEX J

BEST AVAILABLE COPY

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

DAMANHUR EL ZOMOR THERMAL POWER PROJECT

Power Sector Statistical Data 1967-1977

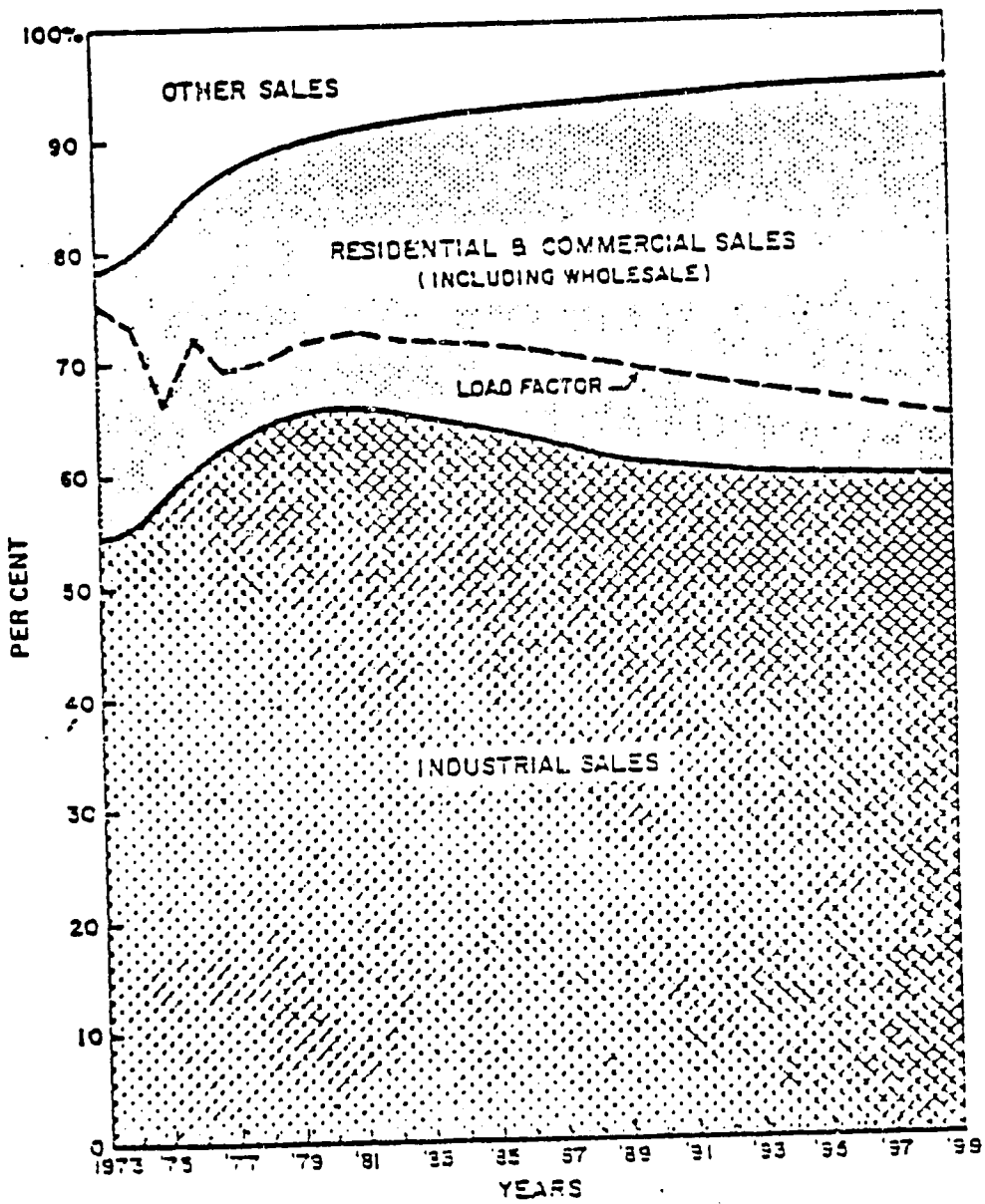
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Annual Average Growth Rate 1967-77 (%)
Sales, GWh	4,750	5,235	5,580	5,917	6,218	6,169	6,118	6,909	8,254	9,337	11,429	9.2
Increase, %		10.1	6.6	6.4	4.7	- 0.8	- 0.8	12.9	20.0	12.6	22.4	
System Generation, GWh												
Thermal	1,473	1,842	2,457	2,825	2,282	2,225	2,279	2,377	3,039	3,643	4,534	
% Total	68	50	38	32	31	30	31	28	31	31	33	
Hydro	1,363	3,002	3,980	4,690	5,041	5,159	5,158	6,122	6,790	8,003	9,037	
% Total	36	50	62	68	69	70	69	72	69	69	67	
Total	2,836	6,044	6,445	6,915	7,323	7,384	7,435	8,519	9,799	11,646	13,571	9.6
Increase, %		11.3	6.6	7.3	5.9	0.8	0.7	14.6	15.0	18.8	16.5	
Losses 1/, GWh	676	809	865	978	1,105	1,215	923	1,624	1,491	1,909	2,141	
%	12.4	13.4	13.4	14.1	15.1	16.5	16.9	19.1	15.2	17.0	15.8	
System Demand, MW	872	930	987	1,100	1,160	1,176	1,248	1,433	1,733	1,909	2,238	9.9
Increase, %		6.7	6.1	11.4	5.5	1.4	6.1	14.8	20.9	10.2	17.2	
System Load Factor, %	71.1	74.2	74.5	71.8	72.1	71.7	68.0	67.9	64.5	69.6	69.2	
Installed Capacity, MW												
Thermal	1,207	1,350	1,410	1,330	1,330	1,330	1,330	1,330	1,330	1,344	1,556	
% Total	50	44	38	35	35	35	35	35	35	35	39	
Hydro	1,221	1,730	2,333	2,445	2,445	2,445	2,445	2,445	2,445	2,445	2,445	
% Total	50	56	62	65	65	65	65	65	65	65	61	
Total	2,428	3,080	3,743	3,775	3,775	3,775	3,775	3,775	3,775	3,789	4,001	
Plant Factors, %												
Thermal	22.8	25.7	19.9	19.1	19.6	19.1	19.6	20.6	25.8	30.9	33.1	
Hydro	18.4	19.8	19.5	21.9	23.5	24.1	24.1	28.6	31.7	37.4	42.2	
Overall	25.5	22.4	19.7	20.9	22.1	22.3	22.5	25.8	29.6	35.1	38.7	

1/ Losses in transmission and distribution, plus station use.

March 1978

ANNEX K

PERCENTAGE OF
SALES BY
CLASSIFICATIONS



[illegible]
(Sheet 1 of 1)

ANNEX L

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Projected Sales to Large Industrial Customers - 1978-1985

Industrial Project	Location	Estimated Annual Load Factor %	Actual 1977 MW	1977 GWh	1978 MW	1978 GWh	1979 MW	1979 GWh	1980 MW	1980 GWh	1981 MW	1981 GWh	1982 MW	1982 GWh	1983 MW	1983 GWh	1984 MW	1984 GWh	1985 MW	1985 GWh
Steel Mill (3 sub-stations)	Helwan	70	90	977	90	990	125	790	140	890	180	1,100	199	1,220	199	1,220	199	1,220	199	1,220
Sponge Iron	Alexandria	35	-	-	-	-	-	-	-	-	-	-	30	224	60	447		447		447
Sponge Iron	Sadat City	35	-	-	-	-	-	-	-	-	20	140	40	298	40	298	40	298	40	298
Electric Steel	Alexandria	45	-	-	-	-	-	-	-	-	-	-	40	158	70	276	100	394	100	394
Electric Steel	Sadat City	45	-	-	-	-	-	-	-	-	-	-	-	-	90	197	290	956	300	1,183
Fertilizer-Kima	Aswan	90	215	1,587	290	1,750	290	1,752	290	1,752	290	1,752	290	1,752	290	1,752	290	1,752	290	1,752
Ferro-Silicon	Edfu	80	-	-	-	-	-	-	50	350	85	600	120	841	120	841	120	841	120	841
Iron	Alexandria	90	-	-	-	-	15	109	15	109	15	109	15	109	15	109	15	109	15	109
Caustic Soda	Alexandria	75	-	-	-	-	20	131	20	131	20	131	20	131	20	131	20	131	20	131
H_2SO_4 and Iron	Talkha	90	35	276	75	389	60	420	75	527	75	526	75	526	75	526	75	526	75	526
Phosphate Mining	Esna	70	-	-	10	61	10	61	10	61	10	61	10	61	10	61	10	61	10	61
Phosphate Mining	Abu Tartur	90	-	-	-	-	-	-	-	-	-	-	80	631	80	631	80	631	80	631
Aluminum Smelter	Nag Hammadi	95	210	1,730	220	1,831	300	2,497	370	3,088	400	3,329	400	3,329	400	3,329	400	3,329	400	3,329
Petroleum Refinery	Alexandria	85	-	-	-	-	20	149	20	149	20	149	20	149	20	149	20	149	20	149
Petroleum Refinery	Alexandria	85	-	-	-	-	-	-	20	149	30	223	30	223	30	223	30	223	30	223
Sumed Pipeline	Suez	80	40	190	130	894	150	894	190	994	190	1,051	190	1,051	190	1,051	190	1,051	190	1,051
Cement	Helwan	80	-	-	-	-	35	245	40	281	40	280	40	280	40	280	40	280	40	280
Cement	Assiut	80	-	-	-	-	35	245	35	246	35	245	35	245	35	245	35	245	35	245
Cement	Suez	90	-	-	-	-	-	-	50	351	50	350	50	350	50	350	50	350	50	350
Beneficiation of Iron		85	-	-	-	-	-	-	-	-	-	-	-	-	35	260	35	260	35	260
Nitrates	[illegible]	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	140
Polyester Fibre	Kafr-El-Dawar	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	233
Sugar	Gerga	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	37	10	37
Weaving	Various	70	-	-	-	-	-	-	13	80	13	80	13	80	13	80	13	80	13	80
Seamless Steel Pipe	Various	70	-	-	-	-	-	-	-	-	-	-	-	-	12	77	12	77	12	77
Cold Storage Projects	Various	45	-	-	-	-	-	-	-	-	12	48	12	48	12	48	12	48	12	48
Bone Print	Various	50	-	-	-	-	-	-	-	-	-	-	-	-	10	43	10	43	10	43
Edible Oil Refinery	Various	50	-	-	-	-	-	-	10	42	10	42	10	42	10	42	10	42	10	42
Passenger Cars	Various	60	-	-	-	-	7	35	7	35	7	35	7	35	7	35	7	35	[illegible]	35
Electro Tinning of Steel Strip	El Tebbin	70	-	-	-	-	-	-	-	-	6	37	6	37	6	37	6	37	6	37
Steel Mill	Alexandria	70	-	-	-	-	-	-	-	-	-	-	-	-	9	27	9	27	9	27
Writing Paper	Edfu	80	-	-	-	-	-	-	-	-	-	-	3	21	3	21	3	21	3	21
Sugar	Kafr-El-Dawar	45	-	-	-	-	-	-	-	-	-	-	3	10	3	10	3	10	3	10
Farm Tractors		50	-	-	-	-	-	-	3	13	3	13	3	13	3	13	3	13	3	13
Trucks and Buses		50	-	-	-	-	3	13	3	13	3	13	3	13	3	13	3	13	3	13
Sponge Iron		35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	595	50	597
New Projects ** 1983			-	-	-	-	-	-	-	-	-	-	-	-	-	902	-	902	-	902
1984			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]	-	[illegible]
1985			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[illegible]
Increase			-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]
TOTAL			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	-	[illegible]
60% Realization of Forecast Increase				[illegible]		[illegible]*		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]

* 60% realization of increase above forecast made in mid-year.
** New Projects to match growth rate of total industrial sales 7.5% p.a.

March 1978

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

EHOURRAH EL KHEIMA THERMAL POWER PROJECT

Actual and Forecast Sales by Consumer Categories, 1978-1999
(GWh)

	Actual					Growth Rate 1973-77 % p.a.	Forecast																	
	1973	1974	1975	1976	1977		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Industrial - General	2,069	2,161	2,331	2,901	2,991	9.6	3,272	3,611	3,936	4,332	4,747	5,208	5,727	6,289	6,912	7,221	7,763	8,151	8,973	9,425	10,271	10,995	11,874	12,824
Industrial - Large Consumers	1,490	1,666	2,491	3,331	4,170	34.4	5,180	6,274	7,367	8,105	9,017	9,896	10,896	11,965	12,755	13,711	14,760	15,864	17,014	18,214	19,502	20,867	22,328	23,890
Total Industrial	3,559	3,827	4,822	5,632	7,161	20.9	8,452	9,885	11,303	12,437	13,764	15,104	16,623	18,114	19,667	20,932	22,503	24,015	25,986	27,639	29,773	31,862	34,202	36,714
% Total Sales	54.1	55.0	58.2	61.3	62.7		64.0	65.3	66.0	65.7	65.4	65.0	64.6	64.0	63.3	62.7	61.9	61.2	60.6	60.2	60.1	59.9	59.7	59.5
Residential/Commercial 1/	1,550	1,681	1,976	2,305	2,796	17.2	3,188	3,638	4,149	4,733	5,397	6,177	7,020	8,006	8,980	10,069	11,247	12,671	14,241	15,948	16,667	18,019	19,540	21,206
% Total Sales	23.9	24.4	23.8	24.7	24.4		24.2	24.1	24.2	25.0	25.7	26.5	27.4	28.2	29.2	30.1	31.0	32.0	33.0	33.7	33.5	33.8	34.1	34.4
Irrigation/Agriculture	635	690	666	620	660	1.4	700	700	700	735	772	810	851	893	938	985	1,034	1,086	1,140	1,197	1,257	1,320	1,386	1,455
% Total Sales	11.1	9.9	8.0	6.6	5.8		5.3	4.6	4.1	3.9	3.7	3.5	3.3	3.2	3.1	2.9	2.9	2.7	2.6	2.6	2.5	2.4	2.4	2.3
General Purpose 2/	499	548	586	542	534	3.8	555	576	599	622	646	672	698	725	750	777	804	832	861	892	924	956	989	1,024
% Total Sales	7.8	7.8	7.1	5.8	4.7		4.2	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.3	2.2	2.1	2.0	1.9	1.9	1.8	1.7	1.6
Government Utilities	241	251	244	258	278	8.2	305	333	365	400	439	478	524	573	618	668	720	776	840	905	973	1,047	1,126	1,211
% Total Sales	3.8	3.8	2.9	2.6	2.4		2.3	2.2	2.2	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL SALES	6,118	6,997	8,294	9,317	11,429	16.9	13,200	15,132	17,116	18,927	21,018	23,241	25,696	28,311	30,751	33,431	36,358	39,563	43,090	46,220	49,571	53,195	57,071	61,311
Losses 3/	963	1,219	982	1,749	1,261		2,329	2,566	2,786	2,954	3,141	3,320	3,499	3,861	4,194	4,557	4,958	5,395	5,870	6,303	6,755	7,254	7,781	8,358
ENERGY REQUIREMENT	7,081	8,178	9,276	11,066	12,690	16.4	15,529	17,698	19,902	21,881	24,159	26,561	29,155	32,172	34,947	37,990	41,316	44,958	48,960	52,523	56,331	60,449	64,852	69,669
Losses, %	13.1	15.0	10.6	15.8	9.9		15.0	14.5	14.0	13.5	13.0	12.5	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Load Factor, %	71.3	69.9	62.6	68.9	64.7		70.0	71.4	72.1	72.7	72.5	71.9	71.6	71.3	71.0	70.5	70.0	69.4	69.0	68.5	68.0	67.5	67.0	66.5
MAXIMUM DEMAND, MW	1,128	1,348	1,691	1,837	2,238	18.7	2,537	2,830	3,151	3,438	3,804	4,217	4,648	5,151	5,619	6,151	6,738	7,384	8,043	8,743	9,457	10,243	11,092	11,995

	Forecast																							
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Industrial - General	13,840	14,945	16,141	17,432	18,827	20,333	21,960	23,717	25,614	27,663	29,876	32,266	34,847	37,635	40,646	43,898	47,410	51,203	55,299	59,723	64,501	69,661	75,234	81,253
Industrial - Large Consumers	25,581	27,396	29,338	31,417	33,643	36,028	38,583	41,321	44,254	47,396	50,761	54,364	58,220	62,346	66,758	71,476	76,520	81,911	87,675	93,838	100,430	107,481	115,025	123,096
Total Industrial	39,421	42,341	45,479	48,849	52,470	56,361	60,543	65,038	69,868	75,059	80,637	86,630	93,067	99,981	107,404	115,374	123,930	133,114	142,974	153,561	164,931	177,142	190,259	204,349
% Total Sales	59.3	59.1	59.0	58.9	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8
Residential/Commercial 1/	22,941	24,844	26,900	29,120	31,516	34,102	36,894	39,907	43,158	46,665	50,447	54,525	58,921	63,660	68,767	74,271	80,201	86,589	93,469	100,879	108,857	117,446	126,689	136,635
% Total Sales	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5	34.5
Irrigation/Agriculture	1,528	1,605	1,685	1,769	1,858	1,951	2,049	2,151	2,259	2,372	2,491	2,615	2,746	2,883	3,027	3,178	3,337	3,504	3,679	3,863	4,056	4,259	4,472	4,696
% Total Sales	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
General Purpose 2/	1,075	1,129	1,185	1,245	1,307	1,373	1,442	1,514	1,590	1,670	1,753	1,841	1,933	2,030	2,131	2,237	2,349	2,466	2,589	2,719	2,855	2,998	3,148	3,305
% Total Sales	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Government Utilities	1,302	1,400	1,505	1,618	1,740	1,871	2,012	2,163	2,326	2,501	2,689	2,892	3,110	3,344	3,596	3,866	4,157	4,470	4,807	5,170	5,560	5,979	6,430	6,914
% Total Sales	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL SALES	66,267	71,319	76,754	82,601	88,891	95,658	102,940	110,773	119,201	128,267	138,017	148,503	159,777	171,898	184,925	198,924	213,974	230,143	247,518	266,192	286,259	307,824	331,000	355,899
Losses 3/	8,958	9,594	10,274	11,000	11,776	12,606	13,494	14,444	15,461	16,549	17,714	18,962	20,298	21,729	23,262	24,904	26,664	28,550	30,572	32,740	35,067	37,564	40,245	43,123
ENERGY REQUIREMENT	75,225	80,913	87,028	93,601	100,667	108,264	116,434	125,217	134,662	144,816	155,731	167,465	180,075	193,627	208,187	223,828	240,638	258,693	278,090	298,932	321,326	345,388	371,245	399,022
Losses, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Load Factor, %	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5	66.5
MAXIMUM DEMAND, MW	12,955	13,937	14,990	16,121	17,338	18,647	20,054	21,569	23,200	24,956	26,844	28,875	31,059	33,408	35,936	38,657	41,587	44,743	48,142	51,805	55,753	60,008	64,594	69,538

1/ Includes sales to municipalities.
2/ Includes street lighting, transportation and sewage treatment.
3/ Losses in transmission and distribution.

