PD-ABB-349

UNCLASSIFIED

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

AGENCY FOR INTERNATIONAL DEVELOPMENT

CAIRO, EGYPT

PROJECT PAPER

PROJECT NO. 263-0215

JUNE 1990

# EGYPT: POWER SECTOR SUPPORT - AMENDMENT NO. 1

UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT

# PROJECT DATA SHEET

1. TRANSACTION CODE: C (A = Add, C = Change, D = Delete)

Amendment Number: 1

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: EGYPT

3. PROJECT NUMBER: 263-0215

4. BUREAU/OFFICE: ASIA/NEAR EAST 03

5. PROJECT TITLE (maximum 40 characters): POWER SECTOR SUPPORT

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 02 DD 28 YY 99

7. ESTIMATED DATE OF OBLIGATION (Under 'B:' below, enter 1, 2, 3, or 4)

A. Initial FY 89 B. Quarter 4 C. Final FY 91

8. COSTS ($000 OR EQUIVALENT $1 = LE 2.7 )

| A. FUNDING SOURCE | FIRST FY 89 B. FX | C. L/C | D. Total | LIFE OF PROJECT E. FX | F. L/C | G. Total |
|---|---|---|---|---|---|---|
| AID Appropriated Total | $136,000 | | $136,000 | $351,000 | | $351,000 |
| (Grant) | ($136,000 ) | ( ) | ($136,000 ) | ( $351,000 ) | ( ) | ( $351,000 ) |
| (Loan) | ( ) | ( ) | ( ) | ( ) | ( ) | ( ) |
| Other U.S. 1. | | | | | | |
| Other U.S. 2. | | | | | | |
| Host Country | | $ 23,815 | $ 23,815 | | $247,889 | $247,889 |
| Other Donor(s) | | | | $580,000 | | $580,000 |
| TOTALS | $136,000 | $ 23,815 | $159,815 | $931,000 | $247,889 | $1,178,889 |

9. SCHEDULE OF AID FUNDING ($000)

| A. APPROPRIATION | B. PRIMARY PURPOSE CODE | C. PRIMARY TECH. CODE 1. Grant | C. 2. Loan | D. OBLIGATIONS TO DATE 1. Grant | D. 2. Loan | E. AMOUNT APPROVED THIS ACTION 1. Grant | E. 2. Loan | F. LIFE OF PROJECT 1. Grant | F. 2. Loan |
|---|---|---|---|---|---|---|---|---|---|
| (1) ESF | 740B | 825 | | $136,000 | | $115,000 | | $351,000 | |
| (2) | | | | | | | | | |
| (3) | | | | | | | | | |
| (4) | | | | | | | | | |
| TOTALS | | | | $136,000 | | $115,000 | | $351,000 | |

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code

B. Amount

13. PROJECT PURPOSE (maximum 480 characters)

To support past and promote continued GOE progress in reducing electricity subsidies and in making other energy sector policy changes by providing capital infrastructure incentives to the GOE.

14. SCHEDULED EVALUATIONS

Interim MM 10 YY 90 | MM 10 YY 91 Final MM 06 YY 97

15. SOURCE/ORIGIN OF GOODS AND SERVICES

☒ 000 ☐ 941 ☐ Local ☐ Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ______ page PP Amendment.)

USAID/Egypt Controller concurs with the proposed methods of implementation and financing.

James Brody
James Brody
(A)AD/FM

17. APPROVED BY

Signature: Marshall Brown

Title: Marshall D. Brown, Director

Date Signed: JUN 13 1990

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

UNITED STATES GOVERNMENT

# memorandum

DATE: June 4, 1990

REPLY TO ATTN OF: OD/PDS/PS, Frank Miller

SUBJECT: Power Sector Support Project Paper Amendment No. 1 (263-0215): Issues for Executive Committee Review

TO: See Distribution

The following issue has been identified for the Executive Committee review of the Power Sector Support Project Amendment. The review is scheduled for June 5 (Tuesday) at 2:00 p.m. in the 9th Floor Conference Room.

**USAID Financing for the Power Plant at El-Kureimat:**

The Power Sector Support Project is a policy reform project in which release of funds is tied to substantial adjustments in power tariffs. Each phase of financing is designed to stand alone as a discrete activity. In the case of this amendment, $100 million is identified to provide technical assistance and equipment for a proposed power plant at El-Kureimat, and the project proposes follow-on financing in FY 91 to fund a second generating unit at El-Kureimat. Would the assistance proposed under this amendment be justified if there was no substantial tariff increase next year to trigger the release of the third phase of funding ($100 million) under the project?

**Distribution:**

DIR, Marshall Brown
AD/AGR, Edwin Stains
A/AD/FM, James Brody
AD/TI, Gregory Huger
AD/PDS, Vivikka Molldrem
AD/DR, Paul Thorn
AD/HRDC, William Gelabert
AD/LEG, Brian Miller
PDS/E, Paul O'Farrell
A/OD/PDS/P, Daniel Leaty

UNITED STATES GOVERNMENT

# memorandum

DATE: June 10, 1990

REPLY TO ATTN OF: OD/PDS/PS, Frank Miller

SUBJECT: Power Sector Support Project Paper (263-0215) Amendment No. 1: Executive Committee Review of the Decision Memorandum

TO: Members of the Executive Committee (See Distribution)

The Executive Committee met on June 5, 1990 to review the subject Project Paper Amendment (PPA). The PPA was approved. Modifications will be incorporated to reflect the following:

1) The PPA should explain how funds will be used if either or both of two assumptions regarding financing for Kureimat prove false:

(a) That another substantial electricity price increase scheduled for next year will permit USAID to provide a third tranche of funding of $100 million, which would finance the balance of consultant services for the construction of the two unit plant and the companion equipment package for the second unit.

(b) That a number of international and multinational financing agencies will provide all additional foreign exchange financing required to construct the two-unit power plant at El-Kureimat.

If the other financiers for El-Kureimat are unable to provide assistance or are only able to provide a portion of the planned financing for the first unit, USAID would need to rexamine its commitment to the project in consultation with the Egyptian Electricity Authority (EEA).

If commitments from other financiers for El-Kureimat become available, but the Government of Egypt does not authorize a tariff increase next year, the third tranche of USAID funding ($100 million) would not be made available and the financial plan in the PPA for equipment would need to be modified. AID's second tranche funding would be utilized to fully finance the consultant engineer services throughout the construction of the one or two unit plant and any remaining funds would be used to finance one or more smaller packages of equipment for both generating units.

2) Two changes were recommended in the Executive Summary, page iii.

(a) Delete the phrase..." rather than for general balance of payment support," starting on the fourth line of page iii.

(b) Delete the phrase..." and to reduce the national budget dificit" starting on the eleventh line of page iii.

Distribution:

DIR, Marshall Brown
AD/AGR, Edwin Stains
A/AD/FM, James Brody
AD/LEG, Brian Miller
AD/TI, Gregory Huger
A/OD/PDS/P, Daniel Leaty
DD, Charles Weden
AD/DR, Paul Thorn
AD/HRDC, William Gelabert
AD/MGT, Harold Daveler
OD/PDS/E, Paul O'Farrell

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

CAIRO, EGYPT

June 6, 1990

ACTION MEMORANDUM FOR THE DIRECTOR

FROM : OD/PDS/PS, Frank Miller

THRU : AD/PDS, Vivikka Molldrem

SUBJECT : Power Sector Support Project Amendment No. 1: Approval of the Project Paper Amendment and First Amendment to Project Authorization

PROBLEM : Your signature is required to approve the Project Paper Amendment (PPA) for the Power Sector Support Project, No. 263-0215, for $115 million.

DISCUSSION : The Project Paper Amendment was reviewed by the Project Committee on May 31, 1990 and by the Executive Committee on June 5, 1990. There are no further issues pending, and the following changes requested by the Executive Committee have been made in the PPA.

1. The PPA describes the various scenarios for financing should AID's third tranche or other donor funding not be provided (see p. 24 and pp. 2 and 3 of Annex H).

2. References to "general balance of payments support" and "reduction in the national budget deficit" on page iii in the Executive Summary have been deleted.

All necessary clearances have been obtained.

RECOMMENDATION : That you sign the subject Project Paper Amendment facesheet and the Project Authorization, the

Certification Pursuant to Section 611(e) of the Foreign Assistance Act of 1961, and the Certification Pursuant to the Gray Amendment.

Clearances:

OD/DR/UAD, Michael Gould ____________
AD/DR, Paul Thorn ____________
A/AD/FM, James Brody ____________
LEG, Brian Miller ____________

## EGYPT - POWER SECTOR SUPPORT

TABLE OF CONTENTS



9

ANNEXES

A. LOG FRAME MATRIX
B. STATUTORY CHECK LIST
C. REQUEST FOR ASSISTANCE
D. LEGAL CERTIFICATIONS
E. SURVEY OF THE ECONOMICS OF ELECTRICAL ENERGY IN EGYPT
F. CAPACITY NEED ANALYSIS
G. TECHNICAL ANALYSIS
H. FINANCIAL ANALYSIS
I. ECONOMIC ANALYSIS
J. SOCIAL SOUNDNESS ANALYSIS
K. MANAGERIAL/ADMINISTRATIVE ANALYSIS
L. ENVIRONMENTAL ANALYSIS
M. COST ESTIMATE
N. IMPLEMENTATION SCHEDULE

GLOSSARY OF ABBREVIATIONS

| | |
|---|---|
| ADB | African Development Bank |
| A.I.D. | Agency for International Development |
| AFESD | Arab Fund For Economic & Social Development |
| CDSS | Country Development Strategy Statement |
| D L/COMM | Direct Letter of Commitment |
| DR/UAD | Development Resources Directorate<br>Office of Urban Administration and Development |
| EDA | Egyptian Distribution Authority |
| EEA | Egyptian Electricity Authority |
| EGPC | Egyptian General Petroleum Corporation |
| EIB | European Investment Bank |
| FM | Financial Management Directorate, USAID/Cairo |
| FP | Fixed Price (Contract) |
| FSN | Foreign Service National |
| GDP | Gross Domestic Product |
| GOE | Government of Egypt |
| HC | Host Country |
| IBRD | International Bank for Reconstruction and Development<br>(World Bank) |
| IMF | International Monetary Fund |
| Km | Kilometer |
| kV | Kilovolt |
| KFAED | Kuwait Fund for Arab Economic Development |
| kWhr | Kilowatt-hour |
| L/C | Letter of Credit |
| LE | Egyptian Pound |

| | |
|---|---|
| MEE | Ministry of Electricity and Energy |
| MIC | Ministry of International Cooperation |
| MSCM | Million Standard Cubic Meters |
| MVA | Mega volt amperes |
| MW | Megawatt |
| MWhr | Megawatt-hour |
| NECC | National Energy Control Center |
| O&M | Operations and Maintenance |
| OPEC | Organization of Petroleum Exporting Countries |
| PACD | Project Assistance Completion Date |
| Project | The Power Sector Support Project |
| project | Individual components of the Project being implemented as stand-alone projects |
| PSC | Personal Services Contract |
| PDS/E | Program Development and Support Directorate, Office of Economics, USAID/Cairo |
| PDS/P | Program Development and Support Directorate, Office of Programs, USAID/Cairo |
| PPC | Petroleum Pipelines Company |
| RPM | Revolutions per Minute |
| Tonne | Metric Ton |
| TDD | Terminal Disbursement Date |
| USAID | United States Agency for International Development - Cairo Mission |

REFERENCES:

Project Paper-Power Sector Support, Project No. 263-0215 dated September 18, 1989.

Project Paper-National Energy Control Center, Project No. 263-0023 dated September 16, 1976.

Draft Report-Egypt Energy Sector, dated 1990, prepared by the World Bank.

Report-1200 MW Thermal Power Plant Engineering Economic Feasibility Study, December 1985, prepared by Stone & Webster, Inc., ECG/CH2M Hill, USAID Grant No. 263-0102 which includes:

EXECUTIVE SUMMARY
PHASE I Report
PHASE II Report
ANNEX A - Environmental Assessment
ANNEX B - System Studies
ANNEX C - Geotechnical Investigation
ANNEX D - Capability of Egyptian Firms
ANNEX E - Coal Ash Utilization in Egypt
ANNEX F - Transportation of Coal to the El-Kureimat Site

Final Report, 1200 MW Gas/Oil Thermal Power Plant Engineering/Economic Feasibility Study for El-Kureimat, July 1989, prepared by Stone & Webster Engineering Corporation and Engineering Consultants Group, USAID Grant No. 263-0102.

Co-Financiers Report For El-Kureimat 1200 MW Power Plant, October 1989, prepared by the Egyptian Electricity Authority.

Report, Technical Reasons for the Upgrade of the National Energy Control Centre, May 1990, prepared by the Egyptian Electricity Authority.

Annual Report of Electric Statistics 1988/1989, prepared by the Egyptian Electricity Authority.

Monthly Reports of Operation, prepared by the Egyptian Electricity Authority.

## CONVERSION FACTORS:

| | |
|---|---|
| **Power and Energy:** | |
| 1 Kilowatt (kW) | = 1,000 Watts |
| 1 Megawatt (MW) | = 1,000 Kilowatts |
| 1 Kilowatt hour (kWhr) | = 1,000 Watt hours |
| 1 Gigawatt hour (GWhr) | = 1,000,000 kWhr |
| **Pressure:** | |
| 1 Atmosphere (atm) | = 14.7 pounds/square inch (psi) |
| 1 bar | 0.9869 atm. |
| **Weight:** | |
| 1 Kilogram | = 2.2 pounds (lbs) |
| 1 Tonnes | = 1,000 Kilograms |
| | = 2,200 pounds |
| **Area:** | |
| 1 Hectare | = 2.47 Acres |
| **Volume:** | |
| 1 Barrel (oil) | = 42 gallons |
| **Distance:** | |
| 1 Meter | = 3.38 Feet |
| 1 Km | = 0.6214 miles |
| **Frequency:** | |
| 1 Hertz | = 1 Cycle per Second |

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

CAIRO, EGYPT

## FIRST AMENDMENT TO PROJECT AUTHORIZATION

Name of Country: Arab Republic of Egypt

Name of Project: Power Sector Support

Number of Project: 263-0215

1. Pursuant to Section 532 of the Foreign Assistance Act of 1961, as amended, the Power Sector Support Project was originally authorized on September 18, 1989. The authorization is hereby amended as follows:

a. Paragraph 1 is amended by deleting "$136 million" and inserting "$251 million" therefor. Paragraph 1 is also amended by deleting "four years and three months" and inserting "nine years and five months" therefor.

b. Paragraph 2 is amended by adding the following sentence thereto: "The Project will also support the design of a 1200 MW thermal power station at El-Kureimat consisting of two 600 MW units, the construction of the first of the two 600 MW units and upgrading and expanding the computer hardware and software at the National Energy Control Center (NECC)."

c. Paragraph 5.a.(4.)(d) is deleted in its entirety.

d. Paragraph 5.a.(7.) is deleted in its entirety.

e. Paragraphs 6 d. and e. are deleted in their entirety.

2. The authorization cited above remains in force except as hereby amended.

Marshall D. Brown
Director, USAID/Egypt

June 13 1990
Date

Clearances:
OD/DR/UAD, MGould MSG
AD/DR, PThorn
AD/PDS, VMolldrem for
(A)AD/FM, JBrody JB
PDS/PS, PDowns

DRAFTED:LEG:MSWard:mf:(5/16/90):1PATH215

# EGYPT: POWER SECTOR SUPPORT - AMENDMENT NO. 1
## EXECUTIVE SUMMARY

## I. Introduction

Electric energy in Egypt is heavily subsidized and the average price of electricity has ranged from 20 to 30 percent of its economic or long-run marginal costs in recent years. The subsidy comes in varying intensities, mainly from underpricing of fuels used to generate electricity.

In 1989 the Economics Office estimated the implicit energy subsidies for the GOE FY 89/90 at LE 4.7 billion ($1.6 billion) based on calculations of petroleum products at world market prices and implicit subsidies for electrical energy were estimated at LE 6.3 billion ($2.1 billion). The current average price of electricity is 5.5 piasters per kWhr., which is significantly below the 14 to 19 piasters economic and financial cost per kWhr. Increases on the order of 150 to 250 percent would be needed to cover the economic cost - i.e., the long run marginal cost.

The subsidies to consumers have not been evenly distributed. The structure of electricity pricing has favored public sector industry and low income residential and commercial consumers. The lowest rates are charged for the first 100 kWhr. per month of residential consumption, the first 100 kWhr. per month of commercial consumption and the total consumption of large public sector companies which operate on very high voltages. Private sector industry pays substantially more for electrical energy than the average price charged to comparable public sector firms. Further, there is no rate differential for on/off peak load consumption for any category of consumer.