June 1979

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EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Load Forecasts

Year	Main Forecast		Low Forecast		High Forecast	
	MW	Gwh	MW	Gwh	MW	Gwh
1978	2,532	15,529	2,500	15,331	2,565	15,727
1979	2,830	17,698	2,763	17,283	2,896	18,113
1980	3,151	19,902	3,051	19,267	3,252	20,537
1981	3,438	21,881	3,305	21,048	3,567	22,714
1982	3,804	24,159	3,637	23,098	3,971	25,220
1983	4,217	26,561	4,011	25,260	4,424	27,862
1984	4,648	29,155	4,400	27,595	4,897	30,715
1985	5,151	32,172	4,853	30,310	5,449	34,034
1986	5,619	34,947	5,275	32,808	5,963	37,087
1987	6,151	37,990	5,756	35,547	6,547	40,434
1988	6,738	41,316	6,285	38,540	7,191	44,093
1989	7,384	44,956	6,868	41,816	7,900	48,097
1990	8,093	48,920	7,508	45,384	8,694	52,547
1991	8,753	52,523	8,104	48,627	9,417	56,510
1992	9,457	56,333	8,739	52,056	10,190	60,701
1993	10,223	60,449	9,430	55,760	11,031	65,229
1994	11,050	64,853	10,176	59,724	11,939	70,073
1995	11,945	69,582	10,983	63,980	12,922	75,275
1996	12,916	74,678	11,859	68,566	13,989	80,881
1997	13,967	80,139	12,806	73,481	15,143	86,888
1998	15,103	85,977	13,828	78,735	16,387	93,310
1999	16,333	92,287	14,940	84,414	17,743	100,251

MW figures - maximum demand

Gwh figures - net generation

March 1979

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EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

EEA's Available Generating Capacity, 1978-1986

(MW)

Name of Station	Number and Nominal Capacity of Units	Maximum Net Capability of MW Assuming All Units in Service								
		1978	1979	1980	1981	1982	1983	1984	1985	1986
Steam										
Cairo West	3 x 87	165	165	197	229	240	261	261	261	261
Cairo South	4 x 60	150	170	200	220	220	240	240	240	240
Cairo North	2 x 30 + 1 x 20 + 2 x 10	64	64	64	64	50	36	36	-	-
El Tebbin	3 x 15	33	30	30	30	30	45	45	45	45
Talkha	3 x 12.5 + 3 x 30	117	100	100	100	100	117	117	117	36
Damanhour	2 x 15 + 3 x 65	200	200	200	200	200	225	225	225	225
El Seyout	2 x 26.5 + 2 x 30	45	45	45	45	70	113	113	113	113
Karmouz	4 x 16	22	22	22	-	-	-	-	-	-
Asslut	3 x 30	78	78	78	78	78	90	90	90	90
Suez (Old)	4 x 25	45	80	80	80	80	100	100	100	100
Kait El Bawar	3 x 110	-	110	220	220	330	330	330	330	330
Cairo West	1 x 87	-	87	87	87	87	87	87	87	87
Abu Qir	4 x 150	-	-	300	600	600	600	600	600	600
Ismailia	2 x 150	-	-	-	-	-	300	300	300	300
Suez (New)	2 x 150	-	-	-	-	300	300	300	300	300
Shoubra El-Kheima	3 x 300	-	-	-	-	-	-	300	900	900
600 MW Thermal (1986)		-	-	-	-	-	-	-	-	600
		-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-
Total Steam		919	1,151	1,623	1,953	2,385	2,844	3,144	3,708	4,227
Combustion Turbines										
El Max	2 x 14	22	22	22	22	22	22	22	22	22
Suez	1 x 17	17	17	17	17	17	17	17	17	17
Ismailia	1 x 22	22	22	22	22	22	22	22	22	22
Cairo North	1 x 22	22	22	22	22	22	22	22	22	22
Port Said	2 x 23	46	46	46	46	46	46	46	46	46
Fayum	1 x 22	22	22	22	22	22	22	22	22	22
Helwan	Total of 120 MW	-	120	120	120	120	120	120	120	120
Talkha	Total of 192 MW	-	192	192	192	192	192	192	192	192
Tahrir Matamon	1 x 23	23	22	22	22	22	22	22	22	22
Heliopolis	3 x 12.5	37	37	37	37	37	37	37	37	37
Karmouz	2 x 12.5	25	25	25	25	25	25	25	25	25
El Tebbin	2 x 25	-	50	50	50	50	50	50	50	50
Cairo East	2 x 25	-	50	50	50	50	50	50	50	50
Total Combustion Turbines		236	647	647	647	647	647	647	647	647
Hydro										
High Dam		1,383	1,423	1,462	1,502	1,541	1,581	1,626	1,676	1,726
Aswan (See Note)		183	183	183	183	183	183	183	183	183
Esna		-	-	-	-	-	-	-	-	47
Nag Hammadi		-	-	-	-	-	-	-	-	-
Asslut		-	-	-	-	-	-	-	-	-
Pumped Storage		-	-	-	-	-	-	-	-	-
Total Hydro		1,566	1,606	1,645	1,685	1,724	1,764	1,809	1,859	1,956
Total System Capability		2,721	3,404	3,915	4,285	4,756	5,255	5,600	6,214	6,830
Peak Load		2,532	2,830	3,151	3,435	3,804	4,217	4,648	5,151	5,619
Reserve										
MW		189	574	764	850	952	1,038	952	1,063	1,211
Percent of Load		7.5	20.3	24.3	24.8	25.0	24.6	20.5	20.6	21.6

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ANNEX O

ANNEX P

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EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

EEA'S Available Net Generation, 1978-1986
(GWh)

Name of Station	Number and Nominal Capacity (MW) of Units	1978	1979	1980	1981	1982	1983	1984	1985	1986
Steam 1/										
Cairo West	3 x 87	1,115	1,115	1,379	1,603	1,680	1,827	1,827	1,827	1,827
Cairo South	4 x 60	1,050	1,190	1,400	1,540	1,540	1,680	1,680	1,680	1,680
Cairo North	2 x 30 + 1 x 20 + 2 x 10	448	448	448	448	350	252	252	-	-
El Tebbin	3 x 15	231	210	210	210	210	315	315	315	315
Talkha	3 x 12.5 + 3 x 30	819	700	700	700	700	819	819	819	819
Damanhour	2 x 15 + 3 x 65	1,400	1,400	1,400	1,400	1,400	1,575	1,575	1,575	1,575
El Seyouf	2 x 26.3 + 2 x 30	315	315	315	315	490	791	791	791	791
Karmouz	4 x 16	154	154	154	-	-	-	-	-	-
Assiut	3 x 30	544	544	544	544	544	630	630	630	630
Suez (old)	4 x 25	315	560	560	560	560	700	700	700	700
Kafr El Dawar	3 x 110	-	770	1,540	1,540	2,310	2,310	2,310	2,310	2,310
Cairo West	1 x 87	-	609	609	609	609	609	609	609	609
Abu Qir	4 x 150	-	-	2,100	4,200	4,200	4,200	4,200	4,200	4,200
Ismailia	2 x 150	-	-	-	-	-	-	2,100	2,100	2,100
Suez (new)	2 x 150	-	-	-	-	-	2,100	2,100	2,100	2,100
Shoubra El-Kheima	3 x 300	-	-	-	-	-	-	-	3,150	6,300
600 MW Thermal (1986)		-	-	-	-	-	-	-	-	-
Total Steam		6,393	8,017	11,361	13,671	14,595	17,808	19,908	22,806	25,357
Combustion Turbines 2/										
El Max	2 x 14	68	68	68	68	68	68	68	68	68
Suez	1 x 17	68	68	68	68	68	68	68	68	68
Ismailia	1 x 22	88	88	88	88	88	88	88	88	88
Cairo North	1 x 22	88	88	88	88	88	88	88	88	88
Port Said	2 x 23	184	184	184	184	184	184	184	184	184
Fayoum	1 x 22	88	88	88	88	88	88	88	88	88
Helwan	Total of 120 MW	-	480	480	480	480	480	480	480	480
Talkha	Total of 192 MW	-	768	768	768	768	768	768	768	768
Taheria Matamma	1 x 23	92	92	92	92	92	92	92	92	92
Heliopolis	3 x 12.5	150	150	150	150	150	150	150	150	150
Karmouz	2 x 12.5	100	100	100	100	100	100	100	100	100
El Tebbin	2 x 25	-	200	200	200	200	200	200	200	200
Cairo East	2 x 25	-	200	200	200	200	200	200	200	200
Total Combustion Turbines		946	2,594	2,594	2,594	2,594	2,594	2,594	2,594	2,594
Hydro Stations 3/										
Aswan Dam	7 x 46 + 2 x 11.5	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
High Dam	12 x 175	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200
Aswan Expansion	Total 160 MW	-	-	-	-	-	-	-	-	516
Esna	Total 89 MW	-	-	-	-	-	-	-	-	-
Nag Hammadi	Total 53 MW	-	-	-	-	-	-	-	-	-
Assiut	Total 48 MW	-	-	-	-	-	-	-	-	-
Total Hydro		9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,516
Total Available		16,339	19,611	22,955	25,265	26,189	29,402	31,502	34,400	37,467
Required Generation		15,529	17,698	19,902	21,881	24,159	26,561	29,155	32,172	34,[illegible]
Margin (Deficit)		810	1,913	3,053	3,384	2,030	2,841	2,347	2,228	2,[illegible]
As % of Required Generation		5.2%	10.8%	15.3%	15.5%	8.4%	10.7%	8.1%	6.9%	7.[illegible]%

1/ Based on 7,000 hour average yearly operation. Increases reflect plant rehabilitations. Reductions reflect scheduled retirement of old plant.
2/ Based on 4,000 hours average yearly operation.
3/ Based on expected annual water releases for irrigation needs.

SOURCE: EEA & 900-MW Shoubrah El Kheima Feasibility Study, Phase II Report, Sanderson & Porter, Inc., January 1979.

June 1979

ANNEX Q

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SECOUBAH EL KHEIMA THERMAL POWER PROJECT

Description of WASP Program

The Wien Automatic System Planning Package (WASP) consists of six int related computer code modules developed to meet the needs of the international Atomic Agency's Market Survey for Nuclear Power in Developing Countries. It is designed to find the economically optimized generation expansion programs for a electric power system within user specified constraints.

The economic criterion used for optimization is the present worth of the total cost stream for the period simulated, in this study the period from 1978 through 1999. This cost stream includes a salvage value credit for the remaining life of plants still in service at the end of the study period.

WASP uses a probabilistic estimation of reliability and production c and the dynamic programming method of optimization. System load data are pro in the form of system peak and mathematical representation of the load duratio for up to 12 periods per year.

Capital costs are inputted in the form of total cost of the time the plant is commissioned, including interest during construction. The program t deducts the interest during construction and spreads the remaining constructi costs over the construction period in accordance with a predetermined schedul of expenditures.

Using the probabilistic reliability computations and the inputted reliability requirement, expansion programs using all combinations of availabl alternative generator installations are determined within the constraint of specified maximum and minimum reliability. Each expansion program is then co using the probabilistic production cost program and the capital cost procedur and the total cash flow stream determined. This cost stream is converted to present worth using an inputted discount rate and the expansion programs are optimized by a dynamic programming technique and ranked in the order of least present worth of the total cost stream. Data for a specified number of exp programs are then outputted in accordance with that ranking.

The program can also be used to determine the present worth of the annual cost stream, using the same computation of procedure except omitting t selection of alternative expansion programs, by suitable input controls.

March 1979

ANNEX R

EGYPT

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SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Comparison of Sites

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	1979	1980	1981	1982	1983	1984	1985	1986	1987-2015	Total Capital Cost
1. SHOUBRAH EL KHEIMA										
Capital Costs										
Demolition/Clearance	-	1,606	1,370	1,800	771	471	649	-	-	6,067
Access Road	-	214	-	-	-	-	-	-	-	214
Fuel Delivery	-	-	-	357	2,857	2,300	-	-	-	5,714
Power Transmission	-	-	651	1,334	2,360	651	1,137	-	-	6,133
Subtotal	-	1,820	2,021	4,891	5,988	3,422	1,786	-	-	20,128
Remainder of Plant	941	9,834	32,111	88,225	75,196	40,192	39,290	12,118	-	297,867
Total Capital Costs	941	11,654	34,132	93,116	81,184	43,774	41,076	12,118	-	317,995
Operating Maintenance Costs										
Fuel	-	-	-	-	-	-	50,085	100,170	100,170	
Generation O & M	-	-	-	-	-	-	5,850	11,700	11,700	
Transmission O & M	-	-	-	-	-	-	105	122	122	
Transmission Losses	-	-	-	-	-	-	5,409	10,818	10,818	
Total O & M Costs	-	-	-	-	-	-	61,449	122,810	122,810	
TOTAL COSTS	941	11,654	34,132	93,116	81,184	43,774	102,525	134,928	122,810	
2. SUEZ										
Capital Costs										
Circulating Water	-	-	-	-	964	-	107	-	-	1,071
C.W. Intake and Discharge	-	-	-	1,428	707	-	214	-	-	2,349
Make-up and Potable Water	-	-	-	-	1,735	-	192	-	-	1,927
Soils and Foundations	-	-	385	-	-	-	42	-	-	427
Power Transmission	-	-	921	4,680	2,691	-	921	-	-	9,213
Construction Labor Premium	-	642	1,414	1,800	1,157	707	707	-	-	6,427
Construction Labor Housing	-	357	714	-	-	-	-	-	-	1,071
Operator Housing	-	-	-	-	214	3,214	3,000	-	-	6,428
Subtotal	-	999	3,434	7,908	7,468	3,921	5,183	-	-	28,913
Remainder of Plant	941	9,834	32,111	88,225	75,196	40,152	39,290	12,118	-	297,867
Total Capital Costs	941	10,833	35,545	96,133	82,664	44,073	44,473	12,118	-	326,780
Operating and Maintenance Costs										
Fuel	-	-	-	-	-	-	48,825	97,650	97,650	
Generation O & M	-	-	-	-	-	-	5,850	11,700	11,700	
Transmission O & M	-	-	-	-	-	-	124	138	138	
Transmission Losses	-	-	-	-	-	-	7,211	14,422	14,422	
Operating Labor Premium	-	-	-	-	-	-	193	193	193	
Fuel for Desalination	-	-	-	-	-	-	297	297	297	
Chemicals for Desalination	-	-	-	-	-	-	25	25	25	
Total O & M Costs	-	-	-	-	-	-	62,485	124,385	124,385	
TOTAL COSTS	941	10,833	35,545	96,133	82,664	44,073	106,958	136,503	124,385	
3. AIN SOUKHNA										
Capital Costs										
Access Road	714	1,428	-	-	-	-	-	-	-	2,142
Circulating Water	-	-	-	-	964	-	107	-	-	1,071
C.W. Intake and Discharge	-	-	-	1,428	500	-	214	-	-	2,142
Make-up and Potable Water	-	-	-	-	2,121	-	235	-	-	2,356
Fuel Delivery	-	-	-	89	714	625	-	-	-	1,428
Soils and Foundations	-	-	385	-	-	-	42	-	-	427
Power Transmission	-	-	728	3,856	2,720	535	728	-	-	8,567
Construction Labor Premium	-	857	1,885	2,400	1,542	942	942	-	-	8,568
Construction Labor Housing	-	714	1,428	-	-	-	-	-	-	2,142
Operating Labor Housing	-	-	-	-	357	1,357	5,000	-	-	10,714
Subtotal	714	2,999	4,426	7,773	8,918	7,499	7,268	-	-	39,597
Remainder of Plant	941	9,834	32,111	88,225	75,196	40,192	39,290	12,118	-	297,867
Total Capital Costs	1,655	12,833	36,537	95,998	84,114	47,611	46,558	12,118	-	337,464
Operating and Maintenance Costs										
Fuel	-	-	-	-	-	-	40,140	98,280	98,280	
Generation O & M	-	-	-	-	-	-	5,850	11,700	11,700	
Transmission O & M	-	-	-	-	-	-	118	129	129	
Transmission Losses	-	-	-	-	-	-	7,115	14,231	14,231	
Operating Labor Premium	-	-	-	-	-	-	643	643	643	
Fuel for Desalination	-	-	-	-	-	-	321	321	321	
Chemicals for Desalination	-	-	-	-	-	-	12	12	12	
Total O & M Costs	-	-	-	-	-	-	63,219	125,336	125,336	
TOTAL COSTS	1,655	12,833	36,537	95,998	84,114	47,611	109,777	137,454	125,336	

Present Worths at 1/1/80

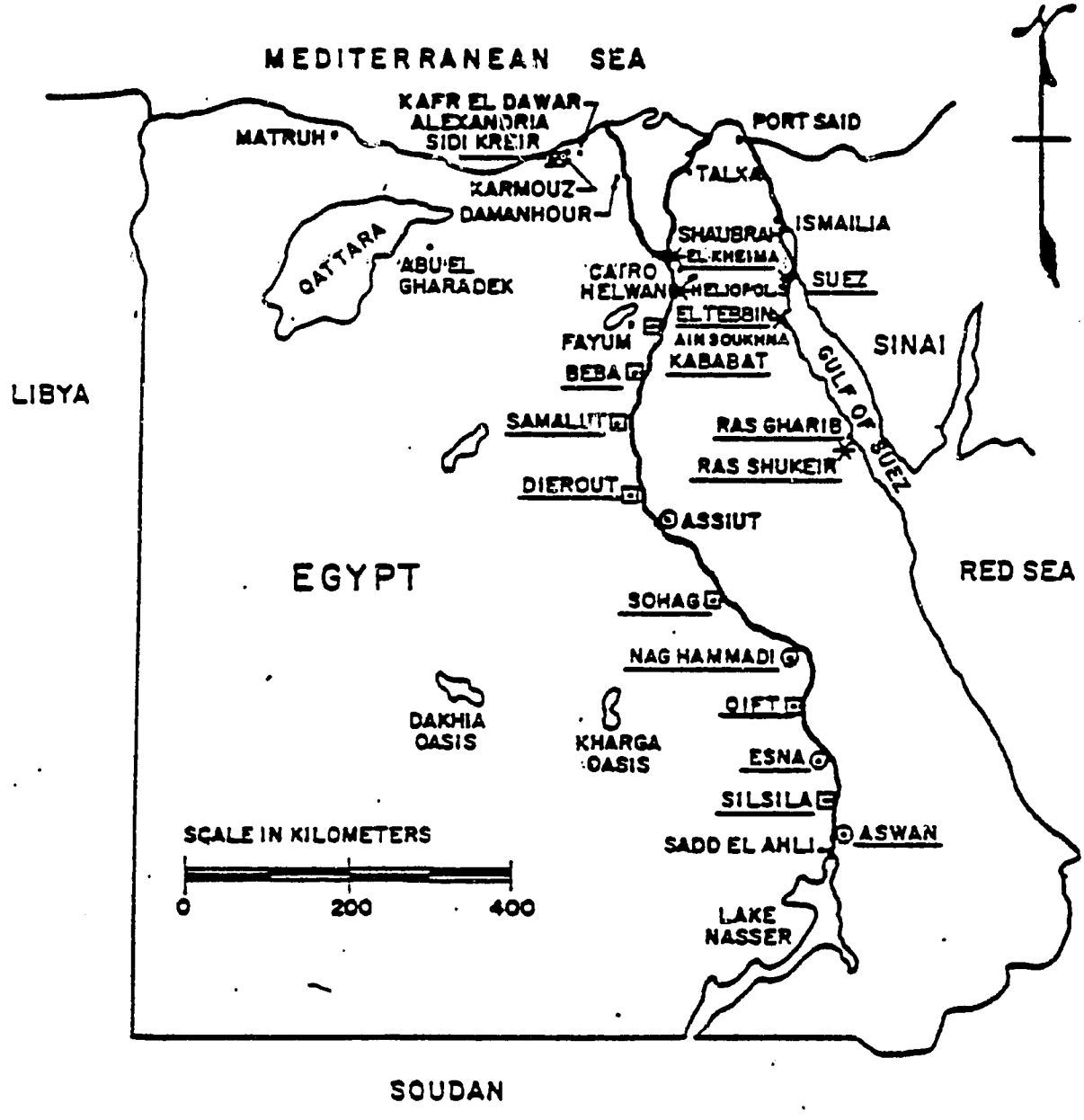
	Discount Rate 10%	8%
Shoubrah El Kheima	778,311	495,761
Suez	791,109	463,775
Ain Soukhna	802,629	471,872

June 1979

ANNEX S/1

POWER PLANT SITES LOCATION MAP

STATIONS NEAR ALEXANDRIA
- EL MOX
- KARMOUZ
- ABU KIR
- KAFR EL DAWAR
- EL SEYOUT



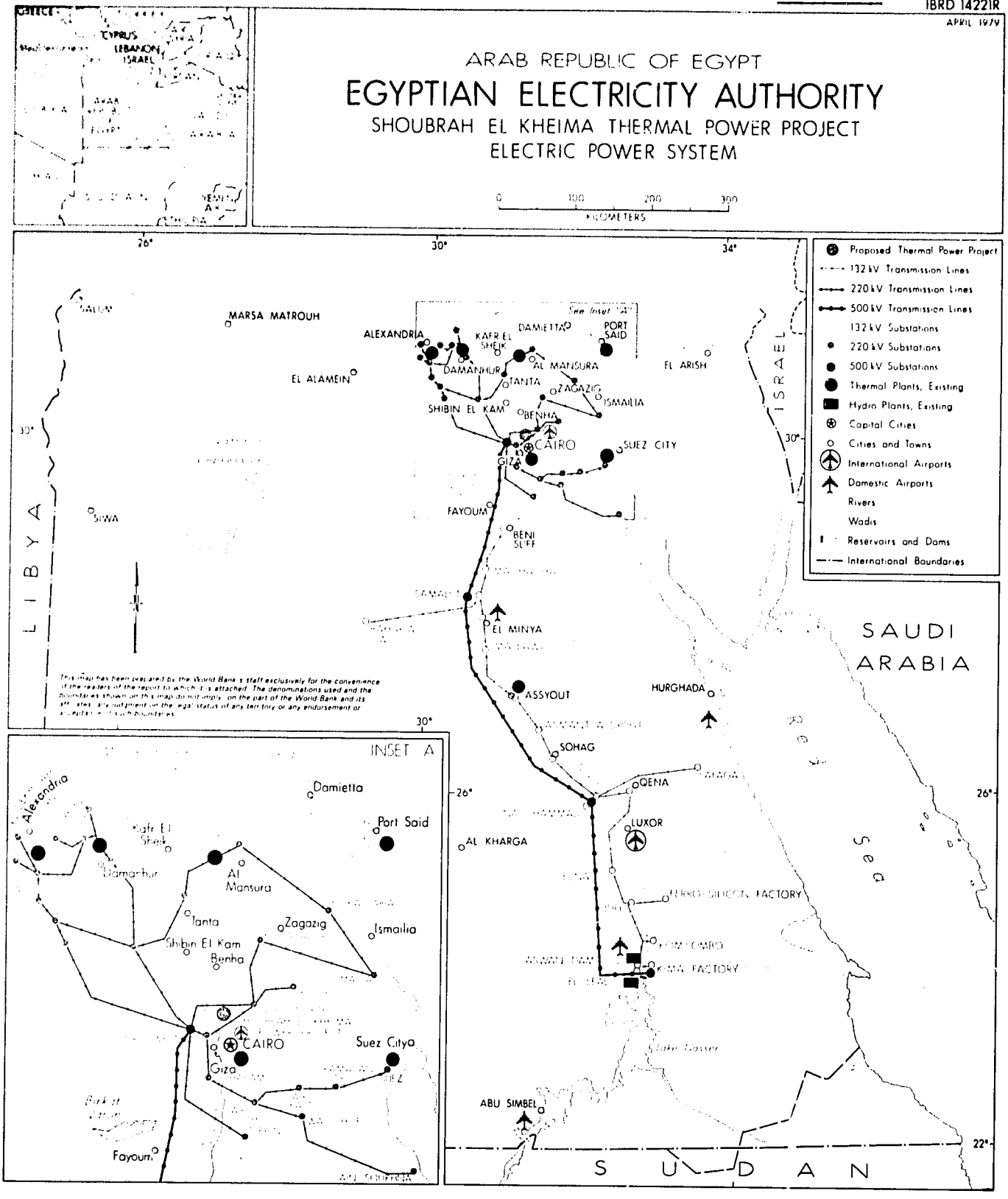
LEGEND

PROPOSED THERMAL SITES: ----* SUEZ
EXISTING DAMS OR BARRAGES: ---⊙ ESNA
PROPOSED BARRAGES: --------⊡ BEBA
PROPOSED NUCLEAR SITE: ----△ SIDI KREIR