Artificially low energy prices send false cost signals to the consumer, which lead to over-consumption and reduced efficiency of the capital plant. Therefore, the low price of electricity is one of the key economic distortions affecting the pattern of resource allocation in Egypt. Egypt's per capita energy consumption is about 150 percent higher than in countries with comparable per capita income. The Economics Office estimates the current annual cost due to higher domestic consumption of petroleum products is approximately $900 million in foreign exchange earnings forgone, and forgone annual revenue from energy on the order of $2.0 billion. This amounts to about 5 percent of GDP, and as an annual flow it would make a significant impact on the domestically financed public sector deficit.

During the past several years, the GOE has grown increasingly more aware of the importance and need to correct the price structure of electricity and reduce the distorting subsidies. Both AID and the World Bank (IBRD) have highlighted the need for price corrections in policy dialogues with the GOE. The GOE has increased the average electricity selling price by 35 percent in 1986, 29 percent in April 1987, 30 percent in March 1989 and 38 percent in May 1990. Both the 1989 and 1990 increases have reduced some of the distortions in the rate structure by including generally higher percentage increases charged to state-owned industrial customers. The GOE has embarked on an economic reform program that will raise the average electricity price to its economic cost by the mid-1990s.

There is an extensive history of USAID's dialogue with the Egyptian authorities on the necessity of reducing the electricity subsidy. Energy pricing has also been a central topic in the macroeconomic policy reform agenda discussions between the International Monetary Fund (IMF), the IBRD and the GOE. This project fits within a larger effort involving the IMF and IBRD to help the government stabilize and restructure Egypt's economy. The IBRD has taken the lead role in negotiating the pace of adjustment of electricity prices with the GOE. This project specifically supports the Government's reform program by providing the framework for policy discussions and technical studies related to electricity price corrections and improved system efficiency. Our experience in policy dialogue suggests that AID should continue to set a goal of achieving annual increases in electricity prices in real terms of 10 to 20 percent. as a condition for continued support. In the case of the IBRD, the African Development Bank (ADB) and USAID, the allocation of significant new resources for power generation have been conditioned upon progress in reducing the subsidy.

The net effect of macroeconomic reform and price adjustments is expected to slow the rate of growth in demand. In recent years the annual growth of demand for electricity has declined from 12 percent in 1980-1984 to 5 percent in 1985-1989. Energy consumption is forecast to continue to increase at an annual rate averaging five percent per annum through the year 2000. If consumption continues to grow at an average of five percent per year and natural gas production is not expanded rapidly, Egypt could become a net petroleum importer. The primary force in increasing demand for electricity is the growth of GDP. For each one percent growth in GDP, there is a corresponding one and one half percent increase in electrical demand. In addition, economists expect a decrease in demand of 0.1 to 0.3 percent for each 1 percent increase in the real price. However, even with the elimination of uneconomic uses, the growth of demand for electricity will require additional generation capacity and distribution facilities over the period of the Project. Replacement and rehabilitation of older steam generating plants, 1200 MW of which is in excess of 20 years of age and 600 MW in excess of 30 years of age, is critical to preventing outages in the 1990s.

Consequently, USAID support for electricity price reforms is being programmed for the electricity sector. Project resources will assist in the development of the electricity sector through provision of technical and capital assistance to expand generating capacity and updating the computer-based energy management system to monitor the bulk power system.

## II. Project Description

The goal of this Project Amendment is to promote rational investment and consumption decisions throughout the economy. The Project purpose is to support past and promote continued GOE progress in reducing electricity sector subsidies and in making other energy sector policy changes by providing capital infrastructure incentives to the GOE.

The Project Paper, approved in September 1989, provided life of project (LOP) funding of $336 million, with phased obligations contingent upon satisfactory policy reform in the electric energy sector. The initial phase of $136 million provided assistance for five discrete projects: installation of a combined cycle generating unit; rehabilitation of a thermal power station; relocation and refurbishment of three gas turbines; expansion of the communications network supplying data to the national dispatching center; and procurement of commodities.

Through this Amendment, an additional authorization of $115 million is being proposed for two additional discrete projects: the design of a major thermal power station and procurement of equipment for the first unit (with other financiers supplying the funds required for the balance of equipment and construction services); and for the replacement of the computer system at the National Energy Control Center (NECC). If further significant policy reforms are undertaken, an additional $100 million authorization will be proposed to fund the balance of consultant services for the plant and one or more equipment packages for unit 2. The LOP funding is being increased to $351 million. The focus of this Amendment is continued support to the GOE to add generating capacity which more fully utilizes natural gas and for upgrading the national control center so that the Egyptian power system can continue to operate at optimum efficiency and reliability. These additional projects (components) were anticipated in the 1989 Project Paper and authorizations were anticipated as an incentive for GOE electricity pricing policy reforms and other improvements in managing the sector.

The FY-90 Tranche

On December 31, 1989, the Minister of Electricity and Energy requested that the remaining two funding phases of the Project be used to finance a portion of the foreign exchange costs in the design and construction of the 1200 MW thermal power plant at El-Kureimat, 95 km., south of Cairo on the Nile River. El-Kureimat was one of five candidate sites (identified by EEA in 1981 for a study) for a major power station. Specifically, the EEA has asked USAID to finance, at a minimum, the design and construction management services for the plant. USAID financed the feasibility study for the plant in 1985. The study concluded that a 1200 MW generating plant would be required by the early 1990s and that two 600 MW units at Kureimat was cost effective. With substantial new discoveries and refining capability for natural gas, natural gas was considered as the primary fuel for the proposed 1200 MW plant. Despite the probability that sufficient supplies of natural gas would be in place by the mid-1990s to operate the plant, the EEA and the consultant adopted a more conservative recommendation for supplying fuel for the plant, assuming that only 50 percent of the plant would be fired by natural gas with the remainder being Mazout.

On November 8, 1989, EEA presented the results of the technical, economic and financial feasibility to a group of potential bilateral and multilateral financing agencies. The EEA estimated the cost of completing the plant at $780 million equivalent and LE 528 million.

In April 1990 the Minister of Electricity requested $15 million from USAID to finance technical assistance and equipment to upgrade the NECC. The NECC is the nerve center for the entire Egyptian power system. The Center was financed by AID in 1976 and placed in operation in 1983. The Center monitors and analyzes the operation of the generation and bulk transmission network and adjusts the generating units to assure economic and reliable performance. The Center is quickly reaching its limit to monitor the expanding power system and, therefore, the computer system and software programs must be upgraded.

Project Outputs

The ultimate objective for the Project, including this amendment, is significant annual increases in the price of electric energy sufficient to eliminate electricity sector subsidy in the second half of the 1990s. The outputs of this Project Amendment are:

- Engineering and procurement services for a planned 1200 MW thermal power station at El-Kureimat.
- Construction of the first of two 600 MW steam turbine generating units at El-Kureimat and, if further price reforms are taken, the second 600 MW unit.
- Expansion of the data processing capability of the NECC from 60 stations to 200 stations.

The initial design will be based on a two unit plant. Procurement of equipment for the first unit will include purchase options with firm pricing for duplicate equipment and services and EEA can exercise this option when sufficient funding is available.

## III. Cost Estimates and Financial Plan

The cost estimates for designing, equipping and constructing two 600 MW generating units at Kureimat is estimated at $780 million and LE 604 million. AID and the following bilateral and multilateral financing agencies have indicated an interest in financial support for the two unit project. Appraisal missions are scheduled through October 1990 to develop the necessary financing documents.

| | | |
|---|---|---|
| AID | $200.0 | million |
| African Development Bank | $300.0 | million |
| Arab Fund | $100.0 | million |
| Kuwait Fund | $100.0 | million |
| European Investment Bank | $ 80.0 | million |
| World Bank | $100.0 | million |
| Total | $880.0 | million |

The cost estimates for the construction of the two units at El-Kureimat and replacement of the computer systems at the NECC are summarized below:

SUMMARY OF COST ESTIMATES
(U.S.$ AND LE MILLION)

| | El-Kureimat | | | | | | NECC | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tranche 2 | | | Tranche 3 | | | | | EQUIV. US$ | | LE |
| | AID $ | OTHER $ | EEA LE | AID $ | OTHER $ | EEA LE | AID $ | EEA LE | AID | OTHER | EEA |
| Consultant Services | 15 | 0 | 5 | 35 | 0 | 24 | 3 | 0 | 53 | 0 | 29 |
| Equipment/ Services | 76 | 271 | 449 | 58 | 243 | 70 | 10 | 0 | 144 | 514 | 519 |
| Contingency | 9 | 30 | 47 | 7 | 36 | 9 | 2 | 0 | 18 | 66 | 56 |
| | 100 | 301 | 501 | 100 | 279 | 103 | 15 | 0 | 215 | 580 | 604 |

In addition to the local currency costs shown above, the GOE will provide LE 13.3 million in the form of in-kind contributions for

The initial design will be based on a two unit plant. Procurement of equipment for the first unit will include purchase options with firm pricing for duplicate equipment and services and EEA can exercise this option when sufficient funding is available.

## III. Cost Estimates and Financial Plan

The cost estimates for designing, equipping and constructing two 600 MW generating units at Kureimat is estimated at $780 million and LE 604 million. AID and the following bilateral and multilateral financing agencies have indicated an interest in financial support for the two unit project. Appraisal missions are scheduled through October 1990 to develop the necessary financing documents.

| | | |
|---|---|---|
| AID | $200.0 | million |
| African Development Bank | $300.0 | million |
| Arab Fund | $100.0 | million |
| Kuwait Fund | $100.0 | million |
| European Investment Bank | $ 80.0 | million |
| World Bank | $100.0 | million |
| Total | $880.0 | million |

The cost estimates for the construction of the two units at El-Kureimat and replacement of the computer systems at the NECC are summarized below:

SUMMARY OF COST ESTIMATES
(U.S.$ AND LE MILLION)

| | El-Kureimat Tranche 2 | | | El-Kureimat Tranche 3 | | | NECC | | Total EQUIV. US$ | | LE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | AID $ | OTHER $ | EEA LE | AID $ | OTHER $ | EEA LE | AID $ | EEA LE | AID | OTHER | EEA |
| Consultant Services | 15 | 0 | 5 | 35 | 0 | 24 | 3 | 0 | 53 | 0 | 29 |
| Equipment/ Services | 76 | 271 | 285 | 58 | 243 | 234 | 10 | 0 | 144 | 514 | 519 |
| Contingency | 9 | 30 | 47 | 7 | 36 | 9 | 2 | 0 | 18 | 66 | 56 |
| | 100 | 301 | 337 | 100 | 279 | 267 | 15 | 0 | 215 | 580 | 604 |

In addition to the local currency costs shown above, the GOE will provide LE 13.3 million in the form of in-kind contributions for counterpart personnel costs, services, administration and the fair market value of land contributed to the Project.

USAID's authorization schedule for the $215 million is $115 million in FY 90 for plant design, procurement services and some equipment for Unit 1, and engineering services and equipment for the NECC. An additional $100 million would be provided following another substantial electricity price increase in FY 91 and would be used to finance construction management services and companion equipment for Unit 2. Total AID grant funds for both units will finance the consultant's (design, procurement and construction management) foreign exchange cost ($50 million), and the cost of equipment and installation services for one or more equipment packages ($134 million). A contingency of $9 million is set aside for Unit 1 and $7 million for Unit 2. The $15 million grant for NECC will finance consultant services and computer hardware and software.

The Grant Agreement Amendment will require, among other things, evidence of firm commitments from bilateral and multilateral financiers before the initial disbursement of project funds for consultant services at El-Kureimat and signed agreements for 100 percent of the foreign exchange costs for Unit 1 before any disbursement of Grant funds for equipment or construction services at El-Kureimat. The Amendment will also require that the proceeds of the Grant for consultant services have been passed to EEA as a grant and that the local currency financing for the new components has been budgeted by the GOE and will be available for timely expenditure by the EEA.

The major disbursements will be for consultant services and equipment for El-Kureimat and computers for NECC. Due to the uniqueness of the equipment and computers, which will be custom-designed to meet EEA's specifications, deliveries and major payments will occur in FY-93, 94 and 95. The planned disbursement schedule for consultant services will be spread over the nine year life of the two projects. Following is the anticipated disbursement schedule for AID funding:

DISBURSEMENT SCHEDULE - AID FUNDING
(U.S.$ - MILLIONS)

| FISCAL YEAR | US DOLLARS |
|---|---|
| FY 91 | $ 3 |
| FY 92 | $ 14 |
| FY 93 | $ 25 |
| FY 94 | $136 |
| FY 95 | $ 16 |
| FY 96 | $ 10 |
| FY 97 | $ 7 |
| FY 98 | $ 3 |
| FY 99 | $ 1 |
| TOTAL | $215 |

This Amendment will extended the PACD from December 31, 1993 to February 28, 1999 to provide sufficient time to complete the El-Kureimat unit(s), including the two year warranty period. This will result in a total Project life of approximately nine years and five months.

VI. Summary of Analyses

The Project Amendment is based on sound engineering analyses to achieve project outputs. The plans for accomplishing the project purpose are consistent with good utility practices. Cost estimates for the El-Kureimat plant were prepared by a U.S. consultant in early 1989 and for the NECC by a computer system supplier in early 1990. AID's commitment to the first unit at El-Kureimat is conditioned on firm commitments from other financing agencies for the balance of foreign exchange funds required; for the second unit, AID will require firm funding commitments from other financiers and further electricity pricing reforms. The cost estimates were reviewed by the Project Office, have been adjusted upward according to a reasonable construction schedule and are judged to be reasonable.

The technical justification for the proposed El-Kureimat thermal power station is the forecasted need for additional generating capacity in 1996/97, the availability of a suitable site adjacent to a major highway which will facilitate deliveries of equipment, and access to the Nile River which will furnish adequate quantities of water for condenser cooling and for barge transportation of major equipment to the site. The technical justification for the NECC component is the urgent need to expand the data processing capacity of the Center to meet system requirements and the availability of appropriate computer hardware for data processing, including software applications.

The economic analysis, based on an assessment of power requirements for the mid-1990s, concluded that a 1,200 MW steam power plant, composed of two 600 MW units, would be needed. The proposed two unit plant at El-Kureimat has an economic internal rate of return in excess of 12 percent; if only one unit is constructed, the economic internal rate of return is in excess of 10 percent.

The social and cultural impact of the plant is positive. The plant will contribute to efficiency of energy services to customers thereby benefiting people who utilize Egypt's power system.

The EEA is the operating authority for the Ministry of Electricity and Energy (formed in 1964) and has had extensive experience constructing, operating, maintaining and training personnel in steam turbine generating facilities and control centers. Many of these facilities were financed by groups of bilateral and multilateral funding agencies. The EEA will be the implementing agency for both the El-Kureimat and NECC components. The EEA will have overall responsibility to manage the planning, construction, operation and maintenance of the power plant at El-Kureimat and the planning, installation, operation and maintenance of the NECC computer systems.

The Power Systems Group within the Office of Urban Administration and Development (UAD) monitors all projects in the power sector. This monitoring capability will be strengthened by the addition of a project-funded engineer with extensive electric utility experience.

The construction and operation of the two 600 MW steam turbine generating units will not adversely impact the air or water quality surrounding the thermal power station. USEPA and Egyptian air and water standards will be maintained. An Environmental Monitoring System will be operational at the site to establish and monitor air and water quality. The Initial Environmental Examination was approved by the ANE Bureau Environmental Coordinator on May 23, 1990.

There will be no adverse impact on the environment with the replacement of the NECC computers.

## V. Project Negotiation Status

All project activities and implementation arrangements have been discussed with EEA. EEA is aware of the conditions and covenants discussed in the Project Paper Amendment. The Ministry of Electricity and Energy has requested these projects and USAID's Mission Director has concurred. The Ministry of International Cooperation is in the process of formally requesting these projects as a part of the amended Power Sector Support Project.

## VI. Conclusions

The project has been determined to be technically appropriate and cost effective. The project is warranted since Egypt requires additional power generation to meet demand and support continued expansion in the industrial, commercial and residential sectors. Any additional investments in power generation should be conditioned on further pricing reforms that remove the implicit subsidies.

## VII. Recommendations

The Project Committee recommends that the Mission Director authorize a Grant of $115 million.

## VIII. List of Contributors - the Project Committee

Co-chairs: John P. Hunt, DR/UAD and Peter G. Downs, PDS/PS

Robert W.Adler, PDS/E
Todd Amani, PDS/P
Sydney C. Anderson, PDS/P
Kenneth Lue Phang, DR/ENG/ENV
Mohamed Ahmed Mounir, FM/FA
Mark S. Ward, LEG

GOE Officals:

| | |
|---|---|
| Eng. M. El-Said Issa, | Chairman, EEA |
| Dr. Mostaffa Swidan, | Deputy Chairman Technical Affairs, EEA |
| Eng.Abdel Motaal Yousef, | Deputy Chairman Operations, EEA |
| Eng. Salah El-Dessouki | Deputy Chairman, Projects, EEA |

# I. PROJECT BACKGROUND AND RATIONALE:

## A. BACKGROUND:

1.1 In September 1989 the Agency for International Development (A.I.D.) approved the $336 million Power Sector Support Project (Project) and authorized a grant of $136 million to finance the foreign exchange costs of the project components which included technical assistance, additional generating capacity, rehabilitation and refurbishment of existing generating capacity, expansion of the communication network serving the National Energy Control Center and procurement of commodities.