ANNEX S/2

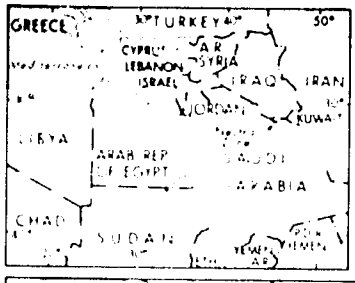
IBRD 14221R

APRIL 1979



IBRD 14222R

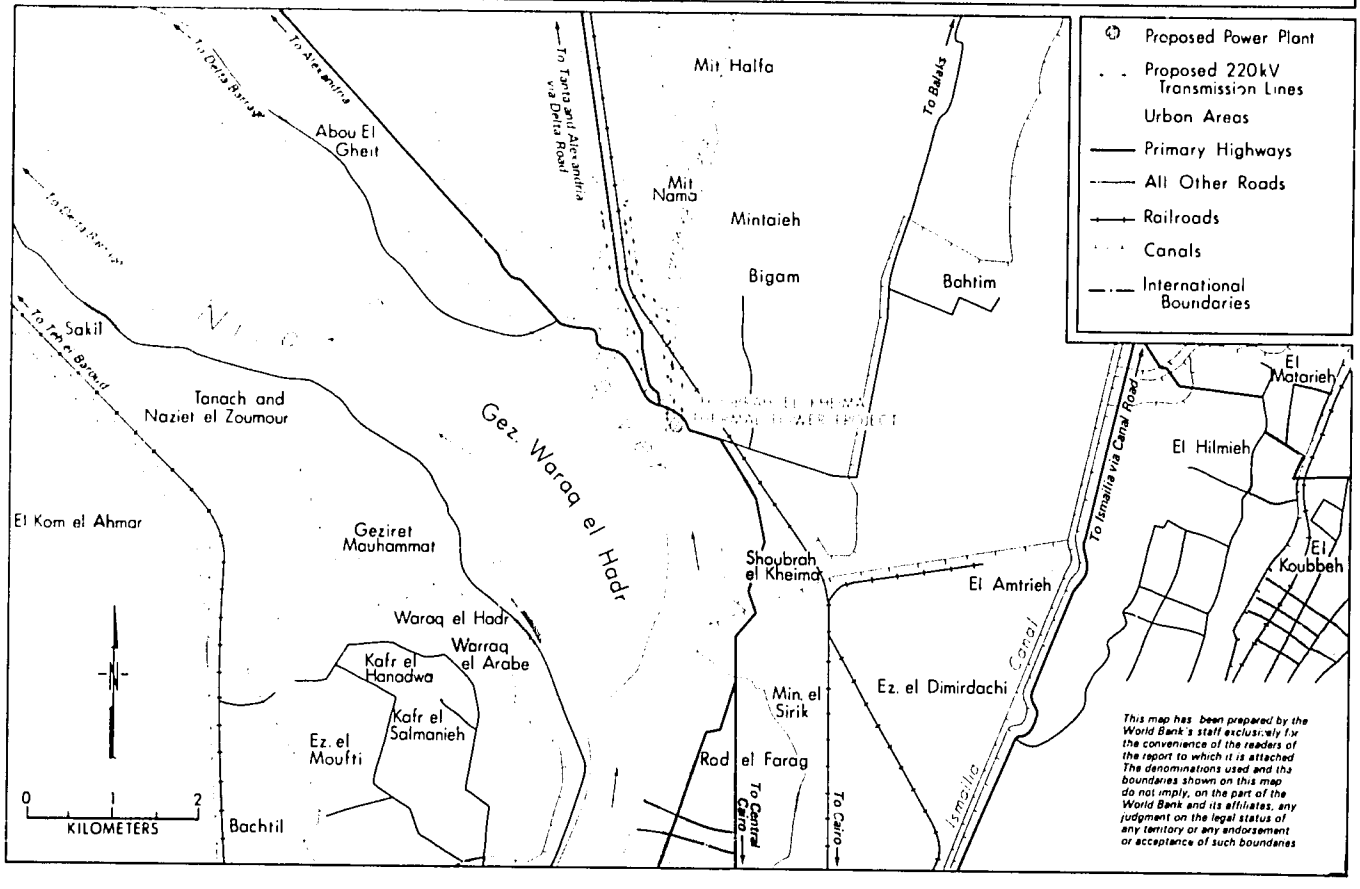
APRIL 1979

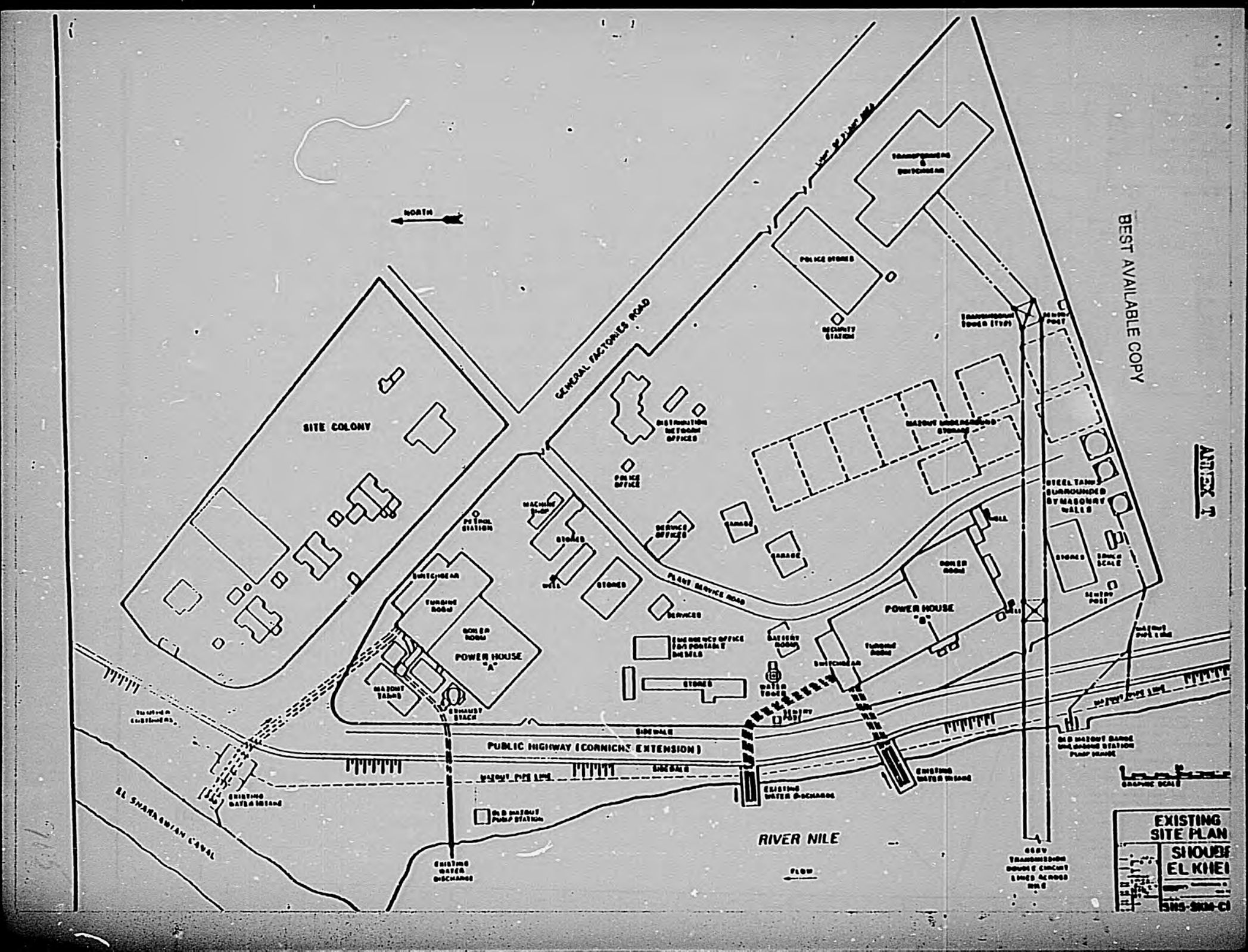


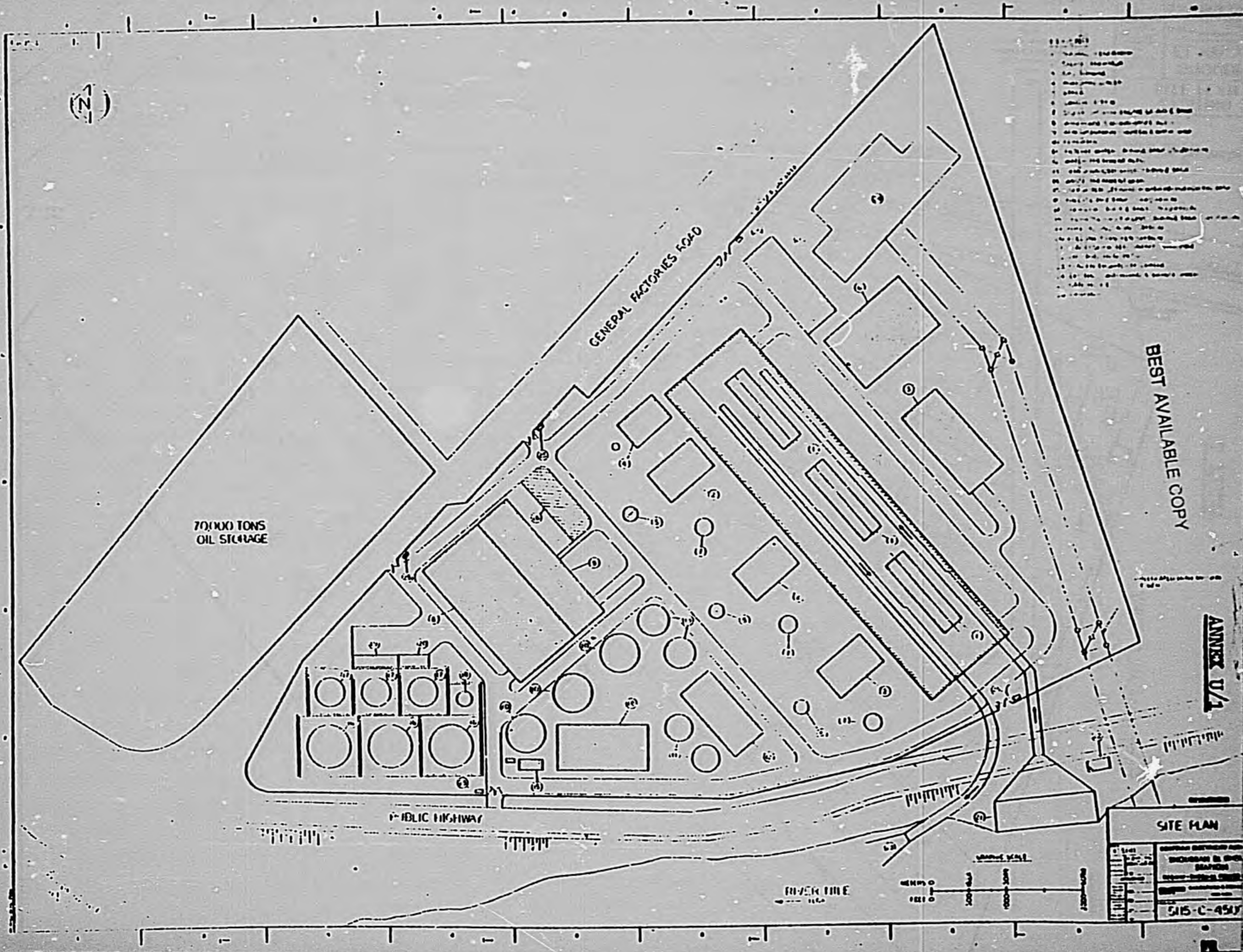
ARAB REPUBLIC OF EGYPT

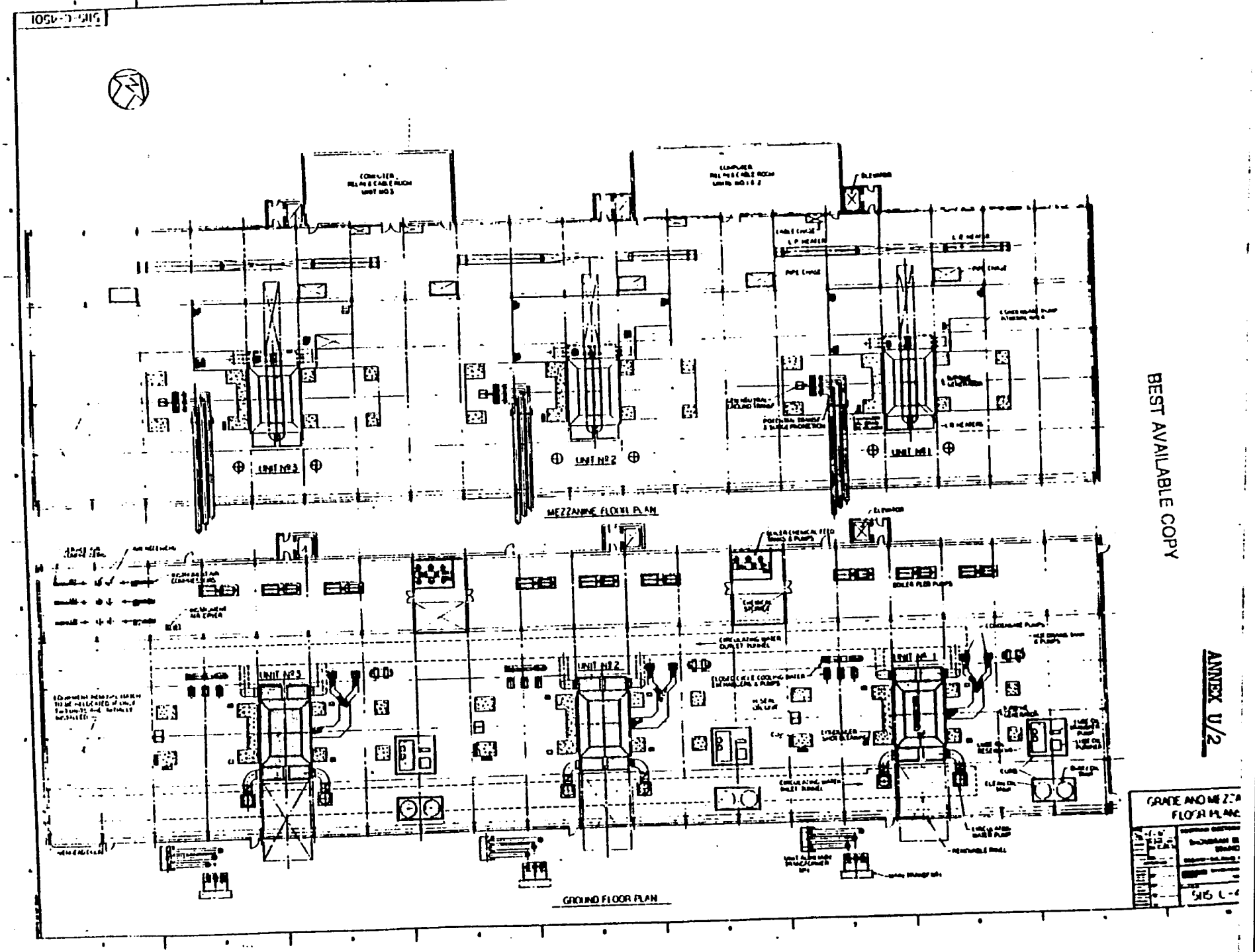
EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT




BEST AVAILABLE COPY
ANNEX I
NORTH
SITE COLONY
GENERAL FACTORIES ROAD
POLICE STORES
SECURITY STATION
DISTRIBUTION NETWORK OFFICES
POLICE OFFICE
PETROL STATION
MACHINE SHOP
STORES
SERVICE OFFICE
GARAGE
PLANT SERVICE ROAD
STEEL TANK SURROUNDED BY MASONRY WALLS
SWITCHGEAR
TURBINE ROOM
BOILER ROOM
POWER HOUSE "A"
MASONRY TANKS
EXHAUST STACK
ENGINEERS OFFICE FOR PORTABLE SHEDS
BATTERY ROOM
WATER TOOLS
POWER HOUSE "B"
PUBLIC HIGHWAY (CORNICHE EXTENSION)
SIDEWALK
WATER PIPE LINE
EXISTING WATER DISCHARGE
EXISTING WATER INTAKE
OLD MASONRY PUMP STATION
OLD MASONRY BARGE LOADING STATION PUMP HOUSE
EL SHARAWIAN CANAL
RIVER NILE
FLOW
GRAPHIC SCALE
EXISTING SITE PLAN
SHOUBR
EL KHEI


N
GENERAL FACTORIES ROAD
70,000 TONS
OIL STORAGE
PUBLIC HIGHWAY
RIVER NILE
BEST AVAILABLE COPY
ANNEX U/1
SITE PLAN



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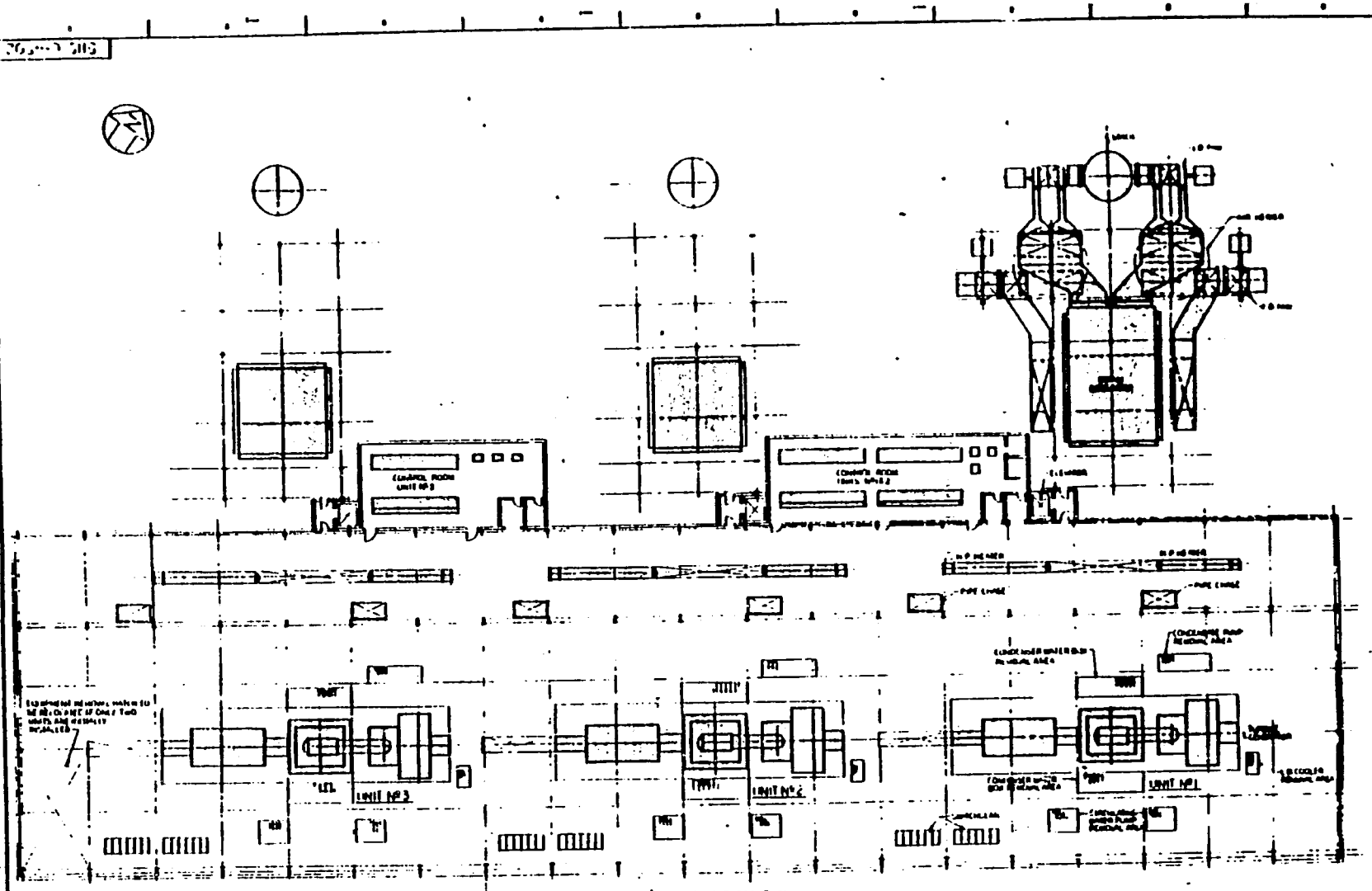
ANNEX U/2



OPERATING FLOOR PLAN

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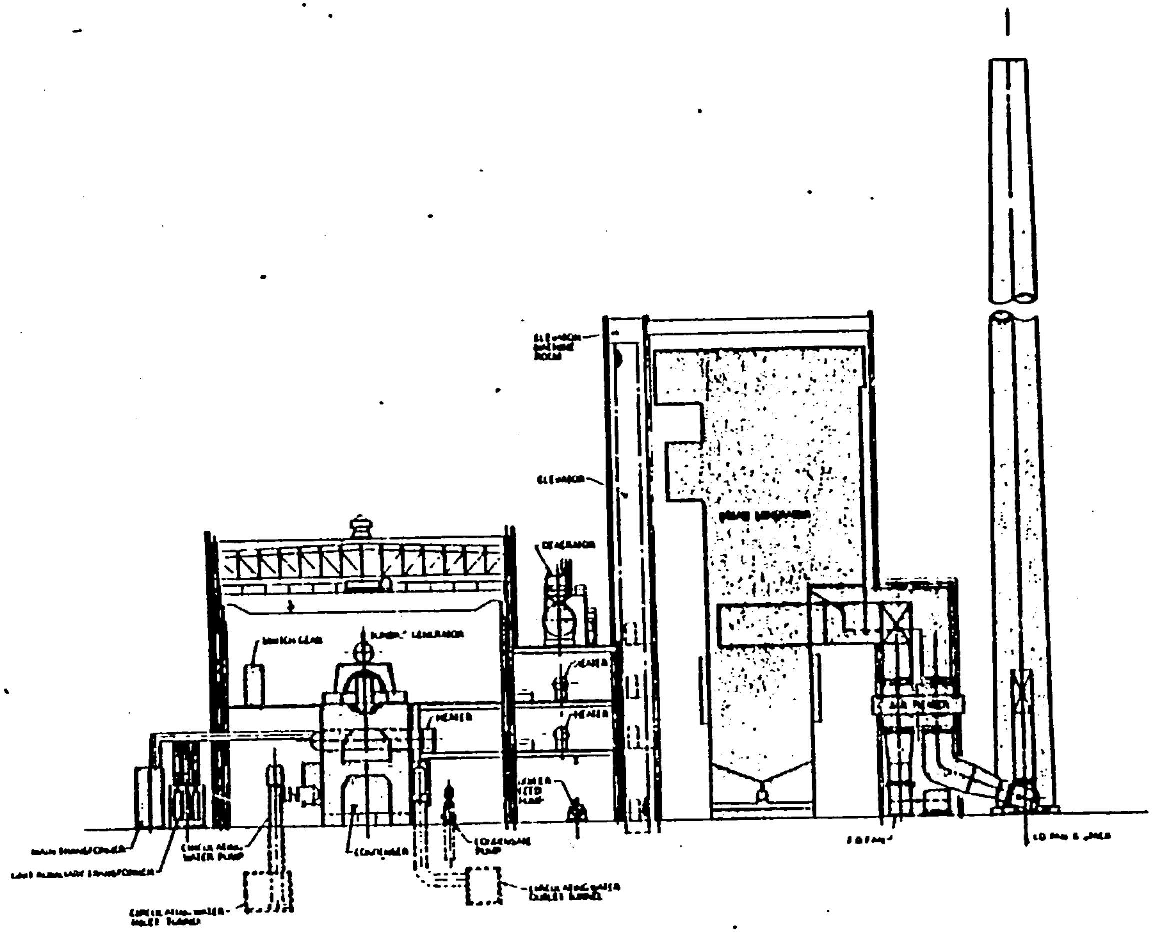
ANNEX U/3

OPERATING FLOOR PLAN



CROSS SECTION

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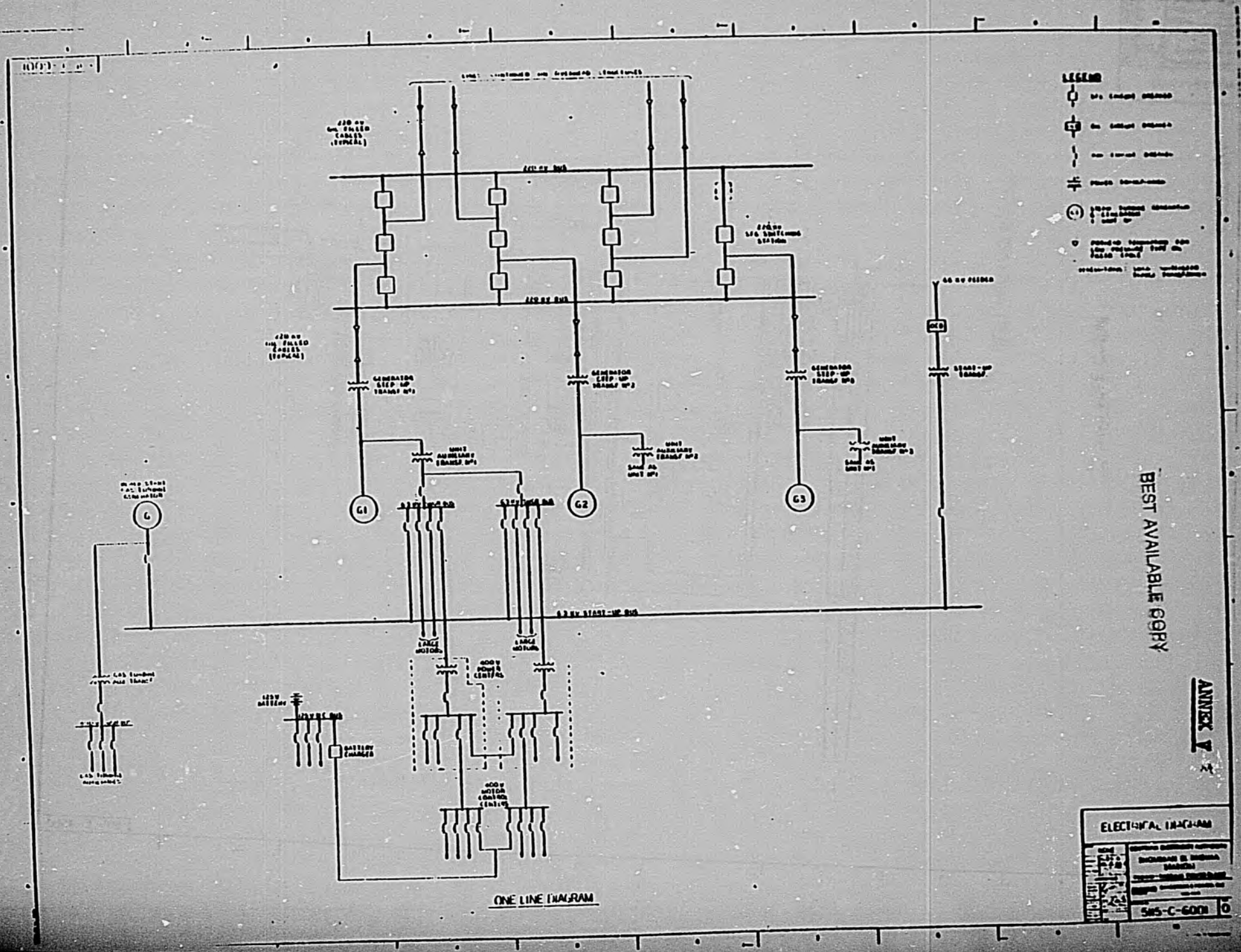
ANNEX U/4

CROSS SECTION

505-C-45


LEGEND
G1
G2
G3
ONE LINE DIAGRAM
ELECTRICAL DIAGRAM
SMS-C-6001
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ANNEX V

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SIDI KRAIR EL-KHEIMA THERMAL POWER STATION

Estimated Local Currency Costs, Thousands of LE

Base Prices, early 1978

Description	1978	1979	1980	1981	1982	1983	1984	1985	Total 1978-1985
A. Power Station									
2 x 300MW Steam Turbine Capacity		155	1,298	3,334	8,933	5,473	2,774	3,487	25,454
Physical Contingency (7 1/2%)		11	97	250	670	411	208	262	1,909
Subtotal		166	1,395	3,584	9,603	5,884	2,982	3,749	26,363
Price Contingency		39	596	2,247	8,172	6,449	4,079	3,751	25,333
Total Power Station		205	1,991	5,831	17,775	12,333	7,061	7,500	52,696
B. Transmission Lines									
4km of four circuits Overhead and UG 220kV				69	351	249	69	120	858
Physical Contingency				7	35	25	7	12	86
Subtotal				76	386	274	76	132	944
Price Contingency				48	328	300	104	221	1,001
Total Transmission				124	714	574	180	353	1,945
C. Technical Assistance									
Studies, Research and Training			300	400					700
Physical Contingency			15	20					35
Subtotal			315	420					735
Price Contingency			134	263					397
Total Technical Assistance			449	683					1,132
TOTAL PROJECT		205	2,440	6,638	18,489	12,907	7,241	7,853	55,773

ANNEX 9/1

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SIDI KRAIR EL-KHEIMA THERMAL POWER STATION

Estimated Foreign Currency Costs, Thousands of LE Equivalent - LE1 = US$1.4

Base Prices, early 1978

Description	1978	1979	1980	1981	1982	1983	1984	1985	Total 1978-1985
A. Power Station									
2 x 300 MW Steam Turbine Station		721	9,194	23,614	63,805	38,756	19,649	24,696	180,435
Physical Contingency (7 1/2%)		54	689	1,772	4,786	2,907	1,473	1,852	13,533
Subtotal		775	9,883	25,386	68,591	41,663	21,122	26,548	193,968
Price Contingency		81	1,717	6,199	21,394	16,578	10,177	15,151	71,297
Total Power Station		856	11,600	31,585	89,985	58,241	31,299	41,699	265,265
B. Transmission Lines									
4km of four circuits Overhead and UG 220kV				523	2,680	1,896	523	914	6,536
Physical Contingency (10%)				52	268	190	52	91	653
Subtotal				575	2,948	2,086	575	1,005	7,189
Price Contingency				140	919	830	277	574	2,740
Total Transmission Lines				715	3,867	2,916	852	1,579	9,929
C. Technical Assistance									
Studies, Research and Training			600	800					1,400
Physical Contingency (5%)			30	40					70
Subtotal			630	840					1,470
Price Contingency			109	205					314
Total Technical Assistance			739	1,045					1,784
TOTAL PROJECT		856	12,339	33,345	93,852	61,157	32,151	43,278	276,978

ANNEX W/2

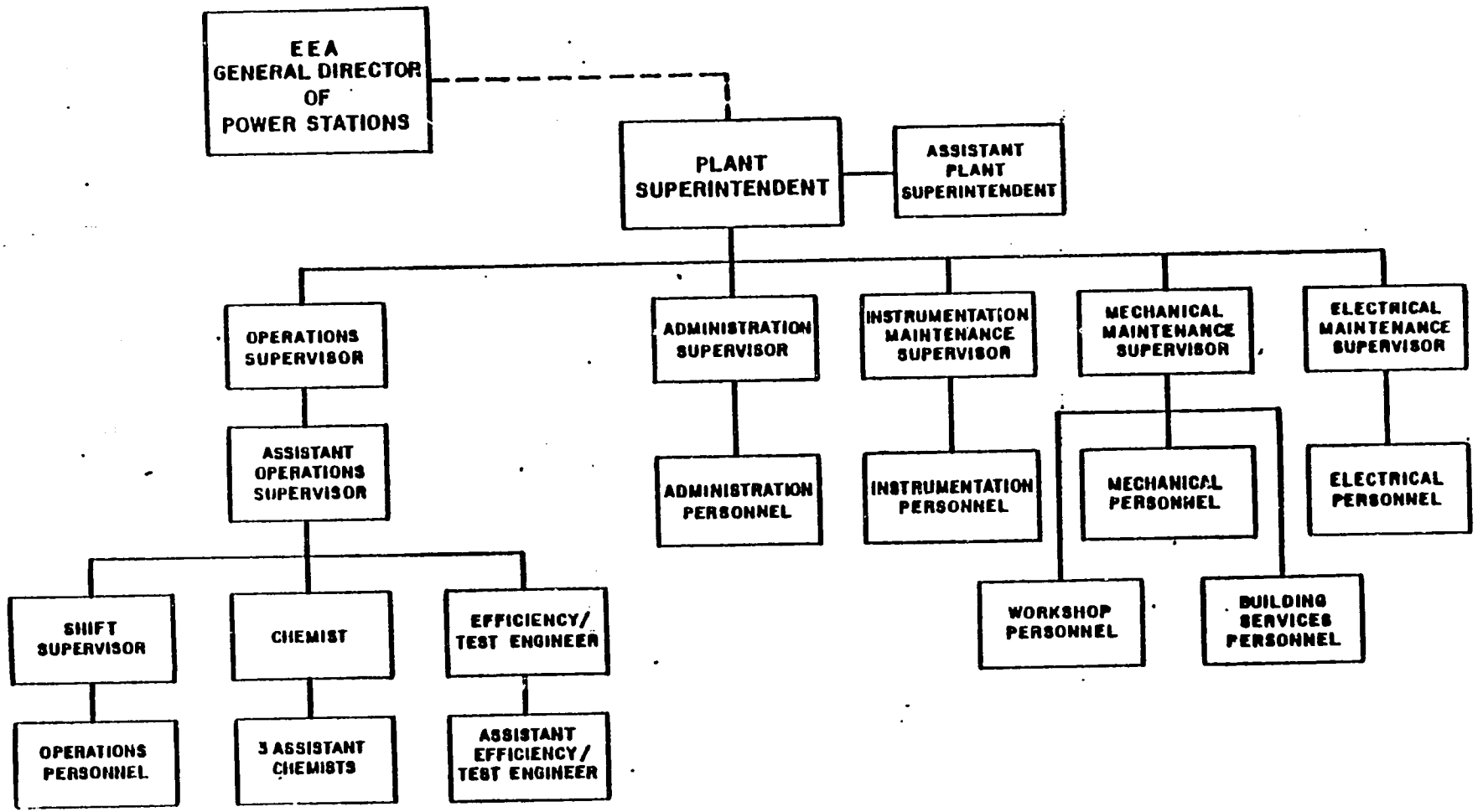
EGYPTIAN ELECTRICITY AUTHORITY

GHAMRAH EL-KHEIMA THERMAL POWER STATION

Summary of Estimated Project Costs

Description	Thousands of LE			Thousands of Eq. US$ 1/		
	Local	Foreign	Total	Local	Foreign	Total
A. Power Station						
(2 x 300), base cost 2/	25,454	180,435	205,889	35,636	252,609	288,245
Contingencies						
Physical	1,909	15,533	15,442	2,673	18,946	21,619
Price	25,333	71,297	96,630	35,466	99,816	135,282
Subtotal	52,696	265,265	317,961	73,775	371,371	445,146
B. Transmission Lines						
(4km, four circuit 2/ 220-kV), base cost	858	6,536	7,394	1,201	9,150	10,351
Contingencies						
Physical	86	653	739	120	914	1,034
Price	1,001	2,740	3,741	1,401	3,836	5,237
Subtotal	1,945	9,929	11,874	2,722	13,900	16,622
C. Technical Assistance						
Studies, Research and 2/ Training, base cost	700	1,400	2,100	980	1,960	2,940
Contingencies						
Physical	35	70	105	49	98	147
Price	397	314	711	556	440	996
Subtotal	1,132	1,784	2,916	1,585	2,498	4,083
TOTAL ESTIMATED PROJECT COST	55,773	276,978	332,751	78,082	387,769	465,851

1/ LE1 = US$1.40
2/ At early 1978 prices.



NOTE:

SEE SHEET 2 FOR PERSONNEL REQUIRED

ANNEX X/1

STATION ORGANIZATION
SHOUBRAH EL KHEIMA

OPERATIONS DEPARTMENT

Operator (STG)	9 (13)
Operator (Electrical)	4 (5)
Operator (Roving)	18 (22)
Operator (Auxiliary)	18 (22)
Operator (Water Treatment)	4 (8)
Operator (Fuel Oil)	9 (13)
Operator (Fuel Oil Auxiliary)	9 (13)
Sub-total	71 (96)
Supervisors & Professional Staff (Sheet 1)	12 (15)
Total Operations Department	83 (111)

MAINTENANCE DEPARTMENT

Workshop Personnel

Foreman	1 (1)
Machinist	2 (3)
Welder	4 (5)
Blacksmith	1 (1)
Steam Fitter	1 (1)
Tool Room Attendant	1 (1)
Helper	2 (4)
Sub-total	12 (16)

Mechanical Personnel

Foreman (Turbine)	1 (1)
Foreman (Boiler)	1 (1)
Mechanic III	4 (5)
Mechanic II	2 (5)
Helper	8 (8)
Crane Operator	1 (1)
Rigger	1 (-)
Sub-total	18 (21)

Electrical Personnel

Foreman	1 (1)
Electrician III	4 (5)
Electrician II	2 (3)
Electrician I	3 (3)
Sub-total	10 (12)

Instrumentation Personnel

Foreman	1 (1)
Instrument Technician Sr	2 (3)
Instrument Technician Jr	2 (3)
Sub-total	5 (7)

Building Services Personnel

Foreman	1 (1)
Bricklayer	1 (1)
Carpenter	1 (1)
Painter	2 (3)
Gardener	2 (2)
Laborer	8 (10)
Sub-total	15 (18)
Sub-total Maintenance Department	60 (74)
Supervisors (Sheet 1)	3 (3)
Total Maintenance Department	63 (77)

ADMINISTRATION DEPARTMENT

Administrator	2 (3)
Assistant Administrator	2 (3)
Typist	4 (5)
Clerk	4 (5)
Guard	4 (5)
Driver	2 (3)
Storekeeper	2 (3)
Laborer	2 (3)
Sub-total	22 (30)
Supervisor (Sheet 1)	1 (1)
Total Administration Department	23 (31)

Superintendent & Assistant Superintendent	2 (2)

Total Plant Staff - 2 Units	171
- 3 Units	(221)

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

DAMANHUR EL BEHEIRA THERMAL POWER PROJECT

Income Statements for the Years Ended December 31, 1976-1986
(Thousands of LE)

	Actual 1976	Actual 1977 /2	Forecast 1979	1980	1981	1982	1983	1984	1985	1986
Sales of Electricity - GWh	9,661	11,488	13,200	15,132 /3	17,116	18,957 /4	21,018 /5	23,841 /6	25,656 /7	28,311 /8	30,753 /9
Average Revenue per kWh sold (millimes)	8.83	8.24	8.23	9.60 /3	11.52	14.96 /4	18.73 /5	23.41 /6	24.15 /7	27.77 /8	28.95 /9
Operating Revenues											
Sales of Electricity	85,343	94,661	108,636	149,504	197,176	283,526	393,667	544,072	619,592	786,196	890,299
Commutation & Maintenance Charges	7,205	448	365	394	419	450	485	516	556	585	590
Other Operating Revenues		9,182	10,550	12,090	13,676	15,123	16,787	18,566	20,497	22,648	24,552
Total Operating Revenues	92,548	104,291	119,551	161,988	211,272	299,099	410,939	563,155	640,645	809,429	915,441
Operating Expenses											
Fuel	11,087	14,070	19,920	32,570	37,540	41,560	50,800	49,260	57,800	66,100	70,540
Salaries and Wages	16,831	18,314	31,792	36,561	42,045	48,352	55,605	63,945	73,537	84,568	97,253
Purchase of Materials and Services	13,243	15,942	20,459	33,520	41,289	63,778	82,056	109,691	121,955	161,178	176,777
Other Operating Expenses	9,014	6,638	7,627	8,741	9,806	10,924	12,125	13,398	14,778	16,300	17,760
Depreciation	16,073	17,408	18,018	25,002	33,577	46,207	60,220	80,946	104,682	130,867	152,074
Total Operating Expenses	66,248	72,372	97,816	136,394	164,333	210,821	260,806	325,840	372,756	458,213	514,704
Operating Income	26,300	31,919	21,735	25,594	46,936	88,278	150,133	237,314	267,889	350,456	397,633
Non-Operating Income (Net)	(4,194)	(1,001)	467	490	500	500	500	500	500	500	500
Gross Income	22,106	30,918	22,202	26,084	47,436	88,778	150,633	237,814	268,389	350,956	398,133
Interest											
Gross Interest	18,577	17,061	20,437	24,562	40,638	47,121	56,738	90,026	135,102	188,495	235,411
Less: Interest Charged to Construction	-	-	(13,920)	(20,051)	(29,960)	(35,160)	(48,019)	(53,467)	(95,975)	(146,751)	(180,200)
Net Interest Expense	18,577	17,061	6,517	4,511	10,678	11,961	8,719	36,559	39,127	41,744	55,211
Net Income	3,529	13,857	15,685	21,493	36,758	76,817	141,914	201,255	229,262	313,212	342,922
Average Net Fixed Assets in Service /1	304,988	316,470	458,674	715,780	942,648	1,397,464	1,877,523	2,656,184	2,974,421	3,876,628	4,418,954
Operating Income as a % Thereof	8.6	10.0	4.7	3.6	5.0	6.3	8.0	9.0	9.0	9.0	9.0
Net Internal Cash Generation (Ignoring working capital changes) as % of Construction Requirements	11	Nil	2	3	4	11	19	24	23	27	24

/1 Assets revalued as of the beginning of 1979 and thereafter as of the end of 1979, 1980, 1983 and 1985 applying an inflation factor of 7.5% p.a.
/2 These figures are preliminary unaudited results.
/3 Assumes an average tariff increase of 4% effective July 1, 1979.
/4 " " " " " " 30% " January 1, 1981.
/5 " " " " " " 24% " January 1, 1982.
/6 " " " " " " 25% " January 1, 1983.
/7 " " " " " " 3% " January 1, 1984.
/8 " " " " " " 15% " January 1, 1985.
/9 " " " " " " 4% " January 1, 1986.