1.2 The Project is intended to: promote rational investments and consumption decisions throughout the economy and to support past reforms and promote continued Government of Egypt (GOE) progress in reducing subsidies in the electricity sector and in making other energy sector policy changes by providing capital infrastructure incentives to the GOE.

1.3 The authorized Life of Project funding was $336 million to be provided in phases (tranches) contingent on the GOE implementing economic policy reforms in the electric energy sector. The first tranche of funding of $136 million was authorized following a March 1989 electricity price increase which, while averaging 30 percent, introduced major increases in the price of electricity to public sector industries. Two subsequent tranches of funding, each of $100 million, were contemplated, each linked to the GOE's implementation of electricity price increases satisfactory to the needs of the macroeconomic reforms.

1.4 The formulation and implementation of a sector economic reform program to reduce the electricity subsidy has been a central topic of the macroeconomic policy agenda which has been under discussion with the International Monetary Fund (IMF), the World Bank (IBRD) and USAID. Both the IBRD and USAID have conditioned the allocation of significant new resources for power generation on progress in reducing the subsidy. This Project is designed to provide significant additional resources linked to real electricity price increases. The Project complements the IMF and IBRD macroeconomic reform agenda.

1.5 Officials of the GOE have informed the United States Agency for International Development (USAID) that an increase in electricity prices was approved by the Cabinet to be effective as of May 6, 1990. The average electricity price increased by 38 percent with generally higher percentage increases for public sector customers and lower percentage increases for residential and commercial customers. We have reviewed the price increase and judge that it constitutes an increase in real terms and reduces the implicit subsidy to electricity customers.

1.6 In anticipation of the 1990 price increase and the electricity price increase scheduled for next year, the Minister of Electricity and Energy on December 31, 1989 requested that the remaining two tranches of funding be allocated to finance a portion of the foreign exchange cost of a 1200 MW thermal power station to be built on the El-Kureimat site, 95 Km south of Cairo on the Nile River. In April 1990, the Minister also requested that additional funding be provided to finance the upgrading of the National Energy Control Center (NECC).

B. EL-KUREIMAT:

1.7 El-Kureimat was one of a number of potential power station sites identified by the Egyptian Electricity Authority (EEA) in 1981 for study. In November 1981 the Ministry of Economy requested USAID financing for the engineering/economic feasibility study for a 1200 MW steam power plant in Upper Egypt. USAID responded in December 1981, advising the GOE that consideration of the study request was dependent on GOE actions on electricity and energy pricing.

1.8 In March 1984, following electricity and energy price increases in 1982, 1983 and early 1984, USAID agreed to finance the study. Consultant selection was completed in November 1984. The consultant services contract was signed in March 1985 and the study was completed in December 1985.

1.9 During the study, the Egyptian General Petroleum Company (EGPC) advised the EEA that natural gas supplies were not available to fuel the plant, so the only fuels considered were coal and Mazout (No.6 oil).

1.10 The completed study was presented to the EEA in January 1986. The study concluded that, based on various load and energy forecasts, a 1200 Megawatt (MW) generating plant would be required by the early 1990's. The economic analysis indicated that the El-Kureimat site was preferred, 600 MW units were cost effective and coal was the economic fuel choice compared to Mazout.

1.11 Shortly after the final report was issued, world oil prices began to tumble severely upsetting the economies of OPEC members, but also having noticeable impacts on the value of petroleum exports for non-OPEC countries like Egypt. While the value of Egypt's oil exports were declining, domestic consumption was expanding at a rate at which new discoveries and refining capability could barely keep pace with the increased needs of domestic consumers. It was within this framework that a focus on exploiting natural gas reserves, long sought by both Egyptian petroleum officials and World Bank advisors, finally occurred and the Egyptian Peoples Assembly (Parliament) approved new gas agreements (e.g., gas clauses) in early 1988.

27

1.12 The new "Gas Clause," which can be appended to existing petroleum agreements with oil companies, has many key features intended to encourage the exploration and development of natural gas in Egypt. The "Gas Clause" encourages exploration for "petroleum" products and the development of all "petroleum" finds (e.g., oil and gas). Subsequent forecasts of natural gas supplies, based on national gas exploration activities, suggested that natural gas could again be considered as a primary fuel for the proposed 1200 MW plant. It suggests the domestic use of all gas produced and the creation of a national unified gas grid (e.g., pipeline network) and provides protection to the drilling companies through provisions for cost recovery and sales of gas to the Government (EGPC) on a take or pay basis.

1.13 In mid-1988, the EEA negotiated additional study services with the consultant to determine the probability that a sufficient quantity of natural gas would be available by the mid-1990's to fuel a 1200 MW power station, and if favorable, to review the original study based on natural gas as the primary fuel and recommend the appropriate plant location, type of plant, capital cost and the economic and financial soundness of the plant. This supplemental study began in October 1988 and was completed in July 1989.

1.14 The supplemental study concluded that gas resources were developing and that there was a high probability of a sufficient gas supply by the mid-1990's to operate the plant. The economic choice of plant type was dependent on fuel mix. A combined cycle plant was favored when gas supplies in excess of plant requirements were assured with a reasonable certainty. If, however, the full availability of gas was not assured (i.e. less than 80 percent), the conventional steam boiler type power station was favored. The EEA and the consultant adopted a conservative approach to fuel supply, electing to assume that only a 50% gas supply would be available for the plant, requiring supplemental burning of Mazout.

1.15 On November 8, 1989, the EEA presented the technical, economic and financial feasibility of the El-Kureimat plant to a group of potential bilateral and multilateral financing institutions. The estimated cost of the plant is $780 million and Egyptian Pounds (LE) 604 million.

1.16 During November and December 1989, the Minister of Electricity and Energy and the EEA solicited expressions of financing interest for the foreign exchange financing of the proposed plant. A total of $580 million is being requested from four bilateral and multilateral financing agencies. The Minister of Electricity has confirmed financial support from the African Development Bank ($300 million) who will be appraising the project in July; the Arab Fund ($100 million) who will be appraising the project in October and the Kuwait Fund ($100 million). The European Investment Bank is considering financial support ($80 million) dependent on Egypt

28

reaching a standby agreement with the IMF and the IBRD will send an appraisal team to Egypyt to review the El-Kureimat project and could provide $100 million in financing for the project. With the expectation of $200 million from USAID, the foreign exchange financing for the El-Kureimat component project is fully satisfied.

C. NATIONAL ENERGY CONTROL CENTER:

1.17 The National Energy Control Center (NECC) is a computer based energy management system that currently monitors 59 generating stations and major transmission substations. These stations are scanned every three seconds and the collected data is analyzed. Adjustments in generator output, to maintain optimum economy, are initiated and selected data are displayed and recorded. Other data is continually analyzed and the system operators are alerted to conditions that could effect the reliability of the power system during normal and emergency conditions. The NECC was financed by AID in 1976 (Project 263-0023). The center was placed in service in 1983. The NECC applied the technology of the 1970's that relied on centralized control system architecture. This architecture was characterized by sizing the data processing system to an ultimate number of stations beyond which the computer system would have to be replaced.

1.18 The NECC data processing system was designed to handle 60 stations. The planned growth of the Egyptian power system up to 1995 will require a data processing system with sufficient capacity to scan and collect data from some 104 remote stations with project expansion beyond the year 2000 requiring a system capacity of 200 remote stations. Since the number of remote stations that can be dynamically scanned is limited to 60 stations, the NECC will not be able to effectively monitor the bulk power system and assure secure and reliable operation of this major power system.

1.19 Other control centers of similar design, that were placed in service in the early 1980's, have been upgraded using current computer technology to meet the data processing demands of their expanded systems. The upgrading proposed by the EEA is consistent with advances in computer technology.

D. ENERGY PRICING:

1.20 The GOE's efforts, at the insistence of AID, the World Bank (IBRD) and the African Development Bank (ADB), have been directed towards improving the structure and increasing the level of electricity rates. The GOE has increased the average electricity price by 35 percent in 1986, 29 percent in 1987, 30 percent in 1989 and 38 percent in 1990. The GOE has also committed itself to attaining an average electricity price equal to the long run marginal cost of electricity in the mid-1990's.

1.21 The current average price of electricity is 5.5 piasters per Kilowatt-hour (kWhr). As a point of comparison, using the international price for fuel oil at $70 per metric ton (tonne), which is a cyclically low price, the long run marginal cost to the weighted average consumer is 14.3 piasters per kWhr. At a more normal price for fuel oil of $120 per tonne, the long run marginal cost of electricity is 19.4 piasters per kWhr (at an exchange rate of LE 2.8 per U.S. $1.00). Thus, the current price of electricity approximates 28 percent to 38 percent of its long run marginal cost. A more detailed discussion of the economics of energy pricing in Egypt is contained in Annex E.

1.22 The EEA recognizes the need for electricity pricing based on the marginal cost of service according to user categories. At present, the EEA is evaluating technical proposals from four US consultants for an electricity pricing strategy study to be financed by the Project. This study will develop price structures which reflect the true economic (marginal) cost of providing electricity to various customer segments but which will also make allowance for the energy needs of low income customers. Such a price structure will discourage waste of electrical energy resources, will encourage investment to reduce the electrical energy intensity of industrial processes, will promote efficient utilization of these resources, and will assure maximization of the society's economic output related to the scarce resource: electrical energy. A Requirement Precedent to Initial Disbursement of FY 90 funds would require a signed contract for this electricity pricing strategy study.

1.23 This Project amendment addresses the issue of electricity pricing by providing a planned second tranche of $115 million in response to the GOE's progress in implementing a program of annual increases in electricity prices. AID will consider additional financing in a third tranche of approximately $100 million following further electricity price increases satisfactory to the needs of the macroeconomic reform. In this regard, the lead donor for negotiating energy price reforms will likely remain the IBRD, and AID's strategy under this Project will be to continue to coordinate our policy objectives with the IBRD.

E. <u>PROJECT RATIONALE</u>:

1.24 The Project supports the government's program to reform the structure of electricity prices and reduce the amount of the subsidy. Reforming the structure of electricity pricing provides customers with more appropriate relative price information on electricity vis-a-vis other productive inputs. Higher electricity prices have two other economic effects: they reduce the growth of consumption of this product, thereby conserving petroleum, so that export earnings from that product are enhanced; GOE fiscal revenues are also increased by higher electricity prices as the EEA is obligated to pay the GOE successively higher prices for fuel oil and natural gas used in the generation of electricity.

1.25 Even though the Egyptian economy appears to have low growth in recent years, due largely to weakness of its balance of payments linked to inadequate macroeconomic policies, the economic stabilization and structural reform programs being discussed by the GOE with the IMF and IBRD give hope that Egypt's economic growth will resume. Moreover, even with continual increases in the real price of electricity, the generally inelastic demand for electricity suggests that annual growth will still be positive (higher than zero). Thus, even with the elimination of uneconomic uses, the increased demand for electricity and anticipated retirements of aging generating units will require additional generating capacity and bulk transmission facilities.

## F. CONFORMITY WITH RECIPIENT STRATEGY AND PROGRAMS:

1.26 In addition to the GOE's price reform commitment within the framework of the structural adjustment, the electricity sector is an important element of the government's Five Year Plan. The GOE considers development of the electric power sector to be a critical element of its long term strategy for national modernization. The GOE's major objectives for the sector are: (1) expand electric generating facilities on a least cost basis in order to meet anticipated demand; (2) maximize the hydroelectric generating potential of the Nile; (3) expand existing gas turbine plants through the addition of steam cycles (combined cycle operation); (4) maximize the use of available natural gas as a primary fuel; (5) reduce system losses; (6) improve the reliability and efficiency of the electric power system; (7) develop solar and wind generation capacity; and (8) implement programs to reduce the rate of growth of electricity consumption.

1.27 The EEA is currently rehabilitating a number of gas and steam turbine generating units with a combined rating of 400 MW and hopes to recover more than 200 MW upon completion of this rehabilitation. More than 1200 MW of the EEA's generating capacity is in excess of 20 years old and many generating units could benefit from a comprehensive rehabilitation program. Other units, generally of low capacity, cannot be economically rehabilitated and should be retired.

1.28 Technical and commercial energy losses in the national power system (transmission and distribution) are estimated to exceed 16% of the energy transmitted. Half of these losses occur on the EEA networks and the balance of these losses occur on distribution companies' systems. These losses are about double the losses on comparable power systems in the U.S. On some distribution company systems, distribution losses have exceeded 20% of the energy purchased from the EEA. The EEA has initiated a reactive power compensation project aimed at reducing these losses by installing capacitor banks on the 11KV busses in 66/11 KV substations. The Urban Electric Distribution Project (Project 263-0033) and the Alexandria Electric Network Modernization Project (Project 263-0194) are funding the installation of capacitors distributed on the 11 kV distribution circuits in Alexandria.

1.29 While rehabilitation of the distribution systems in Cairo, Alexandria, Shibin El Kom, Beni Suef and along the Suez Canal have been effective in lowering distribution system losses, major energy savings are possible in other areas. The Electric Distribution Authority (EDA) has agreed to undertake a study, using Project funds, to identify the sources and magnitude of individual distribution system losses within distribution company systems. The study will recommend specific corrective measures including cost estimates. A Requirement Precedent to Initial Disbursement of FY 90 funds will require a signed contract for this technical assistance.

1.30 The EEA is pursuing energy conservation programs on both the supply and demand sides of the sector, directed at all segments of the Egyptian economy. On the supply side, the EEA is planning to add steam cycles to many gas turbine installations to increase operating efficiencies. The EEA is proceeding with the installation of hydroturbine generators at Esna and plans to make similar installations at Nag Hammadi and Assiut to maximize their hydro energy.

1.31 On the demand side, the EEA's program of energy conservation involves the identification of unnecessary uses of electric energy, introduction of measures to improve the efficiency of energy utilization, and management of customer demand. The EEA's studies of the cement and other industries have identified processes that could be rescheduled to take advantage of off-peak periods without affecting production output and the EEA's recommendations are being implemented.

1.32 This Project, as amended, supports the EEA's program of initiating pricing reforms based on a more rational pricing strategy, by identifying ways to reduce energy losses and achieve efficiency improvements on the supply side. The outputs of the Project will directly contribute to increasing efficiency of supply.

G. RELATIONSHIP TO CDSS:

1.33 USAID's FY-89 Country Development Strategy Statement (CDSS), dated January 19, 1987, identified energy as a key factor affecting Egypt's productivity and noted that a reliable power source is clearly a critical element in the growth of modern industry and agriculture. Equally important to Egypt's development is reform of energy pricing policies which have burdened the economy with over consumption and waste of one of the essential inputs to development. Poor energy pricing policies have led to uneconomic industrial investments and a growing fiscal deficit.

1.34 The CDSS identified a number of problems inherent in the existing power system which could prevent the system from providing reliable power necessary for expanded productive activity. It pointed out that potential shortages over the next few years would result in poor system reliability, inability to meet peak demand, scheduled and unscheduled blackouts, reduced productivity and unproductive investments in standby generation.

1.35 The CDSS concluded that rational energy pricing is the first step in stimulating energy conservation which could resolve many of these problems. It stated that USAID's strategy in the sector would emphasize the need for price increases in concert with other donors and that USAID would focus on a "least cost" energy strategy emphasizing rehabilitation, conservation, training and planning. Given the critical importance of pricing to remove distortions, USAID would not provide any further funding for physical improvements in the sector (rehabilitation or new generation) in the absence of significant price increases.

1.36 Over the past three and a half years the GOE has undertaken reforms but at a slower pace than the CDSS had contemplated. As a result, many opportunities for needed assistance were lost. The CDSS Update (FY-91) dated July 4, 1989 provided greater flexibility in programming funds when progress in policy reform is slow. To the extent possible, USAID will use program and project assistance to support policy progress. Policy-based sector projects will be developed to support sectoral policy reforms when it makes sense to do so. At the project level, the CDSS Update has a policy emphasis on issues of institutional development, cost recovery, operations and maintenance, environmental concerns, participant involvement in decision making and providing choices in the delivery of goods and services.

## H. OTHER DONORS:

1.37 The IBRD considers energy price reforms to be crucial for meaningful economic reform and has indicated a readiness to provide a major infusion of funds in the electric power sector under an effective reform scenario. The IBRD has provided four loans to the power sector for: generating capacity additions at Shoubrah El Kheima and Aswan II; improving the efficiency of gas turbines at Mahmoudia and Dammanhour (combined cycle add-ons); transmission system additions associated with the Damietta combined cycle plant; and for a Rural Electrification Program.

1.38 The African Development Bank (ADB) likewise has taken an active role in the electric power sector. The ADB has financed ten projects in the power sector in the last 15 years. Five projects involved the extension of electrical networks along the Suez Canal and in rural areas of Egypt and the remaining five projects involved generating capacity additions. The ADB has linked financing of two projects to reforms in pricing. These projects are the installation of two 300 MW generating units at Cairo West and two 30 MW generating units at El Arish.

1.39 The European Investment Bank (EIB) has taken an active role in the electric power sector. The EIB has financed portions of the Shoubrah El Kheima plant and is expected to finance equipment for the steam cycle additions at Damietta. EIB financing in the sector is contingent on substantial electricity price increases.

1.40 The Arab Fund for Economic & Social Development (AFESD) has provided financing for: the study of the Egypt-Jordan interconnection; consultant services, equipment and construction services for the interconnection; the study for the integration of the power systems of a number of Arab countries; and for equipment for the steam cycle addition to the gas turbines at Damietta.

1.41 Other donors have provided "soft" loans which have been used for the purchase of cables, switchgear and other accessories for the modernization of electrical networks in Egypt.

## II - PROJECT DESCRIPTION

### A. GOAL AND PURPOSE:

2.01 The goal of the Project, as stated in the original Project Paper, is to promote rational investments and consumption decisions throughout the economy and to reduce the national budget deficit.

2.02 The purpose of the Project is to support past and promote continued GOE progress in reducing electricity sector subsidies and in making other energy sector policy changes by providing capital infrastructure incentives to the GOE.

### B. PROJECT FOCUS:

2.03 The focus of this Project, including the amendment, is the continued support of the program undertaken by the GOE to rehabilitate existing generating capacity and add generating capacity which more fully utilizes natural gas as the fuel for generating electricity. The Project will also upgrade the existing National Energy Control Center (NECC). This Project Amendment will fund additional technical assistance, engineering services and equipment. This assistance is in direct response to the 38 percent increase in electricity prices which the GOE implemented in May 1990. Adding to the Project, including these two components, was anticipated in the 1989 Project Paper to complement GOE policy changes and improvements in the way the sector is managed. The MEE and the EEA are seeking reforms in the sector, particularly a more rational energy pricing structure. This amendment proposes assistance which will support these organizations in achieving their sector policy goals.

### C. PROJECT COMPONENTS:

2.04 The total LOP funding ($351 million) is being authorized in phases contingent on satisfactory policy reforms in the electric energy sector. Consistent with the original Project design objectives, the Power Sector Support Project is structured so that incremental funding can be provided to support specific elements in the energy sector. The initial phase of $136 million was authorized in 1989 as a discrete project, comprising a number of stand alone components which are not dependent on subsequent financing. The components of the Project being financed by this second phase also constitute discrete projects, which can be carried out independent of any other in the Project. Due to the time required in the initial phase of the El-Kureimat component and the high probability of continued annual economic reforms, El-Kureimat will be incrementally funded with subsequent funding contingent upon a further electricity price increase.

2.05 This amendment is the logical next step to attain the larger purpose of significant increases as an incentive in the selling price of electricity. The program of annual increases in the retail price of electricity is designed to eliminate the subsidy early in the second half of the 1990s. The second tranche of funding, as a response to the substantial price increase implemented in May 1990, represents a reaffirmation of AID's commitment to support sectoral policy reforms and substantial electricity price adjustments. Central to policy dialogue and electric energy strategy is successive increases in the price of electrical energy to customers. The electricity pricing strategy study, to be contracted by the EEA in the near future and completed by mid FY 1991, will recommend pricing strategies and include an evaluation of time-of-day pricing which, if implemented, should have a major impact on peak demand.

2.06 Consistent with the original project design:

a. The AID Grant will finance services, equipment and materials with their source and origin in the United States (Code 000).

b. The GOE will finance the local currency costs for the various components of the amended project.

c. The GOE in-kind contributions will include staff, office space and equipment, buildings and land.

d. The EEA will be the implementing agency for the two new components of the amended project.

e. The GOE will provide, or cause to be provided, from other bilateral or multilateral financial institutions, all additional foreign exchange funds required for for the construction of each of the two 600 MW generating units at El-Kureimat.

2.07 The two tranches of funding proposed in this Project Paper amendment (tranches 2 and 3 for the overall Project) will finance the foreign exchange costs of:

a. engineering, procurement, construction management, start-up and training services for two 600 MW generating units;

b. design, supply and erection of one or more equipment packages and associated operation and maintenance training for two 600 MW generating units;

c. engineering services for the upgrading of the National Energy Control Center; and

d. design, supply and installation of computer hardware and software to expand on-line capabilities of the National Energy Control Center to collect and process data from up to 200 stations.

D. PROJECT OUTPUTS:

2.08 The central output of the Project, including this amendment, is significant annual increases in the selling price of electric energy sufficient to eliminate the electricity sector subsidy by the mid-1990's.

2.09 The additional outputs of the two tranches of funding proposed in this Project amendment are:

* Design, procurement of equipment and construction/installation services and construction/project management services for the 1200 MW thermal power station at El-Kureimat.

* Construction of two 600 MW steam turbine generating units at the El-Kureimat site.

* Expansion of the data processing capability of the NECC from 60 stations to 200 stations.

2.10 Electricity price increases in later years will be evaluated to determine if the price increases (a) conform to the longer range plan to eliminate subsidized sales of electricity early in the second half of the 1990s, (b) reduce the gap between the economic price and the current selling price, (c) aim at recovering costs of providing service to the several categories of customers, and (d) allow a monitored subsidy to very poor customers. Additional funds may be added to the Project in the future for:

a. consultant services and major items of equipment for a third 600 MW generating unit at El-Kureimat;

b. consultant services, major equipment, construction and installation services for additional hydraulic generation at sites along the Nile River;

c. consultant services, major equipment, construction and installation services for pump storage hydraulic generation at sites along the Red Sea;

d. consultant services, major equipment, rehabilitation, construction and installation services to relocate gas turbines and integrate steam cycles to provide a combined cycle plant;

e. consultant services, equipment and installation services to establish regional control centers in the EEA operating zones; and

f. consultant services, equipment and materials to reduce energy losses on the distribution systems.

2.11 The El-Kureimat thermal power station will be designed and equipment specified and selected that will result in a completed plant with a full load availability in excess of 78 percent (40.6 weeks/year). This availability is based on a full load forced outage rate of 10 percent (5.2 weeks/year) and a full load scheduled outage rate of 12 percent (6.2 weeks/year). These outages rates are for a "mature" plant. Availability during the first few years of operation can be expected to be somewhat less as the station equipment and personnel gain experience and mature.

## III- COST ESTIMATES AND FINANCIAL PLAN

### A. PROJECT COST ESTIMATE:

3.01 A Project cost estimate (excluding in-kind contributions) has been prepared for the two new components of the Project, and is summarized in Table III-1.

TABLE III-1
SUMMARY OF COST ESTIMATES
(U.S.$ and LE Million)

| | El-Kureimat | | | | | | NECC | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRANCHE 2 | | | TRANCHE 3 | | | | | EQUIV.US$ | | LE |
| | AID $ | Other $ | EEA LE | AID $ | Other $ | EEA LE | AID $ | EEA LE | AID | Other | EEA |
| Consultant Services | 15 | 0 | 5 | 35 | 0 | 24 | 3 | 0 | 53 | 0 | 29 |
| Equipment/ Services | 76 | 271 | 285 | 58 | 243 | 234 | 10 | 0 | 144 | 514 | 519 |
| Audit/Evalu.& Contingency | 9 | 30 | 47 | 7 | 36 | 9 | 2 | 0 | 18 | 66 | 56 |
| | 100 | 301 | 337 | 100 | 279 | 267 | 15 | 0 | 215 | 580 | 604 |

3.02 In addition to the local currency cost shown in Table III-1, the GOE will provide in excess of LE 13.3 million in the form of in-kind contributions. The in-kind contributions include counterpart personnel costs, services, administrative costs, fair market value of land contributed and other similar costs. The EEA will provide in-kind contributions to the project in the following areas: staffing and labor to manage the implementation of the National Energy Control Center and El-Kureimat components; office space at the National Energy Control Center; and the land for the El-Kureimat site. The EEA's in-kind contributions are summarized in Table III-2.

TABLE III-2
IN-KIND CONTRIBUTIONS
(LE - MILLION)

| | | |
|---|---|---|
| Staff: | Project Team | |
| | 15 employees X 6 years @ LE5700/year | =LE 0.5 |
| | Operation Staff (Training) | |
| | 156 employees X2 years @ LE8200/year | =LE 2.6 |
| | Maintenance Staff (Training) | |
| | 195 employees X1 year @ LE7500/year | =LE 1.5 |
| Office Space: | NECC - 100m$^2$ X LE30/m/m$^2$ X 36 months | =LE 0.1 |
| Land: | El-Kureimat(860,000 sq.meters) | =LE 8.6 |
| | Total In Kind Contributions | =LE13.3 |

B. Section 611 (a) Requirements:

3.03 The estimated costs of the goods and services to accomplish the Project purpose have been based on a sound engineering approach to achieving project outputs. The plans for accomplishing the Project purpose are consistent with good utility practices. The cost estimates for El-Kureimat (Annex M) are based on an assessment of capital costs prepared by the feasibility study consultant in early 1989 for the plant. A series of estimates for the community facilities (station staff community) and the transmission connection to the Unified Power Systems were also used to develop the total project cost. The cost estimates for the National Energy Control Center Upgrading are based on recent assessments prepared by a consultant performing a study of control centers for the EEA and an unsolicited price proposal from the original equipment supplier of the NECC system. The cost estimates have been reviewed by the Project office and are judged to be reasonable.

3.04 AID will fund no portion of the equipment procurement or construction services for the initial 600 MW unit at El-Kureimat without signed agreements from other donors for the total estimated cost of the unit. Likewise, if a third tranche is added to the Project to help finance a second unit at El-Kureimat, AID will fund no equipment or construction services for the unit without signed agreements from other donors for the total estimated cost of that second unit.

40

Based on the foregoing, it is the conclusion of the Project Committee that the requirements of Section 611 (a) of the Foreign Assistance Act of 1961, as amended, have been satisfied.

C. PROJECT FINANCIAL PLAN:

3.05 The source and application of funds required for the Project are summarized in Table III-3:

TABLE III-3
SUMMARY FINANCIAL PLAN

| | EQUIV. U.S. DOLLARS (Millions) | | EGYPTIAN POUNDS (Millions) | |
|---|---|---|---|---|
| | AID US$ | OTHER US$ | CASH LE | IN-KIND LE |
| POSSIBLE FUNDING SOURCES | | | | |
| AID Grant | 215.00 | | | |
| African Development Bank | | 300.00 | | |
| Arab Fund | | 100.00 | | |
| Kuwait Fund | | 100.00 | | |
| European Investment Bank | | 80.00 | 604.00 | |
| World Bank | | 100.00 | | |
| GOE Contribution | | - | | 13.30 |
| SubTotal | 215.00 | 680.00 | 604.00 | 13.30 |
| FUNDING APPLICATION TECHNICAL SERVICES | | | | |
| Consultant Services-El-Kureimat | 50.00 | | 29.0 | |
| Consultant Services-NECC | 3.00 | | .20 | |
| SubTotal | 53.00 | | 29.20 | |
| EQUIPMENT AND CONSTRUCTION SERVICES | | | | |
| El-Kureimat | 134.00 | 514.00 | 519.00 | 13.20 |
| National Energy Control Center | 10 00 | 0.00 | 0 | 0.10 |
| SubTotal | 144.00 | 514.00 | 519.00 | 13.30 |
| OTHER | | | | |
| Audit, Monitoring and Evaluation | 0.15 | | | |
| Contingency | 17.85 | 66.00 | 55.80 | |
| SubTotal | 18.00 | 66.00 | 55.80 | |
| TOTAL | 215.00 | 580.00 | 604.00 | 13.30 |

D. FUNDING RESPONSIBILITIES:

3.06 AID grant funds will finance the consultant(s)' foreign exchange costs (design, procurement and construction management services), the cost of equipment and erection services for one or more equipment packages for the El-Kureimat thermal power station, and the cost of computer hardware and software to be installed at the NECC. Payment will be made by USAID through Direct Letters of Commitment (D L/Comm).

3.07 The Grant Agreement Amendment will contain a Requirement Precedent to Initial Disbursement requiring that the Cooperating Country provide evidence that the proceeds of the Grant's funding for consultant services have been passed to the EEA as a grant and the balance of the Grant for equipment materials and installation service have been passed to the EEA as a loan.

3.08 The EEA is expecting commitments from bilateral and multilateral financiers to provide additional foreign exchange. The Grant Agreement Amendment will require evidence of these foreign exchange commitments before the Initial Disbursement of Project funds for consultant services for El-Kureimat, and signed agreements for 100 percent of the foreign exchange financing before disbursement of Project funds for equipment or construction services for El-Kureimat.

3.08 The GOE will finance all local currency costs associated with the Project including land acquisition, storage areas, electric transmission system modifications to their network to connect the El-Kureimat Station to the Unified Power System, and extension of a gas transmission pipelines to El-Kureimat. A Requirement Precedent to Disbursement of funds provided by the Grant Amendment will require evidence that EGPC will provide the necessary transmission facilities to supply 100 percent of the plant requirement and deliver sufficient gas to the El-Kureimat thermal power station to permit the EEA to operate the station, under normal conditions, at least 50 percent on natural gas.

3.09 A Requirement Precedent to Disbursement of funds provided by the Grant Amendment will require evidence that the EEA owns of otherwise has legal jurisdiction of the El-Kureimat plant site and necessary electric and fuel transmission rights-of-way.

3.10 The Grant Agreement Amendment will contain a Requirement Precedent to Initial Disbursement requiring that the Cooperating Country provide evidence that the local currency financing for the Project component included in this Project Amendment has been budgeted by the Cooperating Country and will be available for timely expenditure by the EEA.

E. DISBURSEMENT PROJECTIONS:

3.11 Disbursement of the additional $215 million in AID funds over the project implementation period is outlined in Table III-4 below. The disbursement schedule assumes the Project was authorized in FY 90; all construction or equipment installation will be completed in FY 97; and the consultant will have closed out all contracts in FY 98 and FY 99.

TABLE III-4
DISBURSEMENT SCHEDULE - AID FUNDING
(U.S.$ - MILLIONS)

| FISCAL YEAR | US DOLLARS |
|---|---|
| FY 91 | $ 3 |
| FY 92 | $ 14 |
| FY 93 | $ 25 |
| FY 94 | $136 |
| FY 95 | $ 16 |
| FY 96 | $ 10 |
| FY 97 | $ 7 |
| FY 98 | $ 3 |
| FY 99 | $ 1 |
| TOTAL | $215 |

3.12 The FY 89 Grant Agreement contains a Requirement Precedent to Initial Disbursement requiring that the EEA establish and maintain accounting records of local currency and in-kind contributions for each component of the Project and maintain these records on a quarterly basis. The EEA will be required to establish and maintain accounting records of local currency and in-kind contributions for the El-Kureimat and NECC Upgrading components.

3.13 The FY 89 Grant Agreement also contains a covenant that the EEA will provide to USAID, in a timely fashion, quarterly copies of the accounting information on local currency and in-kind contributions for each component of the Project. The EEA will be required to provide to USAID similar quarterly reports for the El-Kureimat and NECC Upgrading.

43

## F. ASSESSMENT OF THE EEA CONTRACTING AND VOUCHER EXAMINATION CAPABILITIES:

3.14 During the past ten years, EEA has effectively implemented ten projects financed by A.I.D., involving obligations exceeding one billion US Dollars. EEA has utilized Host Country contracting mechanisms for more than 75 contracts for these projects and has extensive experience in contracting for services and equipment being financed from a wide range of bilateral and multilateral financing agencies. During this period, no areas of specific or material weaknesses in EEA's contracting or voucher examination capabilities were observed.

3.15 In compliance with the Administrator's Payment Verification Policy Statements No.'s 1 through 5, a formal assessment of EEA's contracting and voucher examination capabilities will be contracted for with an independent CPA firm. This assessment will be completed prior to the initial disbursement of funds under this Project amendment.