ANNEX X

(Page 1 of)

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SIDI KRIR NUCLEAR POWER PROJECT

Balance Sheets as of December 31, 1976-1986
(Thousands of LE)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
ASSETS											
Fixed Assets in Service	451,063	491,115	732,473	1,119,004	1,348,448	2,007,345	2,606,772	3,489,385	3,794,977	5,169,797	5,732,791
Less: Accumulated Depreciation	(146,365)	(162,872)	(216,877)	(274,332)	(307,905)	(399,426)	(439,646)	(615,419)	(720,101)	(994,824)	(1,109,918)
Net Fixed Assets in Service	304,698	328,243	515,596	844,672	1,040,543	1,607,919	2,167,126	2,873,966	3,074,876	5,174,973	4,622,873
Work in Progress	109,076	146,894	226,183	293,712	516,431	608,185	723,802	1,129,008	1,968,536	2,549,385	3,621,961
Investments	126	4,126	4,126	-	-	-	-	-	-	-	-
Long-Term Receivables	408	407	407	-	-	-	-	-	-	-	-
Current Assets											
Cash	(202)	7,558	7,659	8,000	5,800	91,670	93,829	17,420	13,851	7,000	14,994
Accounts Receivable	110,856	124,191	130,000	75,000	91,000	95,000	98,400	136,000	154,900	196,550	222,580
Inventories	57,640	86,024	125,251	129,451	246,933	381,778	493,503	692,385	682,518	784,236	1,065,321
Total Current Assets	168,294	217,773	262,910	212,451	343,733	568,448	685,732	845,805	851,269	987,786	1,302,895
TOTAL ASSETS	582,602	697,443	1,009,222	1,350,915	1,900,707	2,784,152	3,556,660	4,848,779	5,894,681	7,752,144	9,545,809
LIABILITIES											
Capital and Reserves											
Capital	75,617	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990
Reserves	43,481	61,690	62,390	91,837	369,443	774,310	1,036,249	1,405,897	1,593,526	1,757,710	2,152,822
Legal Reserves	11,560	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932
Reserve for Revaluation of Fixed Assets	-	-	73,509	144,721	144,721	291,186	291,186	582,462	582,462	1,045,869	1,045,869
Retained Earnings	3,649	6,457 /1	22,142	43,635	80,393	157,210	299,124	502,979	732,241	1,045,453	1,368,417
	134,267	155,069	244,963	367,115	681,479	1,309,628	1,713,481	2,578,260	2,995,151	3,935,954	4,654,030
Long-Term Debt											
Total Long-Term Debt	373,802	398,723	530,117	728,985	908,609	1,142,754	1,443,907	1,896,102	2,481,490	3,337,268	4,383,671
Less: Debt due Within One Year	(42,279)	(29,637)	(37,637)	(50,990)	(60,037)	(67,453)	(67,295)	(65,927)	(66,887)	(78,923)	(102,482)
Net Long-Term Debt	331,523	369,086	492,480	677,995	848,568	1,075,301	1,376,612	1,830,175	2,414,603	3,258,345	4,281,191
Current Liabilities											
Long-Term Debt Due Within One Year	42,279	29,637	37,637	50,990	60,037	67,453	67,295	65,927	66,887	78,923	102,482
Accounts Payable & Interest Liabilities	68,814	136,833	226,308	245,837	300,469	320,500	386,847	360,611	402,820	462,174	489,870
Customers Deposits	5,659	6,818	7,634	8,978	10,154	11,230	12,465	13,706	15,220	16,788	18,232
Total Current Liabilities	116,812	173,288	271,779	305,805	370,660	399,183	466,607	440,244	484,927	557,885	610,586
TOTAL LIABILITIES	582,602	697,443	1,009,222	1,350,915	1,900,707	2,784,152	3,556,660	4,848,779	5,894,681	7,752,144	9,545,809
Ratios											
Debt/Equity Ratio	74/26	72/28	60/32	67/33	57/43	47/53	46/54	42/58	45/55	46/54	49/51
Current Ratio	1.4	1.3	1.0	0.7	0.9	1.4	1.5	1.9	1.8	1.8	2.1

/1 After assumed transfer of LE 0,000 to the Ministry of Finance.

Back Page

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

HAMRAWAN EL KIMIMA THERMAL POWER PROJECT

Sources and Applications of Funds
(Thousands of LE)

	1978	1979	1980	1981	1982	1983	1984	1985	1986
Sources of Funds									
Internal Cash Generation									
Gross Income	22,202	26,004	47,436	88,778	150,633	238,414	268,389	350,926	350,175
Depreciation	18,018	25,082	33,573	46,207	60,220	88,946	104,682	130,867	155,694
Total Internal Cash Generation	40,220	51,086	81,009	134,985	210,853	327,360	373,071	481,793	505,869
Grants									
IBRD Grants - For Inshas Plant	578	4,950	4,950	4,950	3,865	-	-	-	-
- For the Project	-	208	3,090	8,354	23,534	15,340	8,055	10,860	-
Ministry of Housing & Construction Grant	122	1,050	1,050	1,050	820	-	-	-	-
Ministry of Finance Grants	-	23,239	268,516	390,513	233,720	324,308	179,574	153,329	335,112
Total Grants	700	29,447	277,606	404,867	261,939	339,648	187,629	164,189	335,112
Borrowings									
Foreign Loans - IBRD/IDA	-	-	11,180	25,350	29,450	9,160	6,110	-	-
- EIB	-	73	1,082	2,924	8,237	5,369	2,819	3,802	-
- EEC	-	73	1,082	2,924	8,237	5,369	2,819	3,802	-
- OPEC	-	21	309	835	2,353	1,534	806	1,686	-
- Others	98,000	183,381	216,957	262,193	320,289	490,058	638,761	763,050	904,230
Local Loans	63,031	52,957	-	-	-	-	-	150,925	221,090
Total Borrowings	161,031	236,505	230,610	294,226	368,566	510,490	651,315	922,665	1,185,320
Liquidation of Investments & Long-Term Receivables	-	4,533	-	-	-	-	-	-	-
Total Sources	201,951	321,571	589,225	834,078	841,358	1,216,498	1,212,015	1,568,672	2,073,709
Applications of Funds									
Construction Requirements (Incl. Interest charged to construction) - Project	-	1,096	15,363	41,772	118,764	83,156	53,700	69,857	-
- Other Construction	211,151	349,459	436,720	517,100	596,280	846,560	1,091,420	1,318,549	1,635,574
Total	211,151	350,555	452,083	558,872	715,044	929,716	1,145,120	1,388,406	1,635,574
Debt Service									
Amortization	29,637	37,637	50,990	60,037	67,453	67,295	65,927	66,887	78,923
Interest (excl. Interest Charged to Construction)	6,517	4,511	10,678	11,961	8,719	34,559	39,127	37,744	75,211
Total Debt Service	36,154	42,148	61,668	71,998	76,172	101,854	105,054	104,631	154,134
Net Change in Working Capital (excl. Long-Term Debt Due Within One Year)	(45,354)	(71,132)	75,474	203,208	50,142	184,928	(38,159)	75,635	284,001
Total Applications	201,951	321,571	589,225	834,078	841,358	1,216,498	1,212,015	1,568,672	2,073,709
Times Annual Debt Service Covered by Internal Cash Generation	1.1	1.2	1.3	1.9	2.8	3.2	3.6	4.6	3.6

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EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SEOUBRAE EL KHEIMA THERMAL POWER PROJECT

Notes and Assumptions for Financial Forecasts

A. General

Formation of Distribution Companies Since the distribution companies have not started operations, and most matters concerning their operations are still unclear, the financial forecasts assume continuance of the present state of affairs.

B. Income Statement

1. Sales of Electricity have been based on information furnished by EEA and its consultants as subsequently modified by the Bank. The forecasts assume annual kWh sales growth of 14.9% in 1978, 14.6% in 1979, 13.1% in 1980, 10.6% in 1981, 11.0% in 1982, 10.6% in 1983, 10.4% in 1984, 10.3% in 1985 and 8.6% in 1986. Average revenue per unit sold is based on actuals for 1978 and assumed average tariff increases of 40% effective July 1, 1979, 30% from January 1, 1981, 25% from January 1, 1982, 25% from January 1, 1983, 3% from January 1, 1984, 15% from January 1, 1985 and 4% from January 1, 1986.

2. Connection and Maintenance Charges are assumed to increase by the same percentages as annual kWh sales of electricity. Maintenance charges are based on forecast sales to municipalities in kWhs at 1.5 milliemes per kWh.

3. Other Operating Revenues are assumed to increase by the same percentages as annual kWh sales of electricity.

4. Fuel and Lubricants are based on estimates of generation from steam units and combustion turbines using fuel prices and heat rates as follows:

(1) Fuel Prices:

Diesel fuel - LE 14.60 ton (combustion turbines)
Fuel oil - LE 7.30 ton (steam turbines)

(2) Heat Rates:

Combustion turbines - 15,475 Btu = 1 kWh
Steam turbines - 12,667 Btu = 1 kWh (1978)
- 12,000 Btu = 1 kWh (1979)
11,000 Btu = 1 kWh (1980 and thereafter)

5. Salaries and Wages are based on EEA's 1977 salaries and wages escalated by 15% each year through 1986. So specific increases in staff are assumed since EEA is overstaffed now and its present staff will be adequate through 1986.

6. Purchase of Materials and Services and Other Operating Expenses are assumed to increase roughly in proportion to the increase in net fixed assets in service.

7. Depreciation is computed at an average annual rate of 3%/a of the gross fixed assets in service at the beginning of the year.

8. Non-Operating Income (Loss) is based on the average of actual non-operating income and expense for the years 1973 through 1977.

9. Interest is calculated at the rate of 5%/a on all loans from the Ministry of Finance. Interest on all existing foreign loans is based on EEA's actual calculations. All new borrowing from the Ministry of Finance is assumed to be at an average interest rate of 5%/a and future foreign borrowing except the identified loans, e.g., IBRD, EIB, etc., for which the specific rates would apply, is assumed to be at 8% (for presently committed generating plants) and 8-1/2% (future expansion facilities). Interest has been added to construction costs at 6.5% in 1978-79, 7.5% in 1980-82 and 8.5% in 1983-86.

B. Balance Sheet

10. Gross Fixed Assets in Service are valued at historical cost through 1977. They have been revalued as of the beginning of 1978 using the consultants' valuation of LE 601 million for gross fixed assets and LE 199 million for accumulated depreciation. Thereafter, they have been revalued in alternate years, i.e., as of the end of 1979, 1981, 1983 and 1985 assuming an average annual price increase of 7.5%.

11. Inventories are based on EEA's actuals as of 1977-end and are estimated to increase roughly in line with the increase in net fixed assets in service.

12. Accounts Receivables The forecasts assume receivables to be the equivalent of three months' sales in 1982 and thereafter.

13. Reserves are increased each year by contributions received from the Ministry of Housing and Reconstruction, Ministry of Finance and grants by USAID.

14. Accounts Payable and Deferred Liabilities are estimated each year on the basis of annual capital expenditures and cash operating expenses.

15. Consumers' Deposits are assumed to increase in line with the increases in kWh sales of electricity.

D. Sources and Applications of Funds

16. Contributions from the Ministry of Housing and Reconstruction and Ministry of Finance are based on EEA's 5-Year Plan estimates.

17. USAID Grants of $127.8 million ($100 million for the Project and the rest for others) are assumed. Disbursements are based on USAID estimates furnished to the Bank.

18. Borrowings All foreign borrowings are converted to Egyptian pounds using the parallel market rate of exchange of LE 1 = US$1.44. EEA's planned borrowing program has been adjusted to meet the needs of the construction program as revised by the Bank and taking into account EEA's internal cash generation and expected grants.

19. Construction Requirements are based on EEA's estimates as revised by the Bank and escalated using the following percentages for price contingencies corresponding to expected conditions in Egypt:

	1978	1979	1980	1981	1982	1983-1986
Equipment	7	6.5	6	6	6	6
Civil Works	15	15	15	14	13.5	13

20. Amortization of Long-Term Debt Ministry of Finance loans are assumed repayable over 12 years after 3 years' grace. Amortization of other existing foreign loans is based on EEA's calculations.

March 1979

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Comparison of Alternatives
Technical and Economic Assumptions

1. Economic Life of Facilities

Hydropower Plant	50 years
Conventional Steam Generating Plant	30 years
Nuclear Generating Plant	30 years
Combustion Turbine	20 years
Transmission	40 years
Distribution	30 years

2. Generating Reserve

20% of System Peak Demand.

3. Specific Fuel Consumption

Conventional Steam Turbine	11,000 Btu/kWh
Combustion Turbine	15,475 Btu/kWh

4. Capital Costs

Combustion Turbine Station (4x75 MW) LE 236/kW (incl. i.d.c.).

5. Fuel Costs

Internal prices of petroleum products in Egypt, which are controlled by the Government, are below world price levels. For the economic analysis, however, the relevant costs are the opportunity costs i.e. the export value, since the alternative to internal use is export. Accordingly, the economic analysis was based on the f.o.b. values of the products at the time of appraisal, which are as follows:

Mazout	US$75	(LE 54)/ton
Gas Oil	US$120	(LE 86)/ton
Kerosene	US$130	(LE 93)/ton

The delivery costs for mazout to the possible steam station site at Suez were taken as negligible, since the fuel would be supplied from the Suez refinery through an existing pipeline.

For the Ain Soukhna site the estimated delivery cost for mazout was taken as US$0.50/ton and for Shoubrah El Kheima as US$2/ton, based on information supplied by the Egyptian General Petroleum Corporation.

This resulted in the following fuel costs per kWh generated:

Steam Station (the Project)

At Suez	15.5 milliemes/kWh
At Ain Soukhna	15.6 milliemes/kWh
At Shoubrah El Kheima	15.9 milliemes/kWh
Combustion Turbine	33.0 milliemes/kWh

For the nuclear power stations included in the long-term development program the following fuel costs were adopted by the consultants:

	LE/million Btu
600-MW Unit	0.342
900-MW Unit	0.315

6. Operation and Maintenance Costs

Steam Generating Plant	1.86 milliemes/kWh
Transmission	1.5% of capital costs
Distribution	2% of capital costs

7. Foreign Exchange

LE 1 = US$1.40

8. Opportunity Cost of Capital

10%

9. Unskilled Labor

Since there is heavy unemployment and underemployment of unskilled labor in Egypt, this was valued at 50% of its money wages for the economic analysis. Unskilled labor was assumed to represent the following proportions of construction costs:

Steam Generating Plant	30% of local costs
Transmission	15% of total costs
Distribution	25% of total costs

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SIDI KRIR 2 X 300 MW THERMAL POWER PROJECT

Costs of Alternative Development Programs
(LE Million)

Year	Program Including Project									Alternative Program (4x75 MW Combustion Turbines Instead of First 300-MW Steam Unit)								
	Capital Costs			Operating Costs			Total Costs			Capital Costs			Operating Costs			Total Costs		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
1979	0.1	0.8	0.9	-	-	-	0.1	0.8	0.9	-	-	-	-	-	-	-	-	-
1980	1.2	10.2	11.4	-	-	-	1.2	10.2	11.4	0.1	0.8	0.9	-	-	-	0.1	0.8	0.9
1981	3.5	29.4	32.9	-	-	-	3.5	29.4	32.9	1.2	9.9	11.1	-	-	-	1.2	9.9	11.1
1982	9.4	78.7	88.1	-	-	-	9.4	78.7	88.1	3.0	25.4	28.4	-	-	-	3.0	25.4	28.4
1983	8.3	69.1	77.4	-	-	-	8.3	69.1	77.4	10.4	88.2	98.6	-	-	-	10.4	88.2	98.6
1984	4.5	37.8	42.3	-	-	-	4.5	37.8	42.3	9.9	84.4	94.3	-	-	-	9.9	84.4	94.3
1985	4.2	35.0	39.2	452.2	-	452.2	456.4	35.0	491.4	2.5	21.1	23.6	452.4	-	452.4	454.9	21.1	476.0
1986	1.3	10.6	11.9	445.2	-	445.2	446.5	10.6	457.1	3.2	26.5	29.7	460.0	-	460.0	463.2	26.5	489.7
1987	-	-	-	651.8	-	651.8	651.8	-	651.8	-	-	-	663.0	-	663.0	663.0	-	663.0
1988	-	-	-	629.6	14.4	644.0	629.6	14.4	644.0	-	-	-	646.7	14.4	661.1	646.7	14.4	661.1
1989	-	-	-	621.4	28.7	650.1	621.4	28.7	650.1	-	-	-	633.3	28.7	662.0	633.3	28.7	662.0
1990	-	-	-	620.2	43.1	663.3	620.2	43.1	663.3	-	-	-	634.1	43.1	677.2	634.1	43.1	677.2
1991	-	-	-	621.8	57.4	679.2	621.8	57.4	679.2	-	-	-	633.1	57.4	690.5	633.1	57.4	690.5
1992	-	-	-	623.8	71.8	695.6	623.8	71.8	695.6	-	-	-	636.1	71.7	707.8	636.1	71.7	707.8
1993	-	-	-	632.2	86.1	718.3	632.2	86.1	718.3	-	-	-	642.9	86.1	729.0	642.9	86.1	729.0
1994	-	-	-	634.3	103.6	737.9	634.3	103.6	737.9	-	-	-	649.1	103.2	752.3	649.1	103.2	752.3
1995	-	-	-	625.0	122.1	747.1	625.0	122.1	747.1	-	-	-	640.7	121.6	762.3	640.7	121.6	762.3
1996	-	-	-	620.5	140.2	760.7	620.5	140.2	760.7	-	-	-	634.8	139.6	774.4	634.8	139.6	774.4
1997	-	-	-	622.7	158.8	781.5	622.7	158.8	781.5	-	-	-	640.3	158.2	798.5	640.3	158.2	798.5
1998	-	-	-	572.1	178.9	751.0	572.1	178.9	751.0	-	-	-	589.1	178.4	767.5	589.1	178.4	767.5
1999	-22.1 1/	-188.5 1/	-210.6 1/	348.6	215.0	563.6	326.5	30.5	377.0	-17.8 1/	-149.4 1/	-167.2 1/	385.8	214.4	600.2	368.0	65.0	433.0

1/ Residual plant value

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Comparision of Alternatives
Sensitivity Tests

	Equalizing Discount Rate (%)
Base Case	17.4
Capital Costs 20% Higher	15.7
Capital Costs 20% Lower	19.5
Fuel Costs 20% Higher	19.1
Fuel Costs 20% Lower	15.4
High Load Forecast	18.0
Low Load Forecast	16.7
Higher Exchange Rate (EE 1 = US$1.75)	19.2
Lower Exchange Rate (EE 1 = US$1.05)	15.1

March 1979

Summary of Estimated Costs

[illegible] Electricity Authority

[illegible] Hydro-Electric Thermal Power Project

Power System Development Programme, Base Case, 1978-1988

(Thousands of $)