TABLE III-5
ASSESSMENT OF THE
METHODS OF IMPLEMENTATION AND FINANCING

| ACTIVITY | METHOD OF IMPLEMENTATION | TYPE OF CONTRACT | METHOD OF FINANCING | COST ESTIMATE $ MILLION | IMPLEMENTING AGENCY |
|---|---|---|---|---|---|
| 1.Consultant Services | Host Country | Cost+ Fixed Fee | Direct L/Comm | 53.00 | EEA |
| 2.El-Kureimat Equipment | Host Country | Lump Sum | Direct L/Comm | 134.00 | EEA |
| 3.NECC Upgrade Equipment | Host Country | Lump Sum | Direct L/Comm | 10.00 | EEA |
| 4.Monitoring/ Evaluation | AID Direct PSC | Fixed Price | Direct Payment | 0.10 | AID |
| 5.Audit | AID Direct | Fixed Price | Direct Payment | 0.05 | AID |

G. AUDIT COVERAGE:

3.16 In order to allow A.I.D. flexibility in carrying out Evaluations, Assessments and Audits in compliance with A.I.D. requirements, the USAID will endeavour to obtain the GOE's agreement for the unilateral use of $150 thousand for this purpose out of the total project costs of $215 million funded by AID.

3.17 At least two contracts will be lump sum fixed price (FP) contracts, not subject to audit of costs. The Project will also utilize consultant engineering services financed through Host Country contracts (HC) which are subject to audit of costs. All contracts, however, are subject to audit for compliance with other AID regulations and funds are allocated for this purpose. The Project budget includes $ 50,000 to cover the estimated auditing costs of these contracts. Audit funds budgeted by activity are summarized in Table III-6.

TABLE III-6
UTILIZATION OF AUDIT FUNDS

| ACTIVITY | NUMBER OF CONTRACTS | TYPE OF CONTRACT | ESTIMATED CONTRACT AMOUNT ($000) | AUDIT FUNDS BUDGETED |
|---|---|---|---|---|
| Technical Services | 2 | HC-C+Fee | $ 53,000 | $ 10,000 |
| El-Kureimat Equipment | 1 | HC-FP | $134,000 | $ 20,000 |
| NECC Upgrade Equipment | 1 | HC-FP | $ 10,000 | $ 20,000 |
| Evaluation | 1 | AID-FP | $ 100 | |

45

## IV. PROJECT IMPLEMENTATION PLAN

### A. IMPLEMENTING AGENCY:

4.01 The EEA will have primary responsibility for the overall management of the components being funded by the Project amendment and for providing direction to the consulting engineer(s) and contractors funded by this Project amendment. The Grant Agreement amendment will contain a Requirement Precedent to Initial Disbursement requiring a statement of the names of the persons authorized to represent the cooperating country for each component of the amended Project together with a specimen signature of each person.

### B. PROJECT PROCUREMENT PLAN - GENERAL:

4.02 The procedures and guidelines contained in AID Handbook 11, Country Contracting, shall apply to the procurement of Technical Services, Construction Services and Commodities, as appropriate, for the components being funded by the Project Amendment with source/origin of goods and services limited to AID Geographic Code 000 (US). Utilization of minority and/or small business owned by socially and economically disadvantaged individuals will be encouraged.

4.03 USAID will approve all Scopes of Work and Services for the El-Kureimat and NECC components prior to issuance and will prepare the appropriate solicitation announcement for publication in the Commerce Business Daily and other appropriate media. USAID will review, modify as necessary and concur in evaluation procedures to be utilized by the EEA; will review the EEA's evaluations for conformance with agreed upon procedures and provide concurrence to the results of the evaluation and proposed contract awards; will review all contracts to assure compliance with AID regulations and will verify the reasonableness of the cost of each contract. All USAID approvals will be by Implementation Letters.

4.04 AID's financing from the second tranche will be utilized to finance:

a. Consultant services for the final design of the El-Kureimat thermal power station, preparation of specifications for all equipment and construction services for the first unit (with options for a second and third unit), preparation of tender documents reflecting the procurement requirements of the appropriate financing agency and assisting the EEA in evaluations and contract awards.

b. One or more packages of equipment for the first unit at El-Kureimat with options for companion packages for a second and third unit.

c. Consultant services, computer hardware and software for the upgrading of the National Energy Control Center.

4.05. The second tranche of funding, if released, will be utilized to finance:

a. The balance of consultant services for the two-unit El-Kureimat thermal power station that will include, at a minimum, scheduling, construction management, project management, start-up services and O&M training services.

b. The companion packages of equipment for the second unit at El-Kureimat with options for a third unit.

C. PROJECT PROCUREMENT PLAN - TECHNICAL SERVICES:

4.06 The EEA will competitively select, in accordance with Handbook 11, Chapter 1 (Technical Services) procedures and guidelines, a consulting engineering firm to finalize the El-Kureimat design, schedule and cost estimate, and provide engineering and full procurement services for a single 600 MW steam turbine-generating unit plant with options for an additional two units. Two 600 MW units are planned at El-Kureimat, but a single 600 MW unit will be constructed initially. The station will be so designed so as not to preclude a third 600 MW unit at a future time.

4.07 The EEA will provide an option for the consultant engineer to provide construction management, project management, performance and acceptance testing, management of initial commercial operation, operation and maintenance (O & M) training and establishment of an adequate spare parts system. The EEA will also provide an option to utilize the consultant engineer for up to two additional identical units. If the EEA elects not to exercise either or both options, and the third tranche of AID financing has been authorized, the EEA will follow Handbook 11, Chapter 1 procedures to select a consulting engineering firm for these additional services. The previously selected consultant would be eligible to compete for these follow-on services in connection with the installation of additional units. In any event, at the EEA's request, AID will finance the total consultant services package for the plant.

47

4.08 The EEA will competitively select, in accordance with Handbook 11, Chapter 1 (Technical Services) procedures and guidelines, a consulting engineering firm familiar with energy management control centers to provide advice on the upgrading of the National Energy Control Center. The consultant will recommend the most effective contracting arrangement to achieve the upgrading objective. The consultant will prepare the necessary technical specification procurement documents based on work previously performed by the EEA, assist the EEA in the evaluation of proposals, assist in contract award and act for the EEA in the management of the control center upgrading.

4.09 Either a US Direct Hire, FSN or PSC electrical engineer, with extensive electric utility and project management experience, assigned to the Mission's Power Systems Group, will oversee the implementation of the components included in this Project Amendment.

D. PROJECT PROCUREMENT PLAN - CONSTRUCTION SERVICES AND COMMODITIES:

EL-KUREIMAT:

4.10 The EEA has made application to a number of bilateral and multilateral financing institutions for loans and grants to finance construction services and equipment packages for the El-Kureimat component. These institutions include AID, the African Development Bank, the Arab Fund for Economic and Social Development, the European Investment Bank, and the Kuwait Fund for Arab Economic Development. Procurement of all equipment, commodities, construction and erection services must comply with the applicable lender/donor regulations and guidelines. All AID funded procurements will be in accordance with AID Handbook 11, Chapter 2 and/or 3 as appropriate.

4.11 Because of the multiple funding sources for the El-Kureimat component, Project equipment and services will be procured under a number of separate, but related contract or purchase order packages. AID intends to finance a major, highly visible plant component, such as a boiler or turbine generator, in accordance with AID procurement regulations. The decision on which packages(s) AID will finance will be based on a future recommendation by the EEA, based on an analysis by the consultant, and concurred in by the other outside lenders/donors.

4.12 Procurement of equipment and commodities will be principally from foreign suppliers. Major equipment and commodity procurement packages will include the boiler, turbine generator, electrical equipment, instrumentation and controls,

48

piping and valves, structural steel, switchyard, pumps, condenser, water treatment plant and transmission and distribution equipment. Construction services procurements would include civil works, structural piling, mechanical and electrical erection. A total of 20 contracts and purchases orders, excluding the consultant services, are anticipated to construct the first unit. Each contract or purchase order will contain specific provisions for a warranty period and will specify performance guarantees.

4.13 The total amount of funding expected from the other financiers, contingent on subsequent economic reforms, is sufficient to finance two 600 MW units; however, only a portion of the funds may be made available initially, with the balance provided following another substantial electricity price increase. Therefore, all equipment and construction services procurements will require that each bidder include optional pricing for a second and third duplicate unit. The EEA would exercise an option following a subsequent electricity price increase and upon the agreement of the lenders/donors to provide the necessary additional funding for the second and third units.

4.14 If during the consultants' final design and preparation of equipment specifications and procurement documents, an electricity price increase sufficient to permit the authorization of the third tranche of funding has not occurred, USAID will reallocate this second tranche funding to fully finance the consultant services contract which includes construction management, project management, scheduling, start-up services and O & M support for unit 1 (and unit 2 if sufficient foreign exchange is available from other financiers for unit 2). The remaining funds after financing the consultant services will be utilized to finance an appropriate equipment package(s) within the available funding.

4.15 A.I.D.'s financing for this project is based on commitments in the form of letters expressing each financier's intent to negotiate financing agreements with the GOE. The release of A.I.D.'s funds for equipment procurements or construction services will be conditioned on signed financing agreements for 100 percent of the foreign exchange required for unit 1, estimated at $385 million, or for Unit 1 and 2, an estimated $580 million (excluding A.I.D.'s funding). If the full foreign exchange financing is not provided to meet the financing requirements for either Unit 1 or Unit 2, USAID will consult with EEA to determine EEA's plans to secure the balance of foreign exchange financing. If additional foreign exchange financing will not be provided on a timely basis, USAID will redesign the project to otherwise utilize A.I.D.'s funds.

NATIONAL ENERGY CONTROL CENTER UPGRADE:

4.16 It is expected that the procurement of the additional computer hardware and software and installation services will be competitively awarded based on A.I.D. Handbook 11, Chapters 2 and/or 3. The contractor will design, supply, factory test, install, site test, start-up and operationally test the new computer system, merge the new and old systems together, reconfigure the data processors and phase out the original computer systems. The contractor will also replace the original 39 remote terminal units and modify the remainder of the remote terminal units to be compatible with the new system. The contractor will warrant the system for a minimum of 24 months and will provide a guarantee for the Center's performance.

E. IMPLEMENTATION SCHEDULE:

4.17 A detailed implementation schedule for El-Kureimat will be included in the Design Report to be prepared by the consultant engineer and submitted to the EEA within two months after the start of work.

4.18 A detailed implementation schedule for the National Energy Control Center Upgrade will be developed by the consultant engineer and submitted to the EEA within six months after the start of work.

4.19 Based on general planning accomplished during the El-Kureimat feasibility study and the EEA's planning for the NECC Upgrading, a preliminary schedule for the implementation actions through 1994 for each component is set forth in Annex N. Principal or milestone dates of this schedule are summarized in Table IV-1 below.

TABLE IV-1
PROJECT MILESTONE SUMMARY

| | | |
|---|---|---|
| Project Authorized | July 1990 | |
| Project Agreement Signed | August 1990 | |
| Requirements Precedent to Initial Disbursement Satisfied | December 1990 | |
| | El-Kureimat | NECC |
| Consultant Contract Signed | August 1991 | |
| Consultant Contract Signed | | August 1991 |
| Final Design and Specifications Complete | March 1992 | |
| Upgrade Contract Signed | | August 1992 |
| Construction Mgt Contract or Option Signed | January 1993 | |
| Unit 1 Construction Started | March 1993 | |
| Unit 2 Construction Started | September 1993 | |
| Unit 1 Construction Completed | June 1996 | |
| Unit 2 Construction Completed | December 1996 | |
| NECC Upgrade Completed | | August 1993 |
| Warranty Period Completed | December 1998 | August 1995 |
| Project Completed | February 1999 | |

F. TRAINING:

4.20 Formal training programs will be conducted by the equipment supply contractors as part of each project component. The EEA will provide overseas air transportation for training from local funds provided by the EEA under the project. The contractors will be responsible for conducting the formal training programs at the contractor's and/or subcontractor's plants and on-site in Egypt.

4.21 A covenant will be included in the Grant Agreement which will provide that the EEA select additional, administrative, operation and maintenance staff as required for each plant, and will commence comprehensive training programs sufficiently in advance of the start up of all plant facilities at El-Kureimat and the NECC so that administrative, operations and maintenance personnel will be on-site, trained and fully qualified to administratively support, operate and maintain the generating units when they are placed in service.

G. AID FINANCING PROCEDURES:

4.22 All Host Country procurements of services and equipment financed by this Grant will be financed by Direct Letters of Commitment (D L/Comm). Upon receipt of an executed contract acceptable to AID and a request from the EEA to issue a Letter of Commitment, AID will issue a Direct L/Comm to the contractor.

H. TERMINAL DATES:

REQUIREMENTS PRECEDENT:

4.23 The terminal date for meeting the Requirements Precedent for Initial Disbursement will be 90 days from the signing of the Grant Agreement Amendment.

PROJECT ASSISTANCE COMPLETION DATE:

4.24 The Project Assistance Completion Date (PACD) will be February 28, 1999, 26 months following the projected date of first commercial operation for the second 600 MW unit at the El-Kureimat Thermal Power Station.

TERMINAL DISBURSEMENT DATE:

4.25 The Terminal Disbursement Date (TDD) will be November 30, 1999, nine months after completion of all services, to allow for final payments.

# V. MONITORING AND EVALUATION PLAN

## A. GENERAL:

5.01 The information collected and analyzed in this monitoring and evaluation plan will be used by the EEA, PDS/E and USAID Project and Mission management.

## B. INSTITUTIONAL LOCUS:

5.02 The Economics Office in USAID monitors policy developments in the electricity and energy sectors as part of its ongoing responsibilities. Information on the impacts of electricity pricing reforms on the macroeconomy are continuously gathered via special studies designed by USAID staff economists and/or via external project evaluations. Data necessary to facilitate decisions regarding obligation and release of the funds under the Power Sector Support Project has been collected, analyzed, and presented to Mission management and to the Project Committee by USAID's Economics Office. Similar data collection, analysis and presentations will be made at the time of the next electricity price increase which may trigger the authorization of the third tranche of project funds.

5.03 Monitoring responsibilities related to the construction of electricity generating infrastructure will be carried out by the Power System Group within the Office of Urban Administration and Development (UAD) of the Development Resources (DR) Directorate. In addition to participating in reviews of contractors' progress and preparation of contractor work plans (described below), Power System Group representatives will conduct periodic site visits to confirm progress indicated in monthly contractor reports (described below).

## C. PROJECT OUTPUT, INDICATORS, QUESTIONS AND DATA COLLECTION METHODOLOGIES:

### PROJECT OUTPUTS:

5.04 Project outputs necessary to achieve objectives include construction of 2-600 MW steam-turbine generating units and installation of replacement computer hardware and software at the NECC to increase the data processing capability to 200 stations.

### INDICATORS:

5.05 The Project indicators that the Project outputs have been achieved are:

Two 600 MW steam turbine generating units in service by January 1997.

NECC computer system capacity to process data for 200 stations in service by September 1995.

OUTPUT LEVEL QUESTIONS:

5.06 The key output level question is whether the construction of the 2-600 MW steam turbine generating units is proceeding as planned and whether the necessary computer hardware and software replacements/modifications are proceeding as planned. If the answer to this question is NO, then what factors are constraining timely or appropriate construction? How can these constraints be overcome?

DATA COLLECTION METHODOLOGY:

5.07 Procedures will be developed by the UAD Power System Group for collecting information on output level indicators.

D. FEEDBACK/MONITORING:

5.08 Project consultants selected to implement the El-Kureimat component and the NECC Upgrade component of the project will have the primary responsibility for monitoring all activities and approving invoices submitted by all contractors for their respective projects. Each consultant will assist the EEA in monitoring contractors' performance and providing general support to the EEA for the respective projects. Each consultant will implement monitoring systems with the following features:

Monthly and Quarterly Reports
Annual Work Plans
Joint Annual Reviews of Progress

5.09 USAID has had considerable experience implementing projects similar to the proposed Project components. The primary responsibility for USAID monitoring of the individual components of the Project will be carried out by the Power System Group within DR/UAD. The group is experienced and will adequately carry out this responsibility.

5.10 In addition to participating in monthly and annual reviews of progress and annual work plans, USAID will conduct periodic site visits to confirm progress indicated in monthly and or quarterly reports.

54

E. MONTHLY AND QUARTERLY (IF DESIRED) PROGRESS REPORTS:

5.11 The purpose of the reports will be to communicate implementation progress and problems to the implementing agency and to USAID project management. These reports will discuss planned versus actual procurement and construction/installation accomplishments of tasks and subtasks and costs; will identify existing or expected problems/constraints which have or could result in delays or slippage; will propose and rank solutions to these problems; and if appropriate will present revised timetables for accomplishment of tasks.

5.12 These reports will be brief, concise and action oriented. They should avoid unnecessary detail. They should be written to be read by a busy project manager.

5.13 These reports will include a prioritized list of issues which require action by either the EEA or USAID project management. Issues will be presented in table format with entries for the following: assigned priority; brief description of issue; date identified; assistance needed; by when; and current status. Issues will be repeated in the table until they are resolved.

5.14 Monthly progress review meetings will be held at each site. The monthly meetings will be attended by USAID, the EEA and the appropriate engineering consultant and contractor(s). Problems will be identified as they occur and will be resolved either on-site or submitted for discussion and resolution at the monthly site meetings. The consultant's monthly (or quarterly) progress report will be the basis for the monthly (quarterly) progress review.