Year Ending, 31st March 1979		Costs in Progress as at December 31, 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total 1978-1988	Total Projects	Beyond 1988
I Generation														
A. Thermal Power Construction														
1. Base (Otiu)	M	-	130	100	-	-	-	-	-	-	-	230	230	-
	E	-	130	30								230	230	
	T	-	260	130								490	490	
2. Otiu #1 Power	M	4,884	1,900	2,183	4,944	4,300	8,136	-	-	-	-	12,467	30,493	-
	E	58,135	158	2,123	1,300	1,300	1,189					12,125	71,345	-
	T	62,430	2,430	4,900	10,144	7,300	10,316					29,592	98,842	-
3. Otiu Wood, 4th Unit	M	-	1,000	2,000	6,955	-	-					10,555	10,555	-
	E	13,368	7,288	5,388	2,108	-	-					14,884	28,864	-
	T	13,000	8,000	7,100	9,051							26,261	39,421	
4. Ata Dam	M	3,630	6,100	1,964	13,777	12,861	-	-	-	-	-	44,600	52,310	
	E	18,198	14,238	46,813	38,567	26,331	-					126,273	126,471	
	T	22,230	20,230	48,337	52,344	37,212						188,433	210,681	
5. Base (Kiwi)	M	60	700	2,130	8,000	8,000	6,329					25,289	25,349	
	E	16,101	1,430	6,000	32,790	32,000	18,289					104,889	130,990	
	T	16,161	2,230	8,130	40,000	40,000	24,639					130,389	156,370	
6. Ararimiro	M	-	500	1,630	2,500	6,000	8,000	6,973				25,273	25,273	
	E	-	500	1,700	4,000	17,500	12,500	10,163				125,000	125,000	
	T	-	1,000	3,330	7,100	23,500	20,500	17,136				150,273	150,273	
7. Waiau & Taiua Combustion Turbines	M	-	2,000	8,600								10,600	10,600	
	E	-	5,400	32,500								37,900	37,900	
	T	-	7,400	31,500								50,900	50,900	
8. Otiwa Combustion Turbines	M	-	3,300	14,060								17,360	17,360	
	E	11,681	12,300	11,140								23,440	35,121	
	T	11,681	15,300	25,120								41,100	52,781	
Total Power Construction	M	9,916	15,130	34,937	46,178	34,161	23,373	6,973				161,674	171,390	
	E	118,174	43,329	109,906	120,493	116,231	83,840	20,130				472,174	599,348	
	T	128,090	61,470	144,837	170,671	150,712	78,955	27,103				633,748	761,638	
B. New Projects														
1. Rhoneroa (Ohakuri Units 1 & 2	M	-	-	-	166	1,395	3,184	9,683	5,884	1,982	3,769	-	27,363	27,363
	E				775	9,883	23,186	48,331	21,683	11,222	14,564		127,764	127,764
	T				941	11,278	26,370	78,194	47,567	14,104	20,297		221,331	221,331
2. Rhoneroa (Ohakuri Unit 3	M	-	-	-	-	66	338	1,434	3,861	2,354	1,193	1,499	10,965	10,965
	E					310	1,832	10,134	17,316	10,681	3,349	10,812	77,586	77,586
	T					376	4,311	11,588	21,277	19,019	9,642	12,116	88,531	88,531
3. 1985-400MW Thermal	M	-	-	-		144	1,207	3,102	8,312	5,093	2,581	1,263	23,686	23,686
	E					671	8,156	11,173	19,348	14,091	18,273	22,678	167,867	167,867
	T					815	9,761	25,075	67,660	41,134	20,853	28,223	191,371	191,371
4. Kaua Hydro	M	-	-	-							1,860	9,290	11,150	33,370
	E										1,570	7,930	9,500	28,298
	T										3,430	17,220	20,650	61,668
5. 1987-400MW Thermal [1]	M	-	-	-			144	1,207	3,102	8,312	5,093	2,584	20,439	23,686
	E						671	8,156	11,173	19,348	14,091	18,268	166,709	167,867
	T						815	9,761	25,075	67,660	41,134	20,853	183,348	191,371
6. Aoyuma Hydro	M											1,630	1,630	17,000
	E											1,570	1,570	11,000
	T											3,200	3,200	48,000
7. 1988-400MW Thermal [1]	M				154	881	1,817	3,343	9,183	10,416	10,152	9,050	47,002	53,267
	E				2,304	5,010	13,838	40,333	68,636	63,811	79,299	68,217	339,374	416,181
	T				2,258	6,811	15,655	43,676	77,767	94,067	87,051	77,273	486,378	471,428
8. Tag Hammond Hydro	M	-	-	-	-	-	-	-	-	-	-	1,660	1,660	31,630
	E											1,430	1,430	18,170
	T											3,070	3,070	57,860
9. Arnua Extension	M	-	-	-	-	-	660	1,200	5,210	8,300	9,300	7,210	33,280	33,280
	E						710	1,200	5,140	9,340	7,300	4,790	33,300	33,300
	T						370	2,200	13,350	13,860	16,500	12,000	58,780	58,780
10. 1989-400MW Thermal	M					154	901	1,817	5,343	9,183	10,416	10,152	37,966	53,267
	E					2,304	5,010	13,838	40,333	68,636	63,811	79,299	331,139	416,181
	T					2,258	6,811	15,655	45,676	77,767	94,067	87,051	329,105	471,428
11. 1990-400MW Thermal	M						154	901	1,817	5,343	9,183	10,416	27,794	53,267
	E						2,304	5,010	13,838	40,333	68,636	83,811	214,284	416,181
	T						2,258	6,811	15,655	45,676	77,767	94,067	242,754	471,428
12. 1990-[illegible]MW Pumped Storage	M											660	660	18,000
	E											310	310	12,000
	T											1,370	1,370	30,000
13. 1991-400MW Thermal	M							154	901	1,817	5,343	9,163	17,378	53,267
	E							2,304	5,010	13,838	40,333	48,934	170,940	416,181
	T							2,258	6,811	15,655	45,676	77,767	187,167	471,428
14. 1992-400MW Thermal	M								154	901	1,817	5,343	9,215	53,267
	E								2,304	5,010	13,838	40,333	61,485	416,181
	T								2,258	6,811	15,655	45,676	70,220	471,428
15. 1993-400MW Thermal	M									743	1,281	1,512	3,877	74,563
	E									2,731	4,843	66,314	73,888	181,484
	T									3,368	6,124	67,826	77,765	436,427
Total New Construction	M				320	1,660	5,223	15,741	34,737	53,135	61,744	74,118	274,747	385,774
	E				5,079	23,475	70,048	202,047	329,649	313,037	389,218	352,484	1,685,018	2,183,297
	T				5,399	25,138	75,271	217,788	364,386	366,172	450,962	426,602	1,959,765	2,569,071
Total Generation	M	9,916	15,130	34,937	46,498	35,821	28,596	22,714	34,737	53,135	61,744	74,118	436,494	557,164
	E	118,174	43,329	109,906	120,493	116,231	83,840	20,130	329,649	313,037	389,218	352,484	2,157,492	2,782,645
	T	128,090	61,470	144,837	170,671	150,712	78,955	27,103	364,386	366,172	450,962	426,602	2,593,986	3,339,809

[1] Assumes 175MW Sectional Capacity Export
Assumes 175 MW Total Return to N.I. 220kV from 400kV Assumed Capacity Export.

Source: Feasibility Report, Phase II, Rhoneroa #1 Ohakuri Thermal Power Project
Consultants & Partners, Inc., January 1979.

ANNEX

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program, Base Costs, 1978-1988

(Thousands of LE)

Early 1977 prices		Work in Progress as of December 31, 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1979-1986	Total Project	Beyond 1986
II Transmission														
A. Project Transmission	FC	-	-	-	-	76	386	274	76	132		944	944	-
	LC					173	1,492	1,088	173	1,092		7,189	7,189	
	T					631	1,134	1,362	631	1,137		8,133	8,133	
B. Other transmission by in-service date 1/														
1. 1978 Projects	FC	12,180	1,360									1,360	13,540	
	LC	13,080	1,368									1,368	14,448	
	T	25,260	2,720									2,720	27,980	
2. 1979 Projects	FC	3,720	4,930	1,360								6,290	14,010	
	LC	6,150	6,310	1,280								8,190	14,440	
	T	11,870	13,860	2,720								18,580	28,450	
3. 1980 Projects	FC	-	3,930	7,500	1,500							14,930	14,930	
	LC		8,440	7,790	1,500							13,930	13,930	
	T		12,370	13,290	3,000							30,860	30,860	
4. 1981 Projects	FC		-	3,290	6,640	1,360						13,290	13,290	
	LC			3,290	6,870	1,290						13,150	13,150	
	T			10,580	13,210	2,650						26,440	26,440	
5. 1982 Projects	FC				6,860	8,370	1,710					17,140	17,140	
	LC				6,860	8,370	1,440					17,070	17,070	
	T				13,720	17,140	3,150					34,210	34,210	
6. 1983 Projects	FC					7,640	9,370	1,930				19,140	19,140	
	LC					14,140	9,600	1,320				25,670	25,670	
	T					21,780	19,170	3,860				44,810	44,810	
7. 1984 Projects	FC						8,140	10,000	2,000			20,140	20,140	
	LC						8,000	10,000	2,000			20,000	20,000	
	T						16,140	20,000	4,000			40,140	40,140	
8. 1985 Projects	FC							9,360	11,640	2,290		23,290	23,290	
	LC							9,360	11,710	2,360		23,430	23,430	
	T							18,720	23,350	4,650		46,720	46,720	
9. 1986 Projects	FC							-	8,640	10,860	2,210	21,710	21,710	
	LC								8,710	10,860	2,140	21,710	21,710	
	T								17,350	21,720	4,350	43,420	43,420	
10. 1987 Projects	FC									9,860	12,360	22,220	24,720	2,500
	LC									9,860	12,360	22,220	24,720	2,500
	T									19,720	24,720	44,440	49,440	5,000
11. 1988 Projects	FC										10,930	10,930	29,070	18,140
	LC										10,930	10,930	29,070	18,140
	T										21,860	21,860	58,140	36,280
Total Transmission	FC	17,900	14,220	14,150	15,000	17,644	19,906	21,564	22,356	13,142	15,508	173,386	211,924	20,640
	LC	19,230	16,930	14,440	14,930	24,273	22,188	23,178	22,292	26,082	25,430	186,963	226,812	20,640
	T	37,130	29,150	28,590	29,930	42,221	41,994	44,940	43,351	47,227	50,938	360,333	438,743	41,280

1/ Includes 500kV, 220 kV & 132kV transmission lines & substations

Source: Shoubrah El Kheima Feasibility Study, Phase II Report, Sanderson & Porter, Inc. January 1979

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

Early 1978 prices		Work in Progress As of December 31, 1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total 1978-1986	Total Project	Beyond 1986
III Distribution														
A. Cairo & Alexandria (EEA), by in-service date 1/													-	
1. 1978 Projects	LC	23,500	23,570	•								15,570	31,070	•
	FC	8,400	8,400									8,400	12,800	
	T	31,900	31,970									31,970		
2. 1979 Projects	LC	•	23,500	23,370								31,070	31,070	
	FC		8,300	8,430								12,730	12,730	
	T		31,800	32,900								63,800	63,800	
3. 1980 Projects	LC	•		28,160	28,210							56,330	56,330	
	FC			6,160	6,210							12,330	12,330	
	T			34,200	34,430							68,700	68,700	
4. 1981 Projects	LC				33,860	27,860						51,720	51,720	
	FC				4,570	4,570						9,150	9,150	
	T				38,430	38,430						60,860	60,860	
5. 1982 Projects	LC					33,570	33,570					67,140	67,140	
	FC					5,000	5,720					11,230	11,230	
	T					39,370	39,500					79,070	79,070	
6. 1983 Projects	LC						37,660	37,660				75,310	75,310	
	FC						6,640	6,640				13,280	13,280	
	T						44,200	44,200				88,590	88,590	
7. 1984 Projects	LC							39,290	39,290			78,580	78,580	
	FC							6,310	6,860			12,790	12,790	
	T							46,220	46,150			92,370	92,370	
8. 1985 Projects	LC								45,790	45,790		91,580	91,580	
	FC								8,140	8,070		16,210	16,210	
	T								53,930	53,860		107,790	107,790	
9. 1986 Projects	LC									42,860	42,860	85,720	85,720	
	FC									7,500	7,500	15,200	15,200	
	T									50,360	50,360	100,720	100,720	
10. 1987 Projects	LC										48,430	48,430	96,860	48,430
	FC										8,570	8,570	17,070	8,500
	T										57,000	57,000	113,930	56,930
B. Rural Electrification (REA) 2/	LC		12,000	18,609	19,970	21,737	18,011	18,000	18,000	18,000	18,000	162,365	162,365	•
	FC		9,367	10,232	9,266	8,665	8,333	12,200	10,000	10,000	10,000	88,960	88,960	
	T		21,930	28,841	29,266	30,402	28,866	28,000	28,000	28,000	28,000	249,325	249,325	
Total Distribution	LC	25,500	63,138	72,319	73,990	81,167	89,131	94,930	103,000	108,530	109,190	793,735	887,465	48,430
	FC	6,400	22,622	22,802	20,126	19,235	21,535	23,370	25,000	23,370	25,370	208,420	221,720	8,500
	T	31,900	89,700	95,121	94,116	100,402	110,570	118,300	128,000	132,220	135,360	1,000,153	1,088,985	56,930
IV General Plant 3/	LC		3,830	3,080	3,230	3,080	3,080	3,500	3,600	3,600	3,700	30,500	30,300	
	FC		4,100	3,620	3,620	6,020	6,340	6,600	6,800	6,900	7,220	55,400	55,400	
	T		7,930	6,700	6,850	9,100	9,400	10,100	10,400	10,500	10,900	85,900	85,900	
V Studies Research and Training	LC		2,130	2,810	2,810	2,810	2,820	2,910	2,910	2,910	2,910	25,040	25,040	
	FC		-	730	730	730	730	740	740	740	740	5,880	5,880	
	T		2,130	3,540	3,540	3,540	3,550	3,650	3,650	3,690	3,650	30,920	30,920	
Total Investment Plan (Early 1978 prices)	LC	33,316	99,328	127,716	143,666	147,889	162,873	176,606	187,070	190,250	213,516	1,430,116	1,880,492	370,061
	FC	163,804	89,172	156,271	184,977	227,537	278,840	360,593	429,072	446,463	483,106	[illegible]	[illegible]	1,983,319
	T	197,120	188,500	283,987	328,643	375,426	441,713	537,199	598,142	646,713	698,622	4,092,757	6,353,437	2,363,380

1/ Includes rehabilitation & extension work.
2/ Includes rehabilitation & extension work, 66kV & below, outside Cairo & Alexandria
3/ Includes small construction, gas projects & housing

Source: Shoubrah El Kheima Feasibility Study, Phase II Report, Sanderson & Porter, Inc. January 1979

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program, Escalated Local Currency Costs, 1978-1986
(Thousands of LE)

Base prices, early 1978	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total 1978-1986
Escalation factor	0.075	0.236	0.437	0.617	0.831	1.096	1.368	1.676	2.024	
I Generation										
A. Projects Under Construction										
1. Suez (Old)										
Base Cost	150	100								[illegible]
Price Contingency	11	24								[illegible]
Total Cost	161	124								[illegible]
2. Kafr El Dawar										
Base Cost	2,500	2,385	4,946	4,500	8,136					22,467
Price Contingency	188	563	2,112	2,8[illegible]	4,924					[illegible]
Total Cost	2,688	2,948	7,058	7,322	13,060					[illegible]
3. Cairo West, 4th Unit										
Base Cost	1,000	2,600	6,953							[illegible]
Price Contingency	75	616	2,970							[illegible]
Total Cost	1,075	3,216	9,923							[illegible]
4. Abu Qir										
Base Cost	6,100	3,942	23,777	12,861						46,680
Price Contingency	458	930	10,153	8,064						[illegible]
Total Cost	6,558	4,872	33,930	20,925						[illegible]
5. Suez (New)										
Base Cost	700	2,250	8,000	8,000	6,339					25,289
Price Contingency	53	531	3,416	5,013	5,394					14,407
Total Cost	753	2,781	11,416	13,013	11,733					39,696
6. Ismailia										
Base Cost	200	1,000	2,500	8,800	8,800	6,973				28,273
Price Contingency	13	236	1,068	5,518	7,489	7,642				[illegible]
Total Cost	213	1,236	3,568	14,318	16,289	14,615				50,241
7. Helwan & Talkha Combustion Turbines										
Base Cost	2,000	8,600								10,600
Price Contingency	150	2,030								2,180
Total Cost	2,150	10,630								12,780
8. Other Combustion Turbines										
Base Cost	3,500	14,060								17,560
Price Contingency	263	3,318								3,581
Total Cost	3,763	17,378								21,141
B. New Projects										
1. Shoubrah El Kheima Units 1 & 2										
Base Cost		166	1,395	3,584	9,603	5,884	2,982	3,749		27,363
Price Contingency		39	596	2,247	8,172	6,449	4,079	3,751		[illegible]
Total Cost		205	1,991	5,831	17,775	12,333	7,061	7,500		52,696
2. Shoubrah El Kheima Unit 3										
Base Cost			66	558	1,434	3,841	2,354	1,193	1,499	10,945
Price Contingency			28	350	1,220	4,210	3,220	4,944	3,034	17,006
Total Cost			94	908	2,654	8,051	5,574	6,137	4,533	27,951
3. 1986-400MW Thermal										
Base Cost			144	1,207	3,102	8,312	5,093	2,581	3,245	23,684
Price Contingency			61	757	2,640	9,110	6,967	7,525	6,568	33,628
Total Cost			205	1,964	5,742	17,422	12,060	10,106	9,813	57,312
4. Esna Hydro										
Base Cost								1,860	9,290	11,150
Price Contingency								9,383	18,083	27,466
Total Cost								11,243	27,373	38,616
5. 1987-400MW Thermal										
Base Cost				144	1,207	3,102	8,312	5,093	2,581	20,439
Price Contingency				90	1,027	3,400	11,371	8,536	5,224	29,648
Total Cost				234	2,234	6,502	19,683	13,629	7,805	50,087
6. Assyout Hydro										
Base Cost									1,430	1,430
Price Contingency									2,896	2,896
Total Cost									4,326	4,326
7. 1988-400MW Nuclear										
Base Cost		254	801	1,817	5,343	9,163	10,416	10,152	9,056	47,002
Price Contingency		60	362	1,139	4,547	10,043	16,249	17,015	18,329	65,724
Total Cost		314	1,143	2,956	9,890	19,206	26,665	27,167	27,385	112,726
8. Nag Hammadi Hydro										
Base Cost									1,640	1,640
Price Contingency									3,319	3,319
Total Cost									4,959	4,959
9. Aswan Extension										
Base Cost				660	1,200	8,210	8,500	9,500	7,210	35,280
Price Contingency				416	1,021	8,998	11,628	13,922	14,593	52,578
Total Cost				1,076	2,221	17,208	20,128	23,422	21,803	87,858
10. 1989-400MW Nuclear										
Base Cost			254	801	1,817	5,343	9,163	10,416	10,152	37,946
Price Contingency			108	502	1,546	5,856	12,535	17,457	20,548	[illegible]
Total Cost			362	1,303	3,363	11,199	21,698	27,373	30,700	96,498
11. 1990-400MW Nuclear										
Base Cost				254	801	1,817	5,343	9,163	10,416	27,794
Price Contingency				159	682	1,491	7,309	15,157	21,082	[illegible]
Total Cost				413	1,483	3,308	12,652	24,320	31,498	[illegible]
12. 1990-150MW Pumped Storage										
Base Cost									640	640
Price Contingency									1,295	1,295
Total Cost									1,935	1,935
13. 1991-400MW Nuclear										
Base Cost					254	801	1,817	5,343	9,163	17,378
Price Contingency					216	578	2,486	8,955	18,546	[illegible]
Total Cost					470	1,379	4,303	14,298	27,709	[illegible]
14. 1992-400MW Nuclear										
Base Cost						254	801	1,817	5,343	8,215
Price Contingency						278	1,296	3,065	10,314	[illegible]
Total Cost						532	1,397	4,882	16,157	[illegible]
15. 1993-400MW Nuclear										
Base Cost							343	1,081	2,453	[illegible]
Price Contingency							69	1,812	4,965	[illegible]
Total Cost							412	2,893	7,418	[illegible]
Total Base Cost	16,150	35,357	48,838	43,186	48,036	53,700	55,126	61,948	74,118	[illegible]
Total Price Contingency	[illegible]	[illegible]	20,854	27,075	40,878	58,833	75,409	113,704	149,294	[illegible]
Total Generation LC escalated Cost	17,363	43,702	69,692	70,261	88,914	112,533	130,533	175,652	223,412	[illegible]

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program, Escalated Local Currency Costs, 1978-1986
(Thousands of LE)

Base prices, early 1978	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total 1978-1986
Escalation Factor	0.075	0.236	0.427	0.627	0.851	1.096	1.368	1.676	2.024	
II Transmission										
A. Project Transmission										
Base Cost				76	386	274	76	132		944
Price Contingency				48	328	300	106	221		1,001
Total Cost				124	714	574	180	353		1,945
B. Other Transmission, by in-service date										
1. 1978 Projects										
Base Cost	1,360									1,360
Price Contingency	102									102
Total Cost	1,462									1,462
2. 1979 Projects										
Base Cost	6,930	1,360								8,290
Price Contingency	520	321								841
Total Cost	7,450	1,681								9,131
3. 1980 Projects										
Base Cost	5,930	7,500	1,500							14,930
Price Contingency	445	1,770	641							2,856
Total Cost	6,375	9,270	2,141							17,786
4. 1981 Projects										
Base Costs	-	5,290	6,640	1,360						13,290
Price Contingency		1,248	2,835	853						4,936
Total Cost		6,538	9,475	2,213						18,226
5. 1982 Projects										
Base Cost	-	-	6,860	8,570	1,710					17,140
Price Contingency			2,929	5,373	1,455					9,757
Total Cost			9,789	13,943	3,165					26,897
6. 1983 Projects										
Base Cost				7,640	9,570	1,930				19,140
Price Contingency				4,790	8,144	2,115				15,049
Total Cost				12,430	17,714	4,045				34,189
7. 1984 Projects										
Base Cost					8,140	10,000	2,000			20,140
Price Contingency					6,927	10,960	2,736			20,623
Total Cost					15,067	20,960	4,736			40,763
8. 1985 Projects										
Base Cost						9,360	11,640	2,290		23,290
Price Contingency						10,259	15,924	3,838		30,021
Total Cost						19,619	27,564	6,128		53,311
9. 1986 Projects										
Base Cost							8,640	10,860	2,210	21,710
Price Contingency							11,820	18,201	4,473	34,494
Total Cost							20,460	29,061	6,683	56,204
10. 1987 Projects										
Base Cost								9,860	12,360	22,220
Price Contingency								16,525	25,017	41,542
Total Cost								26,385	37,377	63,762
11. 1988 Projects										
Base Cost									10,930	10,930
Price Contingency									22,122	22,122
Total Cost									33,052	33,052
Total Base Cost	14,220	14,150	15,000	17,646	19,806	21,564	22,356	23,142	25,500	173,384
Total Price Contingency	1,067	3,339	6,405	11,064	16,854	23,634	30,584	38,785	51,612	183,344
Total Transmission LC Escalated Cost	15,287	17,489	21,405	28,710	36,660	45,198	52,940	61,927	77,112	356,728

ANNEX

EGYPTIAN ELECTRICITY AUTHORITY

SIDI KRIR II, KOREIMA THERMAL POWER PROJECT

Power Sector Development Program, Escalated Local Currency Cost, 1978-1986
(Thousands of LE)

Base Price, early 1978	1978	1979	1980	1981	1982	1983	1984	1985	1986	Total 1978-1986
Escalation factor	0.075	0.236	0.427	0.627	0.851	1.096	1.368	1.676	2.024	
III Distribution										
A. Cairo & Alexandria (EEA), by in-service date										
1. 1978 Projects										
Base Cost	25,570									25,570
Price Contingency	1,918									1,918
Total Cost	27,488									27,488
2. 1979 Projects										
Base Cost	25,500	25,570								51,070
Price Contingency	1,913	6,034								7,947
Total Cost	27,413	31,604								39,017
3. 1980 Projects										
Base Cost		28,140	28,210							56,350
Price Contingency		6,641	12,046							18,687
Total Cost		34,781	40,256							75,037
4. 1981 Projects										
Base Cost			25,860	25,860						51,720
Price Contingency			11,042	16,214						27,256
Total Cost			36,902	42,074						78,976
5. 1982 Projects										
Base Cost				33,570	33,570					67,140
Price Contingency				21,048	28,568					49,616
Total Cost				54,618	62,138					116,756
6. 1983 Projects										
Base Cost					37,570	37,640				75,210
Price Contingency					31,972	41,253				73,225
Total Cost					69,542	78,893				148,435
7. 1984 Projects										
Base Cost						39,290	39,290			78,580
Price Contingency						43,062	53,749			96,811
Total Cost						82,352	93,030			175,391
8. 1985 Projects										
Base Cost							45,790	45,790		91,580
Price Contingency							62,641	76,744		139,385
Total Cost							108,431	122,534		230,965
9. 1986 Projects										
Base Cost								42,860	42,860	85,720
Price Contingency								71,833	86,749	158,582
Total Cost								114,693	129,609	244,302
10. 1987 Projects										
Base Cost									48,430	48,430
Price Contingency									98,022	98,022
Total Cost									146,452	146,452
B. Rural Electrification (REA)										
Base Cost	12,088	18,609	19,920	21,737	18,011	19,000	18,000	18,000	18,000	162,365
Price Contingency	907	4,392	8,506	13,629	15,327	19,728	24,624	30,168	36,433	153,713
Total Cost	12,995	23,001	28,426	35,366	33,338	37,728	42,624	48,168	54,432	316,078
Total Base Cost	63,158	72,319	73,990	81,167	89,151	94,930	103,080	106,650	109,290	793,735
Total Price Contingency	4,738	17,067	31,594	50,891	75,867	104,043	141,014	178,745	221,203	825,162
Total Distribution LC Escalated Cost	67,896	89,386	105,584	132,058	165,018	198,973	244,094	285,395	330,493	1,618,897
IV General Plant										
Base Cost	3,850	3,080	3,030	3,080	3,060	3,500	3,600	3,600	3,700	30,500
Price Contingency	289	727	1,294	1,931	2,604	3,836	4,925	6,034	7,489	29,129
Total Cost	4,139	3,807	4,324	5,011	5,664	7,336	8,525	9,634	11,189	59,629
V Studies, Research & Training										
Base Cost	2,150	2,810	2,810	2,810	2,820	2,910	2,910	2,910	2,910	25,040
Price Contingency	161	663	1,200	1,762	2,400	3,189	3,981	4,877	5,390	24,123
Total Cost	2,311	3,473	4,010	4,572	5,220	6,099	6,891	7,787	8,300	49,163
Total Base Cost										
Total Price Contingency	99,528	127,716	143,668	147,889	162,373	176,604	187,370	198,250	215,518	1,459,116
Total LC escalated Cost	7,468	30,141	61,347	92,723	138,603	193,357	255,313	342,145	435,488	1,557,385
	106,996	157,857	205,015	240,612	301,476	370,161	442,683	540,395	651,006	3,016,501

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EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program, Escalated Foreign Currency Costs, 1978-1986
(Thousands of LE equivalent - LE 1 = US$1.43)

BEST AVAILABLE COPY

Base Prices, Early 1978 / Escalation Factor	1978 / 0.0375	1979 / 0.1048	1980 / 0.1737	1981 / 0.2442	1982 / 0.3119	1983 / 0.3876	1984 / 0.4618	1985 / 0.5707	1986 / 0.6650	Total 1978-1986
I. Generation										
A. Projects Under Construction										
1. Suez (Old) — Base Cost	150	50								200
Price Contingency	6	5								11
Total Cost	156	55								211
2. Kafr El Dawar — Base Cost	150	2,595	5,200	3,000	2,180					13,125
Price Contingency	6	272	903	733	680					2,594
Total Cost	156	2,867	6,103	3,733	2,860					15,719
3. Cairo West, 4th Unit — Base Cost	7,200	4,300	2,106							13,606
Price Contingency	270	472	366							1,108
Total Cost	7,470	4,772	2,472							14,714
4. Abu Qir — Base Cost	18,220	40,615	58,587	24,351						141,773
Price Contingency	683	4,256	10,176	5,947						21,062
Total Cost	18,903	44,871	68,763	30,298						162,835
5. Suez (New) — Base Cost	1,620	6,000	52,000	32,000	18,300					109,920
Price Contingency	61	629	9,032	7,816	5,708					23,246
Total Cost	1,681	6,629	61,032	39,816	24,008					133,166
6. Ismailia — Base Cost	500	1,780	6,600	57,200	35,200	20,130				121,410
Price Contingency	19	186	1,146	13,968	10,979	8,010				34,308
Total Cost	519	1,966	7,746	71,168	46,179	28,140				155,718
7. Helwan & Talkha Combustion Turbines — Base Cost	5,400	42,900								48,300
Price Contingency	202	4,496								4,698
Total Cost	5,602	47,396								52,998
8. Other Combustion Turbines — Base Cost	12,080	11,460								23,540
Price Contingency	453	1,201								1,654
Total Cost	12,533	12,661								25,194
B. New Projects										
1. Shoubrah El Kheima Units 1 & 2 — Base Cost	-	775	9,883	25,386	68,391	41,663	21,122	26,548		193,968
Price Contingency		81	1,717	6,199	21,194	16,578	10,177	15,151		71,297
Total Cost		856	11,600	31,585	89,585	58,241	31,299	41,699		265,265
2. Shoubrah El Kheima Unit 3 — Base Cost			310	3,953	10,154	27,436	16,665	8,449	10,619	77,586
Price Contingency			56	965	3,167	10,917	8,229	4,822	7,062	35,018
Total Cost			366	4,918	13,321	38,353	24,894	13,271	17,681	112,602
3. 1986-400MW Thermal — Base Cost			671	8,354	21,973	59,368	36,061	18,282	22,978	167,687
Price Contingency			117	2,089	6,853	23,623	17,374	10,434	15,280	75,770
Total Cost			788	10,443	28,826	82,991	53,435	28,716	38,258	243,657
4. Esna Hydro — Base Cost								1,570	7,930	9,500
Price Contingency								896	5,273	6,169
Total Cost								2,466	13,203	15,669
5. 1987-400MW Thermal — Base Cost				671	8,354	21,973	59,368	36,061	18,282	144,709
Price Contingency				164	2,868	8,743	28,604	20,580	12,158	72,917
Total Cost				835	11,222	30,716	87,972	56,641	30,440	217,826
6. Assyut Hydro — Base Cost									1,070	1,070
Price Contingency									712	712
Total Cost									1,782	1,782
7. 1988-600MW Nuclear — Base Cost		2,004	6,010	13,638	40,353	68,604	83,651	76,899	68,217	359,376
Price Contingency		210	1,044	3,330	12,186	27,297	40,203	43,886	45,364	174,320
Total Cost		2,214	7,054	16,968	52,539	95,901	123,854	120,785	113,581	533,396
8. Nag Hammadi Hydro — Base Cost									1,630	1,630
Price Contingency									951	951
Total Cost									2,581	2,581
9. Aswan Extension — Base Cost				210	1,000	5,140	5,360	7,000	4,790	23,500
Price Contingency				51	312	2,045	2,382	3,295	3,185	12,170
Total Cost				261	1,312	7,185	7,742	10,295	7,975	35,670
10. 1989-600MW Nuclear — Base Cost			2,004	4,010	13,538	40,353	68,604	83,651	76,599	291,159
Price Contingency			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	154,097
Total Cost			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11. 1990-600MW Nuclear — Base Cost				2,004	5,310	13,633	40,353	68,604	83,651	214,260
Price Contingency				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35,263	[illegible]
Total Cost				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12. 1990-300MW Pumped Storage — Base Cost									[illegible]	[illegible]
Price Contingency									[illegible]	[illegible]
Total Cost									[illegible]	[illegible]
13. 1991-600MW Nuclear — Base Cost					2,006	[illegible]	[illegible]	40,353	[illegible]	[illegible]
Price Contingency					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Cost					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14. 1992-600MW Nuclear — Base Cost						2,004	5,310	13,538	40,353	62,205
Price Contingency						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Cost						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15. 1993-600MW Nuclear — Base Cost							[illegible]	[illegible]	[illegible]	[illegible]
Price Contingency							[illegible]	[illegible]	[illegible]	[illegible]
Total Cost							[illegible]	[illegible]	[illegible]	[illegible]
Total Base Cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Price Contingency	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total Generation FC Escalated Cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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ANNEX

SYRIAN ELECTRICITY AUTHORITY

EUPHRATES II KARIMA THERMAL POWER PROJECT

Power Sector Development Program Escalated Foreign Currency Costs, 1978-1986

(Thousands of LE Equivalent - 1 LE = US$1.40)

Base Prices, early 1978 Escalation Factor	1978 0.0575	1979 0.1048	1980 0.1737	1981 0.2442	1982 0.3119	1983 0.3979	1984 0.4818	1985 0.5707	1986 0.6430	Total 1978-1986
II Transmission										
A. Project Transmission										
Base Cost				575	2,948	2,086	575	1,003		7,189
Price Contingency				140	919	830	277	374		2,740
Total Cost				715	3,867	2,916	852	1,377		9,929
B. Other Transmission, by in-service date										
1. 1978 Projects										
Base Cost	1,360									1,360
Price Contingency	51									51
Total Cost	1,411									1,411
2. 1979 Projects										
Base Cost	6,930	1,360								8,290
Price Contingency	260	143								403
Total Cost	7,190	1,503								8,693
3. 1980 Projects										
Base Cost	6,640	7,790	1,500							15,930
Price Contingency	249	816	261							1,326
Total Cost	6,889	8,606	1,761							17,256
4. 1981 Projects										
Base Cost		5,290	6,570	1,290						13,150
Price Contingency		554	1,141	315						2,010
Total Cost		5,844	7,711	1,605						15,160
5. 1982 Projects										
Base Cost			6,860	8,570	1,640					17,070
Price Contingency			1,192	2,093	512					2,797
Total Cost			8,052	10,663	2,152					20,867
6. 1983 Projects										
Base Cost				14,140	9,600	1,930				25,670
Price Contingency				3,453	2,994	768				7,215
Total Cost				17,593	12,594	2,698				32,885
7. 1984 Projects										
Base Cost					8,000	10,000	2,000			20,000
Price Contingency					2,495	3,979	964			7,438
Total Cost					10,495	13,979	2,964			27,438
8. 1985 Projects										
Base Cost						9,360	11,710	2,360		23,430
Price Contingency						3,724	5,642	1,347		10,713
Total Cost						13,084	17,352	3,707		34,143
9. 1986 Projects										
Base Cost							8,710	10,860	2,140	21,710
Price Contingency							4,196	6,198	1,423	11,817
Total Cost							12,906	17,058	3,563	33,527
10. 1987 Projects										
Base Cost								9,860	12,360	22,220
Price Contingency								5,627	8,219	13,846
Total Cost								15,487	20,579	36,066
11. 1988 Projects										
Base Cost									10,930	10,930
Price Contingency									7,268	7,268
Total Cost									18,198	18,198
Total Base Cost	14,930	14,440	14,930	24,575	22,188	23,376	22,995	24,085	25,430	186,949
Total Price Contingency	560	1,513	2,594	6,001	6,920	9,301	11,079	13,746	16,910	68,624
Total Transmission FC Escalated Cost	15,490	15,953	17,524	30,576	29,108	32,677	34,074	37,831	42,340	255,573

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SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program. Escalated Foreign Currency Costs, 1978-1986

(Thousands of LE Equivalent - 1 LE = US$1.40)

Base prices, early 1978 Escalation factor	1978 0.0373	1979 0.1048	1980 0.1737	1981 0.2442	1982 0.3119	1983 0.3979	1984 0.4818	1985 0.5707	1986 0.6850	Total 1978-1986
III Distribution										
A. Cairo & Alexandria (EEA), by in-service date										
1. 1978 Projects										
Base Cost	6,400									6,400
Price Contingency	240									240
Total Cost	6,640									6,640
2. 1979 Projects										
Base Costs	6,360	6,430								12,790
Price Contingency	239	674								913
Total Cost	6,599	7,104								13,703
3. 1980 Projects										
Base Cost		6,140	6,210							12,350
Price Contingency		643	1,079							1,722
Total Cost		6,783	7,289							14,072
4. 1981 Projects										
Base Cost			4,570	4,570						9,140
Price Contingency			794	1,116						1,910
Total Cost			5,364	5,686						11,050
5. 1982 Projects										
Base Cost				6,000	5,930					11,930
Price Contingency				1,665	1,850					3,515
Total Cost				7,665	7,780					15,245
6. 1983 Projects										
Base Cost					6,640	6,640				13,280
Price Contingency					2,071	2,642				4,713
Total Cost					8,711	9,282				17,993
7. 1984 Projects										
Base Cost						6,930	6,860			13,790
Price Contingency						2,757	3,305			6,062
Total Cost						9,687	10,165			19,852
8. 1985 Projects										
Base Cost							8,140	8,070		16,210
Price Contingency							3,922	4,606		8,528
Total Cost							12,062	12,676		24,738
9. 1986 Projects										
Base Cost								7,500	7,500	15,000
Price Contingency								4,280	4,988	9,268
Total Cost								11,780	12,488	24,268
10. 1987 Project										
Base Cost									8,370	8,370
Price Contingency									5,899	5,899
Total Cost									14,269	14,269
B. Rural Electrification (REA)										
Base Cost	9,862	10,232	9,346	8,665	8,855	10,000	10,000	10,000	10,000	86,960
Price Contingency	370	1,072	1,623	2,116	2,762	3,979	4,818	5,707	6,650	29,097
Total Cost	10,232	11,304	10,969	10,781	11,617	13,979	14,818	15,707	16,650	116,057
Total Base Cost	22,622	22,802	20,126	19,235	21,425	23,570	25,000	25,570	26,070	206,420
Total Price Contingency	969	2,389	3,496	4,697	6,683	9,378	12,043	14,593	17,537	71,467
Total Distribution FC Escalated Cost	23,471	25,191	23,622	23,932	28,108	32,948	37,043	40,163	43,607	277,887
IV General Plant										
Base Cost	4,100	5,620	5,870	6,020	6,340	6,600	6,800	6,900	7,200	55,400
Price Contingency	154	589	1,011	1,470	1,977	2,626	3,276	3,938	4,788	19,829
Total	4,254	6,209	6,881	7,490	8,317	9,226	10,076	10,838	11,988	75,229
V Studies, Research & Training										
Base Cost	-	730	730	730	730	740	740	740	740	5,880
Price Contingency	-	77	127	178	228	294	356	422	492	2,174
Total		807	857	908	958	1,034	1,096	1,162	1,232	8,054
Total Base Cost	86,972	156,271	184,977	227,537	278,640	360,505	409,072	446,463	483,104	2,633,641
Total Price Contingency	3,263	16,276	32,121	55,563	86,909	143,483	197,090	256,797	321,264	1,110,876
Total FC Escalated Cost	90,235	172,547	217,108	283,100	365,549	504,088	606,162	703,260	804,368	3,744,517

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SIKOUBRAH EL KHEIMA THERMAL POWER PROJECT

Power Sector Development Program, Summary of Escalated Costs, 1978-1986
(Thousands of LE)

Description		1978	1979	1980	1981	1982	1983	1984	1985	1986	1978-1986
I. Generation	LC	17,363	43,702	69,692	70,261	88,914	112,555	130,533	175,652	223,412	932,084
	FC	47,020	124,487	168,274	220,194	299,058	428,203	523,871	611,266	705,401	3,127,774
	T	64,383	168,189	237,966	290,455	388,072	540,758	654,404	786,918	928,813	4,059,858
II. Transmission	LC	15,287	17,489	21,405	28,710	36,660	45,198	52,940	61,927	77,112	356,728
	FC	15,490	15,953	17,524	30,576	29,108	32,677	34,074	37,831	42,340	255,573
	T	30,777	33,442	38,929	59,286	65,768	77,875	87,014	99,758	119,452	612,301
III. Distribution	LC	67,896	89,386	105,584	132,058	165,018	198,973	244,094	285,395	330,493	1,618,897
	FC	23,471	25,191	23,622	23,932	28,108	32,948	37,045	40,163	43,407	277,887
	T	90,367	114,577	129,206	155,990	193,126	231,921	281,139	325,558	373,900	1,896,784
IV. General Plant	LC	4,139	3,807	4,324	5,011	5,664	7,336	8,525	9,634	11,189	59,629
	FC	4,254	6,209	6,831	7,490	8,317	9,226	10,076	10,838	11,988	75,229
	T	8,393	10,016	11,155	12,501	13,981	16,562	18,601	20,472	23,177	134,858
V. Studies, Research and Training	LC	2,311	3,473	4,010	4,572	5,220	6,099	6,891	7,787	8,800	49,163
	FC	-	807	857	908	958	1,034	1,034	1,162	1,232	8,054
	T	2,311	4,280	4,867	5,480	6,178	7,133	7,987	8,949	10,032	57,217
Total	LC	106,996	157,857	205,015	240,612	301,476	370,161	442,983	540,395	651,006	3,016,501
	FC	90,235	172,647	217,108	283,100	365,549	504,088	606,162	701,260	804,368	3,744,517
	T	197,231	330,504	422,123	523,712	667,025	874,249	1,049,145	1,241,655	1,455,374	6,761,018

June 1979

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SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Return on Investment

1. The specific technical and economic assumptions used for the calculations, where they differ from those used for the least-cost analysis (Annex CC), are summarized below.

A. Costs

2. The basic cost data for the Shoubrah station (3x300 MW), plus associated transmission and distribution facilities were taken from Annex DD . The transmission component includes, in addition to the specific transmission facilities forming part of the Project, the time slice of EEA's transmission investment program related to Shoubrah, i.e. the items shown in Annex DD as "1984 and 1985 projects", plus part of 1986. Similarly, the parts of EEA's distribution investment program associated with Shoubrah's output were identified as the 1984 and 1985 projects, and part of the 1986 projects, shown in Annex DD , including the rural electrification program for 1984 and 1985. The foreign exchange rate used was LE 1 = $1.40 on foreign exchange costs.

3. For calculating the rate of return the capital costs were adjusted by shadow pricing the unskilled labor components at half the financial cost. The unskilled labor components were assumed to represent the following proportions of the capital costs:

Shoubrah El Kheima Station	30% of local currency costs
Transmission	15% of total costs
Distribution	25% of total costs

Fuel Costs

4. For the economic calculation it was necessary to use the opportunity costs of fuels, based on export values, rather than the current domestic prices, as set by the Government. These are shown below, together with the domestic prices for comparison (gas oil and kerosene are included, since Shoubrah's benefits include reduced consumption of these fuels through substitution of Shoubrah output):

		LE/ton		Milliemes/kWh Generated (Net)
Mazout	- Opportunity Cost	55		15.9 /1
	- Domestic Price	7.50		2.2 /1
Gas Oil	- Opportunity Cost	86	Combustion Turbine	33.0
			Diesel Set	21.9
	- Domestic Price	24.60	Combustion Turbine	9.5
			Diesel Set	6.3
Kerosene	- Opportunity Cost	93		-
	- Domestic Price	32.30		

/1 Shoubrah El Kheima.

Operation and Maintenance Costs

5. The following O & M costs were assumed:

Generation	1.857 milliemes/kWh
Transmission	1.5% of capital costs
Distribution	2% of capital costs

Project Supply

6. It was assumed that the Shoubrah El Kheima station would operate at an average load factor of 80% in the period 1986-1999, generating 6,300 GWh p.a. (for 1985, the first year of operation, an output of 3,150 GWh was assumed).

B. Benefits

Incremental Electricity Sales

7. The main benefits are the incremental supplies of electricity to consumers attributable to Shoubrah. The forecast total sales from 1985 (when the Project comes into operation) and subsequent years are shown in Annex M together with the corresponding generation required. From this and Annex P which shows the available generation from the EEA system up to 1986, it is possible to derive the cumulative annual incremental sales and generation to be met by Shoubrah, and these total figures were then allocated prorata by consumer categories (from Annex M) as follows:

Incremental Electricity Sales and Generation by Consumer Categories

	GWh					
	1985		1986		1987-1999	
	Sales	Required Generation	Sales	Required Generation	Sales	Required Generation
Industry (General)	522	593	985	1,119	1,065	1,210
Industry (Large)	1,029	1,169	1,919	2,181	2,050	2,330
Residential/Commercial	986	1,120	1,960	2,227	2,174	2,470
Irrigation/Agriculture	42	48	87	99	96	109
General Purpose	27	31	52	59	56	64
Government Buildings	49	56	94	107	103	117
Total	2,655	3,017	5,097	5,792	5,544	6,300

The incremental revenues attributable to the Shoubrah sales were calculated using the annual average projected prices derived from the financial projections (Annex Y).

Fuel Savings

8. Part of the output from Shoubrah will result in savings in fuel costs to the economy through the substitution of electricity from the grid for other, more costly energy sources. The consumer categories affected are Residential/Commercial, Industry (General) and Irrigation/Agriculture. The fuel savings were derived as follows:

(a) Residential/Commercial. The load forecast includes projections of the number of consumers in this category, from which the new customers to be supplied as a result of the Shoubrah were derived, as shown below:

	1985	1986	1987-99
New Residential/Commercial Customers (cumulative), '000	482	959	1,044

Part of the supply to these consumers will be for lighting, for which kerosene lamps would otherwise be used. It was conservatively estimated that kerosene consumption for lighting would be 1/2-liter per consumer per day, or 15 liters/month, and that the corresponding electricity consumption would be 15 kWh/month. The comparative annual fuel costs, and resulting savings, per customer are as follows:

	Cost, LE
Kerosene	13.3
Electricity	2.9
Savings	10.4

(b) Industry General. No data are available on the extent of autogeneration in this category, which covers both medium and small industry, nor on the type of autogeneration, i.e. diesel or steam. In the absence of precise data, it has been assumed that, if supply were not available from the grid as a result of Shoubrah, one third of the required generation would come from industry's own diesel sets at a higher fuel cost. The comparative figures are as follows (based on the opportunity costs of fuel):

	Fuel Cost Milliemes/kWh
Supply from Shoubrah	15.9
Autogeneration (Diesel)	21.9
Savings	6.0

(c) Irrigation/Agriculture. Supply from the grid attributable to Shoubrah would replace diesel pumping, for which the same savings in fuel cost are assumed as in the previous case.