F. JOINT ANNUAL REVIEW OF PROGRESS:

5.15 The purpose of the joint annual reviews will be to assess the past year's progress and to develop a strategy for attaining next year's benchmarks. This strategy will be embodied in the annual workplan, discussed below. The contractors, the EEA counterparts, the USAID Project Officer and selected USAID project committee members will participate in the joint annual review. Participants will assess progress on selected indicators to determine whether implementation is progressing satisfactorily and assess the impact of the project outputs on beneficiaries. Implementation problems will be identified at the annual review along with proposed corrections or solutions.

G. ANNUAL WORKPLAN:

5.16 The annual workplan for each component of the Project will be developed together with the consultants, USAID Project management, and the EEA counterparts, using conceptual guidance contained in the Project Paper along with changes suggested by review of implementation experience to date. The annual workplan is intended to answer the questions "What exactly will we achieve this year?" and "How will we achieve it?" The annual workplan will detail:

1) the coming year's impact on the end of Project status, output benchmarks and a plan for data collection; and

2) a strategy for attaining these benchmarks (task(s), sequencing, responsible party(ies), target dates, deliverables), possible impediments/constraints to success, ways of alleviating these impediments/constraints, and alternative courses of action to pursue if they do materialize.

H. EXTERNAL EVALUATIONS:

5.17 USAID, in collaboration with the EEA, will conduct formal reviews of these Project components in early 1992 following the consultant's completion of the final design and specifications of major equipment and again in early 1993 once construction at the site has begun. These formal reviews will determine the status of compliance with covenants, implementation progress and planned future actions.

5.18 A final Project evaluation will be scheduled for early 1997 after the plant begins commercial operations. The purpose of this evaluation will be to assess progress in achieving Project outputs and the impact of these outputs on the GOE's long term energy sector goals. The evaluation will be designed to determine how effective the provision of funding for critical initiatives has been in promoting progress on electricity pricing issues, and determine the impact of electricity pricing reforms on economy wide investment and consumption decisions.

I. BUDGET:

5.19 Roughly $100,000 or 0.05 percent of the $215 million designated for this project amendment has been set aside for special studies, external evaluations and other data collection, monitoring and evaluation activities.

## SECTION VI - SUMMARY OF ANALYSIS

### A. CAPACITY NEED ANALYSIS

#### Load & Energy Forecast

6.01 A load and energy forecast prepared by the IBRD, incorporating reasonable pricing and GDP growth assumptions, presents a 3-stage scenario.

1. A modest 2.5 percent annual demand growth rate for electricity through FY 91, during which electricity prices increase and economic growth stagnates.

2. A modest 5.7 percent annual growth rate in electrical demand during which the Egyptian economy rebounds.

3. A third stage after FY 97 when electricity prices are at the economic value and growth in demand for electricity averages 10 percent per year.

#### Generating Capacity

6.02 The generating capacity installed on the Egyptian power system totals 10,694 MW, but the actual capacity available to meet customer demands is considerably less due to hydraulic limitations on hydro units at Aswan, ambient air conditions and aging plants. The EEA can, however, dependably generate 8000 MW to meet system demands and there is 2100 MW of capacity under construction which is adequate to meet demand through 1995.

6.03 The generating capacity (1200 MW) financed by this project will enter service in 1996-1997 and will provide sufficient capacity to permit the EEA to operate the system reliably and meet customer demand.

6.04 Additional generating capacity being contemplated by the EEA, if contracted for on a timely schedule, could be constructed and ready for operation to meet additional load requirements occurring after 1997. Lower growth rates, customer conservation or system loss reduction would give the EEA the flexibility to curtail the operation of their highest operating cost generating capacity and subsequently retire many of their smaller, inefficient oil-fired units that will have reached the end of their economically useful life.

B. TECHNICAL ANALYSIS

6.05 The technical justification for the proposed power plant at El-Kureimat is the availability of a suitable site adjacent to a major highway and the Nile River. The river and highway will facilitate deliveries of heavy equipment either by barge or truck and the Nile River will furnish substantial quantities of water for condenser cooling. Other technical considerations for the site included the availability and access to natural gas and oil to fuel the plant and access to the necessary transmission system line to deliver the electrical energy to the load centers throughout Egypt.

6.06 The technical justification for the proposed component of the National Energy Control Center is the availability of appropriate computer hardware and software to provide the capacity to process the volume of data necessary for the economic and reliable operation of the Egyptian power system.

EL-KUREIMAT

a. Site:

6.07 The proposed site is located in the Beni Suef governorate 95 km. south of Cairo on the east bank of the river. Soil conditions are suitable for building the facilities and weather conditions, including wind, would not adversely affect the plant. The site lies in a region of low earthquake incidence. Access to the site is by highway or river.

b. Thermal Power Station

6.08 The thermal power station consists of two identical 600 MW steam turbine generating units and unit accessories including condensers, pumps, feedwater heaters and circulating water. There will be fuel storage and transmission connections to the Unified Power System. The two-unit station includes a completely enclosed control room complex and turbine building and open boiler. The power plant and switchyard are located on the plateau near the river, and the Mazout storage tanks will be located to the south and east of the plant.

6.09 A control room complex will contain control, electronic equipment, computer, DC equipment, switchyard and battery rooms. The drum-type boiler is designed to generate steam at 180 bar and 538$^{0}$C, arranged to be fired with either natural gas or Mazout. Each unit has a turbine generator, designed to operate at 3000 RPM. Generator output will be 600 MW, 3 phase, 50 Hertz (Hz), 20 kV, 0.85 PF.

c. Circulating Water Supply

6.10 The two unit plant will require a maximum cooling water flow of 40 cubic meters per second. Current controlled river flows are between 868 cubic meters and 1620 cubic meters per second, so there is a sufficient supply from the Nile River.

d. Fuel Supply

6.11 The gas supply required to operate the two unit plant 100 percent on natural gas is 9 Million Standard Cubic Meters (MSCM) per day. The Petroleum Pipeline company plans to supply El-Kureimat with natural gas from the Gabal El Zeit gas production field by pipe, sized to supply 100 percent of the two unit plant natural gas requirements.

6.12 The Mazout oil supply required to operate the two unit plant 100 percent on Mazout is 5,760 metric tons per day. A 14-inch heavy oil pipeline passes the El-Kureimat site from the Mostorod refinery to Beni Suef and Upper Egypt. The station will provide on-site storage capacity for a 21-day supply.

e. Power Transmission

6.13 It is convenient to link the El-Kureimat transmission to the 500 kV bulk transmission network by two lines crossing the Nile to the existing 2-500 kV lines from Cairo to Sammalut (and Aswan and north to Tebbin). The loss of any one line will not overload the others. This transmission scheme will require 150 kilometers of 500 kV line additions and six line positions on 500 KV busses. A 220 kV line connecting Fayoum and Beni Suef will be looped through El-Kureimat.

f. Operations and Maintenance Staffing and Training

6.14 In excess of 500 employees will be required to operate and maintain the generating facilities. The EEA will need to commence training of staff sufficiently in advance of start-up so that the staff will be available at the appropriate time for start-up. The consultants' staff will provide start-up, operation and maintenance support as required.

g. Community:

A community with housing for the plant employees will be constructed on 450,000 square meters of land northeast of the station. The community will include a full range of public services, including school, hospital, mosque, commercial center, guest house and recreation facilities.

## C. FINANCIAL ANALYSIS

### a. Sources of Project Funding

6.15 The total cost of the project is US dollars 795 million and LE 604 million, to be provided by AID, a group of international lending institutions and the GOE. AID will fund $215 million in two increments as a grant. The first increment of $115 million will be used to upgrade the National Energy Control Center, and to finance consultant technical services for the engineering and procurement requirements of a 1200 MW generating plant, and one or more equipment packages for unit 1. The second funding increment by AID of $100 million is contingent upon the GOE's implementation of energy price reforms and would finance the balance of the consulting services for the plant and companion equipment packages for unit 2.

Table VI-1

Source of Project Funding
(in millions)

| Foreign Exchange | | | Local Costs |
|---|---|---|---|
| AID | Other Donors | Total | GOE |
| $215 | $580 | $795 | LE604 |

### b. Utilization of Project Funds:

6.16 The utilization of $215 million of AID funds to finance foreign exchange costs are summarized in Table 2 below.

Table VI-2

Planned Utilization of AID Project Funds
($000000)

| | El-Kureimat | | | | Grand |
|---|---|---|---|---|---|
| Total | Tranche 2 | Tranche 3 | Total | | NECC |
| Technical Service | 15.00 | 35.00 | 50.00 | 3.00 | 53.00 |
| Equip./Commodities | 76.00 | 58.00 | 134.00 | 10.00 | 144.00 |
| Audit & Evaluation | 0.07 | 0.05 | 0.12 | 0.03 | 0.15 |
| Contingency | 8.93 | 6.95 | 15.88 | 1.97 | 17.85 |
| | 100.00 | 100.00 | 200.00 | 15.00 | 215.00 |

c. Financial Viability

6.17 A project financial analysis and system analysis in terms of the EEA earnings and rate of return conclude that the proposed project can provide an adequate rate of return with varying fuel mixes. The project is financially viable.

D. ECONOMIC ANALYSIS

6.18 AID financial support for increased power generation is justified because the GOE implemented substantial increases in electricity prices in May 1990. The objective of this project is to encourage elimination of the the high level of subsidies in the power sector. The May 1990 electricity price increase was an important step in eliminating the subsidy.

a. Economic Analysis of Plant, Size of Units, Site and Fuel

6.19 Based on an analysis of power requirements for the mid-1990s, a recommendation was made in 1986 to plan for a 1,200 MW steam power plant consisting of two 600 MW generating units constructed on the El-Kureimat site.

6.20 The plant site was chosen from five alternate sites which were compared quantitatively and qualitatively using different combinations of fuel. Site assessments were also made based on the characteristics of each site. Capital, O&M costs, and fuel transportation were compared and the El-Kureimat site was found to be most advantageous.

6.21 A second study, completed in July 1989, reexamined plant type, size, location and fuel from a comparative cost standpoint. Based on the size of the generating units, fuel alternatives, and site specific costs for five sites, the installation of two 600 MW steam turbine generators supplied with steam from their respective natural gas/oil fired boilers was recommended for the El-Kureimat site. The report concluded that sufficient natural gas existed to fire the 1,200 MW plant, but full requirements would only be met by a dual-fired (gas/fuel oil) combination.

b. Cost/Benefit Analysis of the El-Kureimat Plant

6.22 An analysis of the El-Kureimat plant using cost benefit procedures indicated that the proposed plant, when evaluated at appropriate shadow prices, has an economic internal rate of return in excess of 12 percent. Moreover, critical assumptions for the analysis were conservative, including a valuation of capital costs in shadow prices that were 22.7 percent higher than market prices and a shadow price for electricity that was below the EEA estimated long run marginal cost of electricity for the average customer.

6.23 In the event the second 600 MW unit is not built, the EIRR would be lowered to 10 percent (assumes common facilities for a two unit plant are constructed). If, however, EEA constructs only one unit with no provision for a second unit, the EIRR would be between 10 and 12 percent.

E. SOCIAL SOUNDNESS ANALYSIS

a. Socio-Cultural Feasibility

6.24 The socio-cultural impact of the Project, as amended, continues to be positive because of economic reforms in the power sector which enhance efficiency and productivity in electrical production, distribution and use. The entire Egyptian electricity network will benefit by becoming more efficient as a result of the project, thereby assuring customers of a reliable power supply. In terms of adjusted rate structures, special attention will be given to low income Egyptian consumers.

b. Spread Effects

6.25 The additional generating capacity to be financed by this component will build on technology previously introduced in Egypt which has been operating successfully for a number of years. Host country personnel will be trained as part of the project to operate and maintain the new equipment.

c. Benefit Incidence

6.26 The construction of the power plant at El-Kureimat will bring economic benefits to the surrounding area by providing both short and long-term employment in terms of construction, operations and support for the the facilities. Plant personnel will be located near El-Kureimat in a new attractive community which will draw new commercial, business and service industries into the area.

6.27 The thermal power station at El-Kureimat will contribute to the efficiency of energy services to customers and thereby benefit people utilizing Egypt's Unified Power System. In terms of energy price reform, as the Project Paper notes, a restructuring of the electricity pricing structures must be formulated to ensure that benefits are equitably distributed. Special attention should be paid to low income consumers and the feasibility of who can pay more as prices are increased should be carefully addressed. Because this project is part of an effort to support policy reform in the power sector, and there is a possibility of future add-ons, the social soundness and desirability of the reforms from a social perceptive should be carefully considered.

62

## F. MANAGERIAL/ADMINISTRATIVE ANALYSIS

### a. Organization of the EEA

6.28 The implementing agency of the project is the (EEA) which will have overall responsibility to manage the planning, construction, operation and maintenance of the power station at El-Kureimat. The EEA has many years of experience constructing, operating, maintaining, and training personnel in steam turbine generating facilities, many of which have been financed by groups of bilateral and several multilateral financiers.

6.29 The EEA is the operating authority for the Ministry of Electricity and Energy, which was formed in 1964 as the state organization possessing overall authority over individual electric generation, transmission and distribution facilities.

### b. The EEA Project Management

6.30 The EEA will establish a project team which will have the authority to carry out day-to-day decisions and approvals. The team will have expertise in overall management, financial management and environmental affairs. The project team will report to the Deputy Chairman of EEA Projects.

### c. Operation Maintenance and Training

6.31 The EEA will be responsible for providing operations, maintenance and administrative staff to the plant after construction is completed. The station will be operated within the Upper Egypt Zone which includes all bulk power supply facilities between Cairo and Aswan. The personnel assigned to the plant will receive refresher training in disciplines appropriate to plant operations. Equipment supply contractors will be responsible for training in their manufacturing facilities offshore and on-site training. The EEA will coordinate the design of all training programs.

### d. USAID

6.32 The Power Systems group within DR/UAD has monitoring responsibilities for all projects in the power sector. Once the UAD office and Power Systems group is strengthened by the addition of an engineer with electric utility experience (early 1991), there should be sufficient AID monitoring capability.

G. ENVIRONMENTAL ANALYSIS

EL-KUREIMAT

a. Environmental Assessment

6.33 An Environmental Assessment report is required since the construction and operation of power plants normally have a significant effect on the environment. An Environmental Scoping Meeting with representatives of USAID and agencies of the GOE took place in 1985. The Environmental Assessment report was prepared in response to the scope of that meeting and in the format described in 22 CFR 216.6 (C). A Requirement Precedent to Initial Disbursement of Grant funds provided by this amendment will require the EEA's agreement that the El-Kureimat thermal power station will be designed, built and operated to comply with USEPA and Egyptian environmental standards.

b. Land Use

6.34 The proposed site for the power station is in an area of subtropical desert climate, devoid of native vegetation. Displaced flora or fauna caused by construction and operation of the plant can repopulate in similar nearby desert areas. There are no known archeological or cultural items on the site, however, if such items are found during excavation, the proper GOE officials will be notified. The adverse effects of construction will include fugitive dust from on-site traffic, but this condition can be reduced by abatement control procedures. Transmission rights-of-way to Tebbin will cross desert terrain and no adverse effects are foreseen. There is another transmission right-of-way crossing the Nile, and again, no adverse environmental effects are foreseen.

c. Air Quality

6.35 The boilers at El-Kureimat will burn natural gas and Mazout, and flue gases will be discharged into the atmosphere through a 152 meter high concrete stack for each unit. Emissions from clean-burning natural gas are primarily oxides of nitrogen, while emissions from Mazout are sulfur dioxide, oxides of nitrogen and particulates. The design of the stacks will ensure that ground level concentrations of pollutants will not exceed USEPA or established Egyptian standards, and that emitted pollutants will avoid excessive concentrations. A similar Egyptian 1200 MW power station, which burned a comparable mix of fuels, was analyzed and the results demonstrated that plant operation did not adversely effect the environment. Design of the boilers will allow a full range of fuel mixes with minimal production of oxides of nitrogen.

6.36 An Environmental Monitoring System, consisting of three air quality monitoring stations and one meteorological station will be installed at or near El-Kureimat and made operational at least 12 months prior to on-site construction. The project engineer will locate the monitoring sites based on an the results of air quality modeling and will train the EEA personnel to operate and maintain the system. Diffusion conditions and air quality will be measured continuously to measure variabilities in air quality. At the end of each year, the EEA will determine the effects of air quality from the construction and operation of the power station.

d. Water Quality

6.37 The primary use of Nile River water at El-Kureimat is for condenser cooling of turbine exhaust steam. Thermal plume studies have concluded that adequate dispersion of the thermal effects exist out from the shoreline and downstream if the units discharge through diffusers.