9. In addition to the above, there would also be fuel savings through the substitution of generation from Shoubrah in the first two years of its operation for generation from plant with higher incremental fuel costs. These savings will occur in the years 1985 and 1986, when the full output of Shoubrah is not required to meet incremental electricity consumption, but when economic dispatching will cause it to be operated up to its full availability, displacing output from higher cost combustion turbines. This replacement generation was derived as follows:

	1985	1986	1987
Incremental EEA Sales, GWh	2,655	5,097	7,775
Required Incremental Generation, GWH	3,017	5,792	8,835
Project Capability, GWh	3,150	6,300	6,300
Replacement Generation, GWh	133	508	-

The resulting savings were valued at the difference between the fuel cost of generation by combustion turbines and by Shoubrah (i.e. 33 milliemes/kWh less 15.9 milliemes/kWh).

Other Benefits

10. Other benefits comprise the following items:

(a) a stamp tax of 5 milliemes/kWh paid by all residential consumers. For this purpose residential consumption was estimated to comprise 75% of sales in the residential/ commercial category;

(b) a radio license fee of 2 milliemes/kWh by residential consumers in Cairo and Alexandria, and of 1 milliemé/kWh by consumers outside Cairo and Alexandria, on the first 45 kWh/month. Since it was not possible to identify the Cairo/Alexandria and other residential consumers separately, an average value of 1.5 milliemes/kWh was assumed;

(c) connection charges payable by new residential consumers. These range from LE 4 to LE 24, and an average value of LE 10 was assumed. The new customers to be served by the Project were estimated at 362,000 in 1985, 357,000 in 1986 and 64,000 in 1987; and

(d) an annual contract renewal fee of LE 0.3 payable by residential consumers.

Rate of Return

11. The resulting streams of costs and benefits are shown in the attached table. The rate of return was found to be 7.8%. This result was tested for sensitivity to variations in capital costs, fuel costs, load growth and value of foreign exchange. The results are set out in the attached table on pg.7 of 8.

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[illegible] Thermal Power Project

Costs, Benefits and Rate of Return
(£E'000)

Year	COSTS – Capital – Power Station Local	Power Station Foreign	Transmission Local	Transmission Foreign	Distribution Local	Distribution Foreign	Total Capital Costs Local	Total Capital Costs Foreign	Total Capital Costs Total	Fuel Local	O & M Costs Generation Local	O & M Costs Transmission Local	O & M Costs Distribution Local	Total O&M	Total Costs Local	Total Costs Foreign	Total Costs Total	BENEFITS – Sales Revenue	Fuel Savings Industry Gen.	Fuel Savings Resid./Commerce	Fuel Savings Irrig./Agric.	Replacement Generation	Other 2/	Total Benefits
[illegible]	141	775	-	-	-	-	141	775	916	-	-	-	-	-	141	775	916	-	-	-	-	-	-	-
[illegible]	1,242	10,193	-	-	-	-	1,242	10,193	11,435	-	-	-	-	-	1,242	10,193	11,435	-	-	-	-	-	-	-
[illegible]	3,461	29,341	87	575	-	-	3,548	29,916	33,464	-	-	-	-	-	3,548	29,916	33,464	-	-	-	-	-	-	-
[illegible]	9,381	78,745	7,065	10,948	-	-	16,446	89,693	106,139	-	-	-	-	-	16,446	89,693	106,139	-	-	-	-	-	-	-
[illegible]	8,224	69,099	16,553	21,446	33,518	6,930	58,331	97,475	155,806	-	-	-	-	-	58,331	97,475	155,806	-	-	-	-	-	-	-
[illegible]	4,5[illegible]	17,787	12,061	15,739	87,070	45,000	104,447	78,526	182,973	-	-	-	-	-	104,447	78,526	182,973	-	-	-	-	-	-	-
[illegible]	4,204	36,[illegible]	3,509	3,178	59,644	19,[illegible]	67,350	59,497	126,847	50,405	5,850	1,270	3,050	10,170	127,655	59,497	187,150	73,749	1,186	9,013	800	3,276	7,641	9,000
[illegible]	1,276	10,619	314	257	8,521	2,921	10,111	13,097	24,000	100,170	11,700	1,419	4,859	17,978	128,259	13,097	142,156	147,558	2,278	9,976	996	8,667	11,611	190,668
[illegible]	-	-	-	-	-	-	-	-	-	100,170	11,700	1,419	4,859	17,978	118,148	-	118,148	160,458	2,420	10,058	654	-	9,644	182,094
[illegible]	-	-	-	-	-	-	-	-	-	100,170	11,700	1,419	4,859	17,978	118,148	-	118,148	160,458	2,420	10,058	654	-	9,423	183,453
[illegible]	-22,13[illegible] 1/	-104,520 1/	-32,322 1/	-44,121 1/	-112,054 1/	-31,824 1/	-166,784 1/	-260,397 1/	-427,178 1/	100,170	11,700	1,419	4,859	17,978	-48,613	-260,397	-309,030	160,458	2,420	10,058	654	-	9,423	183,453

1/ Residual value, assuming economic life of 30 years for power station, 40 years for transmission equipment and 30 years for distribution equipment.

2/ "Other" benefits comprise proceeds of stamp tax on residential electricity sales, radio license fees, connection charges for new consumers and annual contract renewal fees for residential/commercial consumers.

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Costs, Benefits and Rate of Return Sensitivity Tests

	Rate of Return (%)
Base Case	7.8
Capital Costs 10% Higher	7.0
Capital Costs 10% Lower	8.8
Fuel Costs 10% Higher	6.6
Fuel Costs 10% Lower	9.0
High Load Forecast	7.9
Low Load Forecast	7.6
Higher Exchange Rate (LE 1 = US$1.75)	8.8
Lower Exchange Rate (LE 1 = US$1.05)	6.1
Electricity Sales Revenue 10% Higher	10.0
Electricity Sales Revenue 10% Lower	5.5

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

SHOUBRAH EL KHEIMA THERMAL POWER PROJECT

Costs, Benefits and Rate of Return
Sensitivity Tests

	Rate of Return (%)
Base Case	7.8
Capital Costs 10% Higher	7.0
Capital Costs 10% Lower	8.8
Fuel Costs 10% Higher	6.6
Fuel Costs 10% Lower	9.0
High Load Forecast	7.9
Low Load Forecast	7.6
Higher Exchange Rate (EE 1 = US$1.75)	8.8
Lower Exchange Rate (EE 1 = US$1.05)	6.1
Electricity Sales Revenue 10% Higher	10.0
Electricity Sales Revenue 10% Lower	5.5

March 1979

EGYPT

EGYPTIAN ELECTRICITY AUTHORITY

DAMIETTA EL KIRIMA THERMAL POWER PROJECT

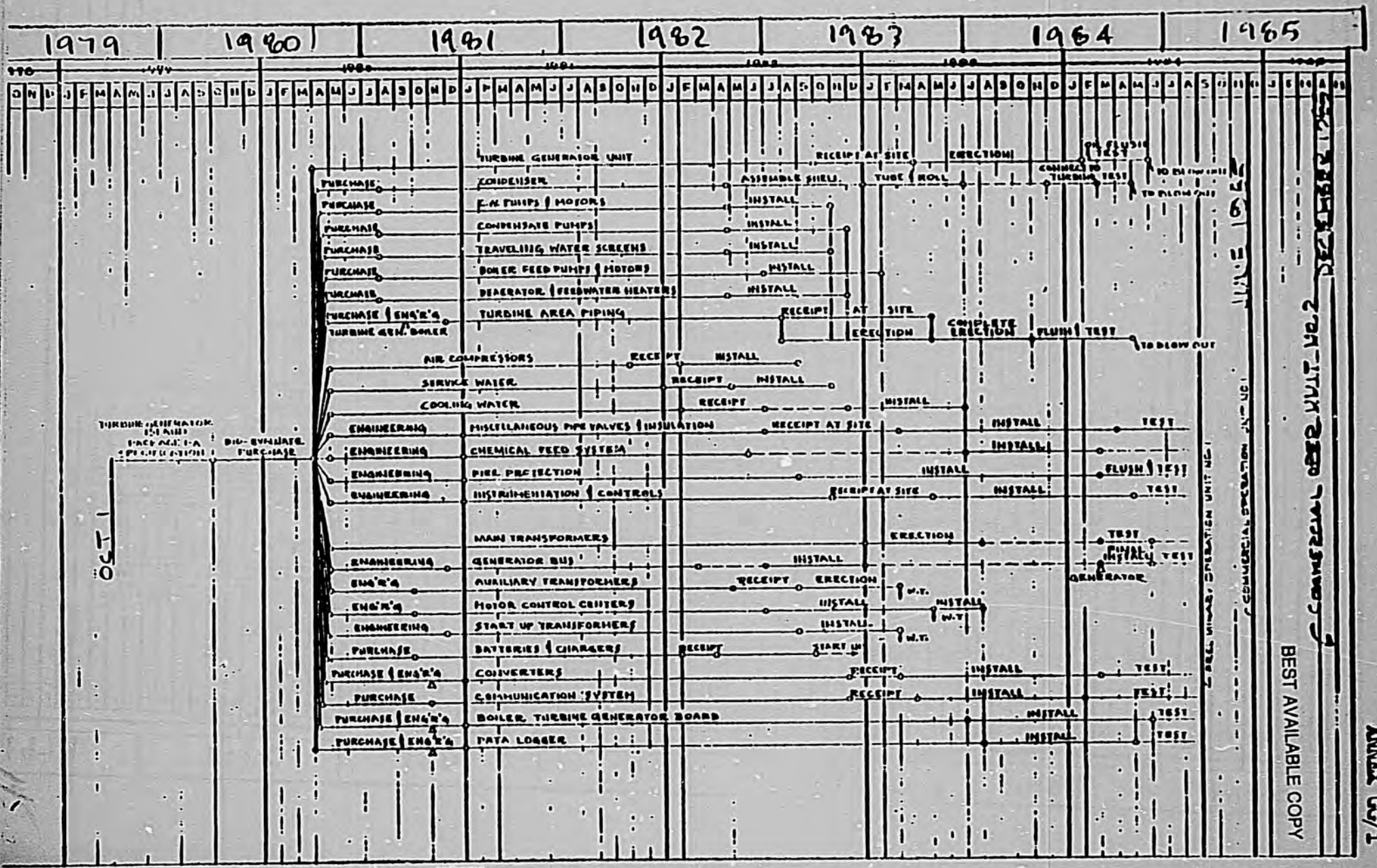
Tentative Allocation of Project Financing By Sources
Thousands of US$ Equivalent (1 LE = US$1.40)

Contract Category	L/C: OCR/KSA	F/C: IBRD/IDA	F/C: IBRD	F/C: EIB 1/	F/C: EIB 2/	F/C: OPEC 3/	F/C: Suppliers' Credits	F/C: Commercial Bank	Total L/C	Total F/C
1. Demolition	4,142	-	-	-	-	-	-	736	4,142	736
2. Construction (Civil, Mech. Elec.)	40,080	-	-	-	31,000	10,000	-	14,810	40,080	55,810
3. Boiler Island										
3a. Boiler & Accessories	18,384 4/	93,550	-	-	-	-	-	-	18,384	93,550
3b. Boiler Controls	-	1,470	-	-	-	-	-	-	-	1,470
3c. High Pressure Piping	-	7,351	-	-	-	-	-	-	-	7,351
3d. Water Treatment 5/	-	8,261	-	-	-	-	-	-	-	8,261
3e. Fuel Handling, Stacks 6/ & Auxiliary Steam Supply 7/	-	5,969	-	-	-	-	-	-	-	5,969
4. Turbine Island										
4a. Turbine Generators	-	-	82,055	-	-	-		?	-	82,055
4b. Condensers & Auxiliaries	-	-	-	-	-	-	11,088	-	-	11,088
4c. BFP & Motors	-	-	-	-	-	-	6,172	-	-	6,172
4d. FW Heaters & Deaerators	-	-	-	-	-	-	2,987	-	-	2,987
4e. Piping & Insulation 8/	-	-	-	-	-	-	9,115	-	-	9,115
5. Electrical Equipment	289	-	-	23,096	-	-	-	-	289	23,096
6. HV Substation	518	-	-	-	-	-	10,295	-	518	10,295
7. Aux Mechanical Equipment	-	-	-	-	-	-	4,841	-	-	4,841
8. Engineering & Management	4,152	399	17,965	-	-	-	-	2,822	4,152	20,366
9. Off-Site Tank Farm	6,210	-	-	-	-	-	13,504	-	6,210	13,504
10. Spares	-	-	-	-	-	-	-	16,705	-	16,705
11. Transmission	2,722	-	-	9,406	-	-	2,458	1,996	2,722	13,860
12. Technical Assistance	1,383	-	-	2,498	-	-	-	-	1,383	2,498
TOTALS	78,082	117,000	100,000	35,000	31,000	10,000	60,500	34,269	78,082	382,782

1/ Special action fund tied to EEC procurement.
2/ EIB funds are untied. Construction contract will be put to ICB under Bank guidelines.
3/ OPEC funds are untied & assigned to construction contract.
4/ Includes installation & erection of all Boiler Island items.
5/ Includes building.
6/ Includes foundation.
7/ Supply of equipment & materials only. I & E covered under construction contract.
8/ Includes small piping.

March 1975

ANNEX 2.2



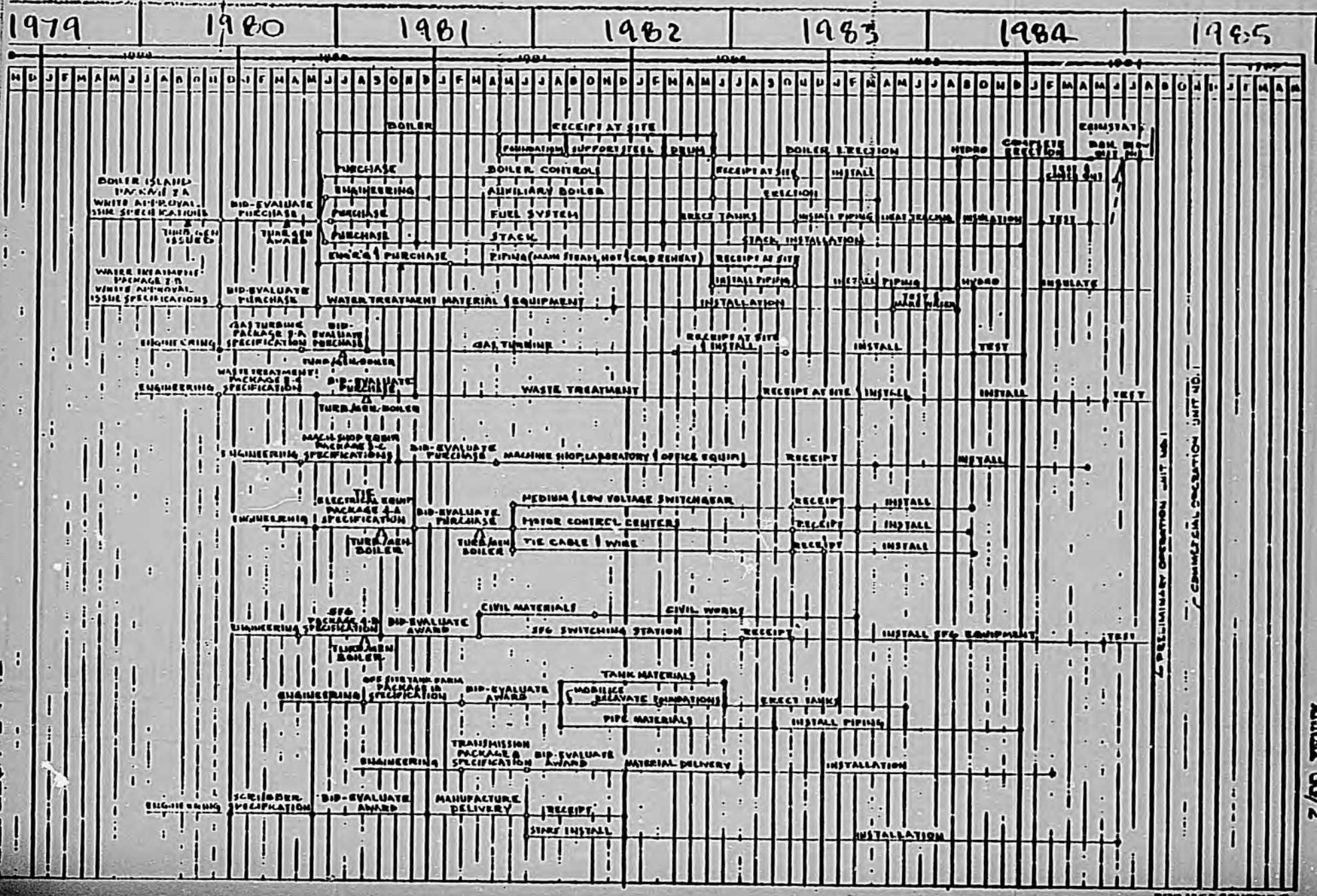
LEGEND

ENGINEERING INFORMATION
ENGINEERING INFORMATION CRITICAL

NOTES-

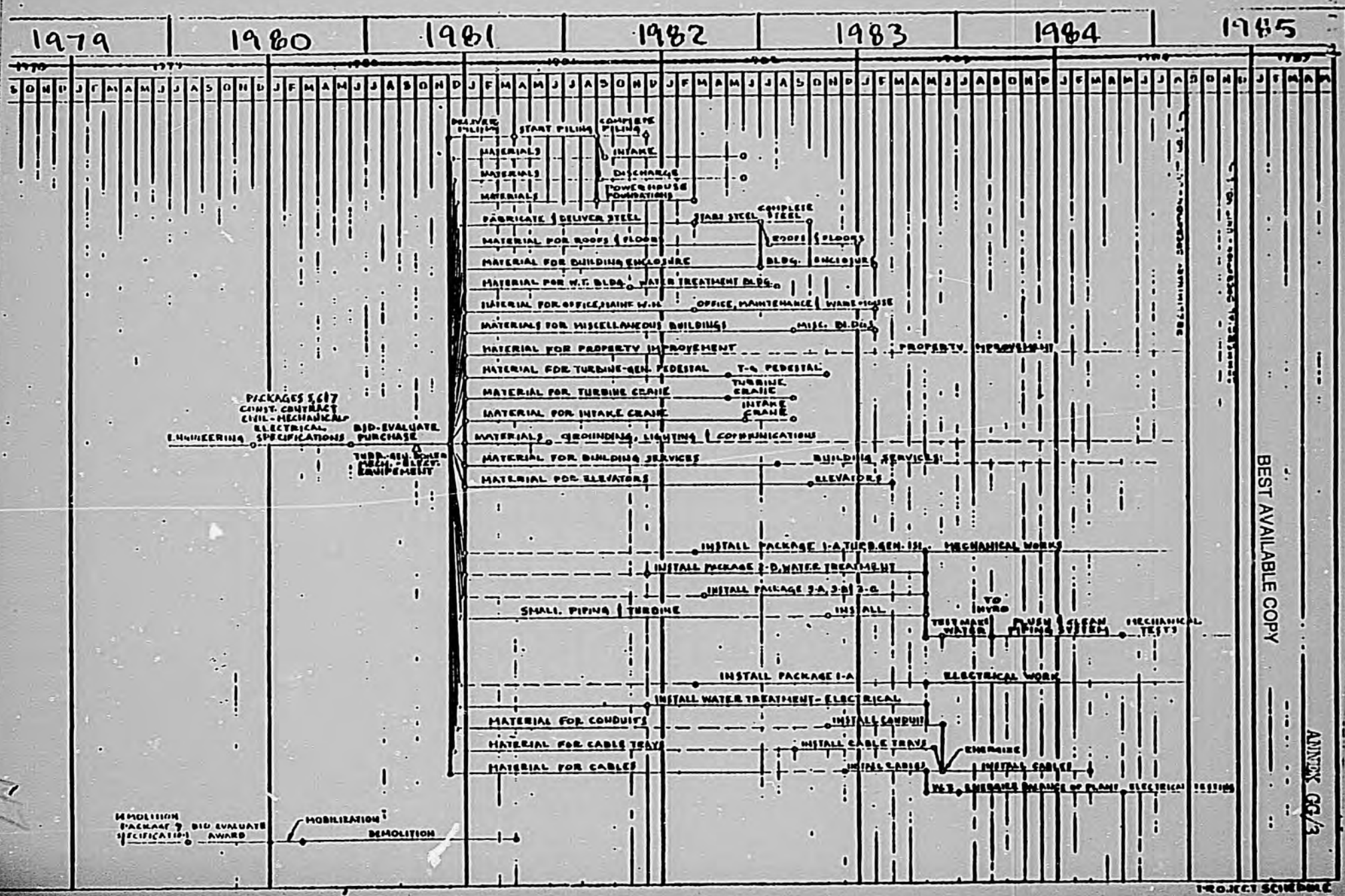
1. UNIT NO. 2 CONTRACTS – SAME TIME COMPLETION SIX (6) MONTHS LATER
2. UNIT NO. 3 CONTRACTS – ONE YEAR LATER COMPLETION ONE YEAR LATER

PROJECT SCHEDULE



BEST AVAILABLE COPY

ATTACHMENT GG/2



FOR LEGEND & NOTES SEE SHEET 1

PROJECT SCHEDULE
ONE 300 MW UNIT
SHOBRAM ELBOHRA
MULTI-PACKAGE