6.38 A wastewater treatment system to discharge into the river will meet USEPA and GOE environmental standards. Non-sanitary plant wastewater, floating oil from the floor, and equipment drainage will be treated through a lined equalization pond and clarifiers. Sanitary wastes will be piped to septic tanks.

6.39 Potential sources of oil spills exist in 3 systems of the power station but adequate measures will be taken by the EEA to prevent and contain spills.

e. Health, Safety

6.40 Appropriate health and safety procedures will be implemented by the EEA and contractors. No Polychlorinated Biphenyls will be used at the facility.

f. Institutional Development

6.41 The EEA will be responsible for operations and monitoring of all environmental control systems. An Environmental Coordinating Committee will advise the EEA management on all aspects of environmental issues. Environmental units representing both air and water disciplines will be represented on the coordinating committee.

g. CONCLUSION

6.42 The construction and operation of the two 600 MW steam turbine generating units will not adversely impact the air or water quality surrounding the thermal power station. USEPA and Egyptian air and water standards will be maintained and an Environmental Monitoring System will be operational at the site to establish and monitor air quality levels. The Environmental Assessment has been reviewed and approved by ANE/PD/ENV and they have concurred that no other environmental concerns have been identified and, therefore, no further action is required.

NATIONAL ENERGY CONTROL CENTER

6.43 There will be no physical construction at the National Energy Control Center. There is no need to expand the water or sewage facilities or access roads which are presently adequate for the operation of the center. There will be no increase in staffing. The equipment to be installed will not contribute to the sound pressure level within the computer room, which is below 35 dB. Therefore, the upgrading of the Center will have no impact on the environment surrounding the Center.

## VII. REQUIREMENTS PRECEDENT, COVENANTS

### A. REQUIREMENTS PRECEDENT TO DISBURSEMENT:

7.01 The Requirements Precedent contained in the Grant Agreement have been satisfied.

7.02 Amendment No. 1 to the Grant Agreement shall contain the following Requirements Precedent:

A. Requirements Precedent to Disbursement:

1) Prior to any disbursement or to the issuance of any disbursement authorization or commitment of funds provided under the First Amendment to the Grant, the Grantee shall, except as the Parties may otherwise agree in writing, furnish to A.I.D., in form and substance satisfactory to A.I.D.:

a) A statement of the names and titles with specimen signatures of the persons authorized to represent the Cooperating Country for Project purposes for the El-Kureimat and National Energy Control Center components of the Project. (4.01)

b) A signed contract, acceptable to USAID, with a U.S. consulting firm for an electricity pricing strategy study, which study could be the basis for future rate design. (1.19)

c) A signed contract, acceptable to USAID, with a U.S. consulting firm which provides technical assistance for a study to identify the sources and magnitude of individual distribution company system losses, nationwide. (1.26)

d) Evidence from the Ministry of International Cooperation that the proceeds provided by the First Amendment to the Grant, except for funds used to finance consultant services and technical assistance, have been loaned to the EEA.(3.06)

e) Evidence from the Ministry of International Cooperation that the local currency financing for the El-Kureimat and NECC components of the Project have been budgeted by the Grantee and will be available for timely expenditure by the EEA. (3.09)

f) Evidence that the Implementing Agency will maintain accounting records for local currency and in-kind contributions to the El-Kureimat and NECC components of the Project. (3.11)

2) Prior to any disbursement of to the issuance of any disbursement authorization or commitment of funds provided under the First Amendment to the Grant for purposes of procuring final design services for El-Kureimat, the Grantee shall furnish to A.I.D., except as A.I.D. may otherwise agree in writing, in form and substance satisfactory to A.I.D.;

a) Signed commitments by bilateral or multilateral financing agencies that the foreign exchange costs of the first unit at El-Kureimat, estimated to be $385 million (or equivalent in foreign exchange), or such amount as the parties may otherwise agree to in writing, has been committed to the El-Kureimat plant. (3.07)

b) Evidence that the thermal power station will be designed, built and operated to comply with USEPA and Egyptian environmental standards. (6.34)

3) Prior to any disbursement or to the issuance of any disbursement authorization or commitment of funds provided under the First Amendment to the Grant for purposes of financing equipment and/or construction services for El-Kureimat, the Grantee shall furnish to A.I.D., except as A.I.D. may otherwise agree in writing, in form and substance satisfactory to A.I.D.:

a) Evidence in the form of signed financing agreements by bilateral and multilateral financing agencies that the foreign exchange costs of the first unit at El-Kureimat, estimated to be $385 million (or equivalent in foreign exchange funds), or such amount as the parties may otherwise agree to in writing, for the construction of the first 600 MW generating unit at El-Kureimat (3.07);

b) Evidence that EGPC will provide the necessary natural gas transmission facilities to meet 100 percent of the plant requirement and deliver sufficient gas to the thermal power station to permit the EEA to operate the station, under normal conditions, on not less than 50 percent gas, without curtailing gas supplies to other EEA facilities; (3.08)

c) Evidence that the EEA owns or will otherwise have legal jurisdiction over the plant site and necessary electric and fuel transmission rights of way. (3.08)

4) Prior to any disbursement or to the issuance of any disbursement authorization or commitment of funds provided under the First Amendment to the Grant for purposes of financing computer hardware, software or related services for the NECC, other than consultant services, the Grantee shall furnish to A.I.D., except as A.I.D. may otherwise agree in writing, in form and substance satisfactory to A.I.D, a signed contract with a U.S. consulting firm to provide services for the upgrading of the control center.

7.03 The terminal date for satisfying the Requirements Precedent to Initial Disbursement of funds provided by the First Amendment to the Grant Agreement (part A.1 above) will be 90 days from the signing of the First Amendment to the Grant Agreement.

B. <u>COVENANTS:</u>

7.04 The Project Agreement also sets forth Covenants to be met throughout the life of the Project. The EEA is complying with these Covenants.

7.05 Amendment No. 1 to the Project Agreement shall contain the following additional Covenants:

a. <u>Plant Operations and Maintenance Training:</u>

The Grantee will ensure that the EEA will select operational, maintenance and administration staff, and will commence a comprehensive training program, sufficiently in advance of the start-up of the first generating unit so that operations and maintenance personnel will be on-site, trained and fully qualified to operate and maintain the generating facilities when they are placed in service and that the administrative personnel will be on site, trained and fully qualified to manage all administrative matters at the appropriate time.

b. Environmental Monitoring:

The Grantee will ensure that the EEA will implement an Environmental Monitoring Program on and around the El-Kureimat site to be in operation one year prior to the start of on-site construction and will endeavour to maintain the monitoring program throughout the life of the plant.

c. Plant Fuel Supply:

The Grantee shall promote the operation by the EEA of all generating units financed under this Project, except El-Kureimat, under normal operating conditions, on gas. For El-Kureimat, the Grantee shall promote the operation by the EEA under normal operating conditions, on no less than fifty percent (50%) gas.

d. Environmental Impacts:

The Grantee will ensure that the EEA will prepare a plan to mitigate environmental impacts to the site, river, atmosphere and surrounding desert and upon USAID approval, will implement the plan.

e. Audit and Evaluation:

The Grantee will ensure that, with reasonable notice, funds provided in the Grant to audit and evaluate the Project will be made available upon request.

AID 1020-28 (1-73)

# PROJECT DESIGN SUMMARY
## LOGICAL FRAMEWORK

Life of Project:
From FY 90 to FY 99
Total U. S. Funding 215 million
Date Prepared: May 19, 1990

Project Title & Number: Power Sector Support (Project 263-0215.6) Amendment No. 1

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| **Program or Sector Goal: The broader objective to which this project contributes: (A-1)**<br>To promote rational investment and consumption decisions throughout the economy and to reduce the national budget deficit. | **Measures of Goal Achievement: (A-2)**<br>Decreased rate of growth in electicity consumption overall and for selected consumer categories.<br>Increased electric energy conservation in all classes of users except large industrial.<br>Reduced contribution to the national budget deficit by electric power sector's implicit subsidy. | (A-3)<br>EEA data<br>PDS/E calculations | **Assumptions for achieving goal targets: (A-4)**<br>Electricity price increases are sufficient to decrease inefficient and wasteful uses.<br>Fuel price increases passed onto consumers. |
| **Project Purpose: (B-1)**<br>To support past and promote continued GOE progress in reducing electricity sector subsidies and in making other energy sector policy changes by providing capital infrastructure incentives to the GOE. | **Conditions that will indicate purpose has been achieved: End-of-Project status. (B-2)**<br>May 1990 electicity price increases are implemented. Electricity price increases sufficient to obtain balance of foreign exchange financing from other bilateral/ multilateral financing agencies. Electricity price increase in 1991 is sufficient to release second increment of funding. Future electricity price increases are based on economic cost to serve various customer classes. | (B-3)<br>Examining and monitoring past and current Mission and Embassy electricity bills and examination of an appropriate cross-section of Distribution Company billing records. | **Assumptions for achieving purpose: (B-4)**<br>May 1990 electricity price increases are in effect and are consistently applied.<br>EEA proceeds with electricity pricing strategy study and future price increases are based on the results of the study.<br>GOE approves pricing structure.<br>Infrastructure incentives provided as planned and lead to continued reforms. |
| **Project Outputs: (C-1)**<br>Significant annual increase in the selling price of electric energy sufficient to eliminate the electricity sector subsidy by the mid-1990's.<br>Construction of two 600 MW steam turbine generating units of the El Kureimat site.<br>Expansion of the data processing capability of the National Energy Control Center to handle planned and contemplated network expansion. | **Magnitude of Outputs: (C-2)**<br>First 600 mw generating unit in operation in mid 1996.<br>Second 600 mw generating unit in operation in early 1997.<br>NECC computer system replacement completed in mid-1993 with a data processing capacity of 200 stations. | (C-3)<br>EEA Monthly Operating Reports.<br>EEA Annual Report of Electric Statistics.<br>Inspection and examination of the work. | **Assumptions for achieving outputs: (C-4)**<br>That sufficient foreign exchange is provided from other financiers to cover equipment and construction services costs for El-Kureimat.<br>That EEA will provide foreign exchange to cover any short fall not covered by other financiers.<br>That the plant will be designed and constructed to comply with appropriate US EPA environmental standards. |
| **Project Inputs: (D-1)**<br>Contracts for engineering services with option for future project scheduling, engineering administration and construction and project management services.<br>Contract for engineering service for NECC upgrade.<br>Contract of computer hardware and software to upgrade NECC.<br>Equipment of contracts components of two steam turbine generating units and balance of plant facilities. | **Implementation Target (Type and Quantity) (D-2)**<br>$50 million<br>$ 3 million<br>$12 million<br>$150<br>_____<br>$215 million | (D-3)<br>Monthly or quarterly consultant and contractor reports.<br>Review and approval of contracts for engineering services.<br>Review and approval of contract for equipment. | **Assumptions for providing inputs: (D-4)**<br>EEA will award contracts to US firms for those services and equipment financed by AID.<br>EEA will award contracts to other firms for services and equipment financed by other donors.<br>EEA will satisfy Requirements Precedent to Disbursement. |

# COUNTRY CHECKLIST

## A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FY 1990 Appropriations Act Sec. 569(b). Has the President certified to the Congress that the government of the recipient country is failing to take adequate measures to prevent narcotic drugs or other controlled substances which are cultivated, produced or processed illicitly, in whole or in part, in such country or transported through such country, from being sold illegally within the jurisdiction of such country to United States Government personnel or their dependents or from entering the United States unlawfully? — No

2. FAA Sec. 481(h): FY 1990 Appropriations Act Sec. 569(b). (These provisions apply to assistance of any kind provided by grant, sale, loan, lease, credit, guaranty, or insurance, except assistance from the Child Survival Fund or relating to international narcotics control, disaster and refugee relief, narcotics education and awareness, or the provision of food or medicine.) If the recipient is a "major illicit drug producing country" (defined as a country producing during a fiscal year at least five metric tons of opium or 500 metric tons of coca or marijuana) or a "major drug-transit country" (defined as a country that is a significant direct source of illicit drugs significantly affecting the United States, through which such drugs are transported, or through which significant sums of drug-related profits are laundered with the — N/A

12

knowledge or complicity of the government): (a) Does the country have in place a bilateral narcotics agreement with the United States, or a multilateral narcotics agreement? and (b) Has the President in the March 1 International Narcotics Control Strategy Report (INSCR) determined and certified to the Congress (without Congressional enactment, within 45 days of continuous session, of a resolution disapproving such a certification), or has the President determined and certified to the Congress on any other date (with enactment by Congress of a resolution approving such certification), that (1) during the previous year the country has cooperated fully with the United States or taken adequate steps on its own to satisfy the goals agreed to in a bilateral narcotics agreement with the United States or in a multilateral agreement, to prevent illicit drugs produced or processed in or transported through such country from being transported into the United States, to prevent and punish drug profit laundering in the country, and to prevent and punish bribery and other forms of public corruption which facilitate production or shipment of illicit drugs or discourage prosecution of such acts, or that (2) the vital national interests of the United States require the provision of such assistance?

3. <u>1986 Drug Act Sec. 2013</u>. (This section applies to the same categories of assistance subject to the restrictions in FAA Sec. 481(h), above.) If recipient country is a "major illicit drug producing country" or "major drug-transit country" (as defined for the purpose of FAA Sec 481(h)), has the President submitted a report to — N/A

Congress listing such country as one: (a) which, as a matter of government policy, encourages or facilitates the production or distribution of illicit drugs; (b) in which any senior official of the government engages in, encourages, or facilitates the production or distribution of illegal drugs; (c) in which any member of a U.S. Government agency has suffered or been threatened with violence inflicted by or with the complicity of any government officer; or (d) which fails to provide reasonable cooperation to lawful activities of U.S. drug enforcement agents, unless the President has provided the required certification to Congress pertaining to U.S. national interests and the drug control and criminal prosecution efforts of that country?

4. FAA Sec. 620(c). If assistance is to a government, is the government indebted to any U.S. citizen for goods or services furnished or ordered where: (a) such citizen has exhausted available legal remedies, (b) the debt is not denied or contested by such government, or (c) the indebtedness arises under an unconditional guaranty of payment given by such government or controlled entity? — No

5. FAA Sec. 620(e)(1). If assistance is to a government, has it (including any government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities? — No

6. FAA Secs. 620(a), 620(f), 620D; FY 1990 Appropriations Act Secs. 512, 548. Is recipient country a Communist country? If so, has the President: (a) determined that assistance to the country is vital to the security of the United States, that the recipient country is not controlled by the international Communist conspiracy, and that such assistance will further promote the independence of the recipient country from international communism, or (b) removed a country from applicable restrictions on assistance to communist countries upon a determination and report to Congress that such action is important to the national interest of the United States? Will assistance be provided either directly or indirectly to Angola, Cambodia, Cuba, Iraq, Libya, Vietnam, South Yemen, Iran or Syria? Will assistance be provided to Afghanistan without a certification, or will assistance be provided inside Afghanistan through the Soviet-controlled government of Afghanistan? — No

7. FAA Sec. 620(j). Has the country permitted, or failed to take adequate measures to prevent, damage or destruction by mob action of U.S. property? — No

8. FAA Sec. 620(l). Has the country failed to enter into an investment guaranty agreement with OPIC? — No

9. FAA Sec. 620(o); Fishermen's Protective Act of 1967 (as amended) Sec. 5. (a) Has the country seized, or imposed any penalty or sanction against, any U.S. fishing vessel because of fishing activities in international waters? (b) If so, has any deduction required by the Fishermen's Protective Act been made? — (a) No (b) N/A

10. FAA Sec. 620(q); FY 1990 Appropriations Act Sec. 518 (Brooke Amendment). (a) Has the government of the recipient country been in default for more than six months on interest or principal of any loan to the country under the FAA? (b) Has the country been in default for more than one year on interest or principal on any U.S. loan under a program for which the FY 1990 Appropriations Act appropriates funds?

(a) Not at present (5/22/90)
(b) No

11. FAA Sec. 620(s). If contemplated assistance is development loan or to come from Economic Support Fund, has the Administrator taken into account the percentage of the country's budget and amount of the country's foreign exchange or other resources spent on military equipment? (Reference may be made to the annual "Taking Into Consideration" memo: "Yes, taken into account by the Administrator at time of approval of Agency OYB." This approval by the Administrator of the Operational Year Budget can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.)

Yes, taken into accoun by the Administrator at time of approval of Agency OYB.

12. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have relations been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?

No

13. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the A.I.D. Administrator in determining the current A.I.D. Operational Year Budget? (Reference may be made to the "Taking into Consideration" memo.)

Egypt (on 5/22/90) is in arrears to the UN regular budget by $478,000 which is les than one year's assessment ($553,000) Egypt is also in arrears of $46,000 o peace keeping accoun This was taken into account by the Administrator at the time of approval of the OYB.

76

14. FAA Sec. 620A. Has the President determined that the recipient country grants sanctuary from prosecution to any individual or group which has committed an act of international terrorism or otherwise supports international terrorism? — No

15. FY 1990 Appropriations Act Sec. 564. Has the country been determined by the President to: (a) grant sanctuary from prosecution to any individual or group which has committed an act of international terrorism, or (b) otherwise support international terrorism, unless the President has waived this restriction on grounds of national security or for humanitarian reasons? — No

16. ISDCA of 1985 Sec. 552(b). Has the Secretary of State determined that the country is a high terrorist threat country after the Secretary of Transportation has determined, pursuant to section 1115(e)(2) of the Federal Aviation Act of 1958, that an airport in the country does not maintain and administer effective security measures? — No

17. FAA Sec. 666(b). Does the country object, on the basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. who is present in such country to carry out economic development programs under the FAA? — No

18. FAA Secs. 669, 670. Has the country, after August 3, 1977, delivered to any other country or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards, and without special certification by the President? Has it transferred a nuclear explosive device to a non-nuclear weapon state, or if such a state, either received or detonated a nuclear explosive device? (FAA Sec. 620E permits a special waiver of Sec. 669 for Pakistan.) — No

19. FAA Sec. 670. If the country is a non-nuclear weapon state, has it, on or after August 8, 1985, exported (or attempted to export) illegally from the United States any material, equipment, or technology which would contribute significantly to the ability of a country to manufacture a nuclear explosive device? — No

20. ISDCA of 1981 Sec. 720. Was the country represented at the Meeting of Ministers of Foreign Affairs and Heads of Delegations of the Non-Aligned Countries to the 36th General Assembly of the U.N. on Sept. 25 and 28, 1981, and did it fail to disassociate itself from the communique issued? If so, has the President taken it into account? (Reference may be made to the "Taking into Consideration" memo.) — No

21. FY 1990 Appropriations Act Sec. 513. Has the duly elected Head of Government of the country been deposed by military coup or decree? If assistance has been terminated, has the President notified Congress that a democratically elected government has taken office prior to the resumption of assistance? — No

22. FY 1990 Appropriations Act Sec. 539. Does the recipient country fully cooperate with the international refugee assistance organizations, the United States, and other governments in facilitating lasting solutions to refugee situations, including resettlement without respect to race, sex, religion, or national origin? — Yes

## B. FUNDING SOURCE CRITERIA FOR COUNTRY ELIGIBILITY

### 1. Economic Support Fund Country Criteria

a. FAA Sec. 502B. Has it been determined that the country has engaged in a consistent pattern of gross violations of internationally recognized human rights? If so, has the President found that the country made such significant improvement in its human rights record that furnishing such assistance is in the U.S. national interest?

No

b. FY 1990 Appropriations Act Sec. 569(d). Has this country met its drug eradication targets or otherwise taken significant steps to halt illicit drug production or trafficking?

N/A

## 5C(2) - PROJECT CHECKLIST

A. GENERAL CRITERIA FOR PROJECT

| | | |
|---|---|---|
| 1. | FY 1990 Appropriations Act Sec. 523; FAA Sec. 634A. If money is to be obligated for an activity not previously justified to Congress, or for an amount in excess of an amount previously justified to Congress, has Congress been properly notified? | Normal Congressional Notification procedures will be satisfied prior to obligation of funds. |
| 2. | FAA Sec. 611(a). Prior to an obligation in excess of $500,000, will there be: (a) engineering, financial or other plans necessary to carry out the assistance; and (b) a reasonably firm estimate of the cost to the U.S. of the assistance? | "Yes" to both questions. |
| 3. | FAA Sec. 611(a)(2). If legislative action is required within recipient country, with respect to an obligation in excess of $500,000 what is the basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of the purpose of the assistance? | N/A |
| 4. | FAA Sec. 611(b); FY 1990 Appropriations Act Sec. 501. If project is for water or water-related land resource construction, have benefits and costs been computed to the extent practicable in accordance with the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, *et seq.*)? (See A.I.D. Handbook 3 for guidelines.) | N/A |

| | | |
|---|---|---|
| 5. | FAA Sec. 611(e). If project is capital assistance (e.g., construction), and total U.S. assistance for it will exceed $1 million, has the Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability to maintain and utilize the project effectively? | Yes. |
| 6. | FAA Sec. 209. Is project susceptible to 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. | This component of the project relies on support from other donors. |
| 7. | FAA Sec. 601(a). Information and conclusions on 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. | Since this is a public sector project it will have no significant impact in these areas. |
| 8. | FAA Sec. 601(b). Information and conclusions 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). | Both services and equipment contracts will be competitively let in the U.S. |
| 9. | FAA Secs. 612(b), 636(h). Describe steps taken to assure that, to the maximum extent possible, the country | Egypt will contribute substantially to the local currency costs of the project. U.S. owned |

| | |
|---|---|
| is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. areutilized in lieu of dollars. | Egyptian currency is not available for this project. |
| 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? | No. |
| 11. FY 1990 Appropriations Act Sec. 521. 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? | N/A |
| 12. FY 1990 Appropriations Act Sec. 547. Will the assistance (except for programs in Caribbean Basin Initiative countries under U.S. Tariff Schedule "Section 807," which allows reduced tariffs on articles assembled abroad from U.S.-made components) be used directly to procure feasibility studies, prefeasibility studies, or project profiles of potential investment in, or to assist the establishment of facilities specifically designed for, the manufacture for export to the United States or to third country markets in direct competition with U.S. exports, of textiles, apparel, footwear, handbags, flat goods (such as wallets or coin purses worn on the person), work gloves or leather wearing apparel? | No. |

13. FAA Sec. 119(g)(4)-(6) & (10). Will the assistance (a) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity; (b) be provided under a long-term agreement in which the recipient country agrees to protect ecosystems or other wild-life habitats, (c) support efforts to identify and survey ecosystems in recipient countries worthy of protection; or (d) by any direct or indirect means significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas?

"No" to all questions.

14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (either dollars or local currency generated therefrom)?

N/A

15. FY 1990 Appropriations Act Title II, under heading "Agency for International Development." If assistance is to be made to a United States PVO (other than a cooperative development organization), does it obtain at least 20 percent of its total annual funding for international activities from sources other than the United States Government?

N/A

16. FY 1990 Appropriations Act Sec. 537. If assistance is being made available to a PVO, has that organization provided upon timely request any document, file, or record necessary to the auditing requirements of A.I.D., and is the PVO registered with A.I.D.?

N/A

17. FY 1990 Appropriations Act Sec. 514. If funds are being obligated under an appropriation account to which they were not appropriated, has the President consulted with and provided a written justification to the House and Senate Appropriations Committees and has such obligation been subject to regular notification procedures.

N/A

18. State Authorization Sec. 139 (as interpreted by conference report). Has confirmation of the date of signing of the project agreement, including the amount involved, been cabled to State L/T and A.I.D. LEG within 60 days of the agreement's entry into force with respect to the United States, and has the full text of the same agreement been pouched to those same offices? (See Handbook 3, Appendix 6G for agreements covered by this provision).

Case-Zablocki Act reporting procedures will be followed with respect to this project.

19. Trade Act Sec. 5164 (as interpreted by conference report), amending Metric Conversion Act of 1975 Sec. 2. Does the project use the metric system of measurement in its procurements, grants, and other business-related activities, except to the extent that such use is impractical or is likely to cause significant inefficiencies or loss of markets to United Stated firms? Are bulk purchases usually to be made in metric, and are components, subassemblies, and semi-fabricated materials to be specified in metric units when economically available and technically adequate?

English and metric systems of measurements will be utilized to the extent practical.

| | |
|---|---|
| 20. FY 1990 Appropriations Act, Title II, under heading "Women in Development." Will assistance be designed so that the percentage of women participants will be demonstrably increased? | This project is gender neutral; it will benefit all Egyptians. |
| 21. FY 1990 Appropriations Act Sec. 592(a). If assistance is furnished to a foreign government under arrangements which result in the generation of local currencies, has A.I.D. (a) required that local currencies be deposited in a separate account established by the recipient government, (b) entered into an agreement with that government providing the amount of local currencies to be generated and the terms and conditions under which the currencies so deposited may be utilized, and (c) established by agreement the responsibilities of A.I.D. and that government to monitor and account for deposits into and disbursements from the separate account? Will such local currencies, or an equivalent amount of local currencies, be used only to carry out the purposes of the DA or ESF (depending on which chapter is the source of assistance) or for the administrative requirements of the United States Government?<br><br>Has A.I.D. taken all appropriate steps to ensure that the equivalent of local currencies disbursed from the separate account are used for the agreed purposes?<br><br>If assistance is terminated to a country, will any unencumbered balances of funds remaining in a separate account be disposed of for purposes agreed to by the recipient government and the United States Government? | N/A |

B. FUNDING CRITERIA FOR PROJECT

1. Economic Support Fund Project Criteria

| | |
|---|---|
| a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the maximum extent feasible, is this assistance consistent with the policy directions, purposes, and programs of Part I of the FAA? | "Yes" to both questions. |
| b. FAA Sec. 531(e). Will this assistance be used for military or paramilitary purposes? | No. |
| c. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made? | N/A |

ANNEX C

APPLICATION BY GOE

## LEGAL CERTIFICATIONS

### CERTIFICATION PURSUANT TO SECTION 611 (e) OF THE FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

As Director and Principal Officer of 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, I do hereby certify that in my judgment Egypt has both the financial capability and human resources capability to maintain and utilize effectively the capital assistance to be provided for the installation of two 600 MW generating units at the El-Kureimat thermal power station and the upgrading of the computer system hardware and software at the National Energy Control Center.

This judgment is based upon general considerations summarized in Section IV - E (Managerial/Administrative Analysis) and in Annex K of the Project Paper Amendment.

Marshall D. Brown
Director

[signature]

Date

JUN 13 1990

CERTIFICATION PURSUANT TO
GRAY AMENDMENT

As Director and Principal Officer of the Agency for International Development in Egypt, I certify that full consideration has been given to the potential involvement of small and/or economically and socially disadvantaged enterprises, historically black colleges and universities and minority controlled private and voluntary organizations.

The attached Project Paper Amendment discusses the efforts that will be undertaken in connection with the procurement plan to maximize the participation of minority owned and small and disadvantaged organizations. At the time of each procurement action, every effort will be made to encourage the participation of these organizations and draw upon their knowledge and expertise.

Marshall D. Brown
Director

Date

JUN 13 1990

# A SURVEY OF THE ECONOMICS OF ELECTRICAL ENERGY IN EGYPT

by Robert W. Adler

Economic Advisor
April 22, 1990
Economics Office
USAID/Egypt

CONTENTS

A. Introduction and Executive Summary.

The purpose of this paper is to survey the economics of the energy sector with particular reference to electrical energy. A substantial volume of work has been done on this topic in recent years by the USAID/Egypt Economics Office but without creating a unified briefing paper on this topic. After an initial reading of over a score of documents and memoranda related to the sector, I decided to construct such a paper. These documents indicate that a substantial debate on energy pricing has taken place and, of necessity, the salient points of debate are described herein. However, certain quantifiable and descriptive facts regarding the energy sector that are potentially useful for analytical purposes have been ignored in this debate. For example, file documents include several memoranda proposing reform of electricity price tariffs, reviewing dialogue strategy, and forecasting electrical system load and revenue, but there is relatively less information available on Egypt's energy resource base, on energy consumption and exports, and on the substantial investment in plant and equipment in electric energy sector. My inspection also indicates that the treatment of the economic cost of electricity and analysis of the negative economic effects of low energy prices could be improved and that sectoral issues could be better articulated with macroeconomic issues. Even if this suspicion is invalid, a broader view aimed at informing persons outside of this sector should enhance our knowledge and reinforce sound proposals for policy reform.

The following paragraphs make up an Executive Summary of this paper.

1. A Net Petroleum Exporter. Egypt is a net oil exporter, and its energy sector, particularly its petroleum subsector, plays a key role in the Egyptian economy. Even with declining oil prices since 1985-86, the petroleum sector accounts for about 5 % of total Gross Domestic Product, 37 % of commodity export earnings, and continues to be a major source of external earnings. Approximately 57 % of petroleum output is exported. However, proved reserves of petroleum will cover about one decade of production at the present rate of extraction. Reserves of natural gas are more abundant and additional finds are judged by experts to be likely.

2. Heavily Subsidized Prices. The weighted average of domestic petroleum prices in Egypt is about 36 % of world prices. Electricity tariffs range from 20 to 30 % of the long-run marginal cost (LRMC) depending mainly on the version of LRMC utilized. Low energy prices have several adverse impacts: (a) a rapid growth in demand and wasteful use of energy, (b) a mal-allocation of industrial investments because artificially low prices have concealed the true economic profitability of investment and allowed financial profitability to substantially exceed economic profitability, (c) an undermining of public sector finances due to higher investment in energy extraction and conversion projects and lowered fiscal revenues from energy production, and (d) increased domestic consumption of petroleum products thereby diverting potential petroleum exports to the domestic market.

3. The Volume of Subsidy. In 1989 the Economics Office calculated the implicit energy subsidies for the GOE FY 1989-90 at LE 4.7 billion ($ 1.6 billion) for petroleum products and LE 6.3 billion ($ 2.1 billion) for electrical energy. (1) The former is based upon calculation of cost of eleven petroleum products at world market prices using free market exchange rate as compared with existing domestic prices. The latter is based upon a LRMC of electrical energy of LE 19.8 piasters (pt.) per KWH.(2)

4. Policy Dialogue. In recent years the energy policy dialogue between the GOE and external donors has focused on the need for a comprehensive program to adjust domestic prices of energy products to levels dictated by opportunity costs, i.e., by economic costs. In 1987 the World Bank and GOE agreed to the objective of raising energy prices to economic cost levels at the latest by the end of the fiscal year 1994-95 (by July 1, 1995). Retrospectively, the average price of electrical energy increased about half as rapidly as the wholesale price index from 1974 to 1984/85, but at about twice the pace of the wholesale price index from 1984/85 to 1987/88.

5. Natural Gas--Promise Existing proved reserves of natural gas amount to 340 billion cubic meters, i.e., about 250 million metric tons of oil equivalent (MTOE). In 1986, the EGPC (Egyptian General Petroleum Corporation) amended the terms for gas exploration with the IOCs (international operating companies) and 30 agreements for oil and gas exploration have been signed with ten IOCs. Several new gas finds have been made in recent years with reserves estimated at about 160 BCM. In 1988 the "new gas clause" was approved by the Egyptian Parliament and became the basis for a new gas sales agreement between Shell and EGPC linking the price of newly discovered natural gas to international fuel oil prices. New concessionary agreements in late 1988 and early 1989 are expected to increase recoverable gas reserves by upwards of 200 BCM. Export of natural gas is not judged economically feasible but utilization of natural gas directly and in the generation of electricity is fundamental to adequate energy availability in Egypt in the 1990s.

6. The Electricity Plant. Given the paucity of undeveloped hydro resources, thermal generation of electricity has grown rapidly in Egypt. In 1989 installed capacity of the unified power system was 9,264 MW and dependable capacity was about 7,400 MW. In the period 1980-1988 a total of 4,235 MW of thermal capacity was added to the system in steam and gas combustion generating units and total output increased from 7,202 million KWH in 1979/80 to 28,110 million KWH in 1987/88. The important negative elements of plant condition are . 1,200 MW of generating capacity in excess of 20 years of age and station use and line losses amounting to 19 % of total production. Expert judgment is that these line losses could be reduced by 5 percentage points.

7. Growth of Demand for Electricity. Growth of demand for electricity has slowed in recent years with annual growth rates declining from 12 % in 1980-84 to 5 % in 1985-88. The principal driving force in the increasing demand for electricity is growth of GDP with demand growing by about 1.5 %

for each 1 % increase in GDP. Estimates of the impact of change in price on demand for electricity are weaker, and economists have assumed a decrease in demand of 0.1 % to 0.3 % for each 1 % increase in price.

8. Price and Cost of Electricity. The real prices of electricity and petroleum products declined in the 1970s and up to about 1985. The current average price of electricity is 4 piasters per KWH (about 1.5 US cents). This is substantially less than the economic and financial cost of electricity, which is on the order of 4.5 to 6.5 US cents per KWH. Thus, increases in electricity tariffs on the order of 200 % to 330 % would be needed to cover the economic cost. The opportunity cost of fuel accounts for about half of the economic cost of electricity but the EEA is currently being charged about one-tenth of the international price for fuel oil.

9. A Distorted Rate Structure. The structure of electricity tariffs favors public sector industry and residential consumers. About 50 % of electricity is used by manufacturing industry. Electricity tariffs are distorted in favor of state-owned enterprise. Private sector industry pays about 270 % more for electrical energy than the average price. In contrast, some stated-owned industrial firms pay only 50 % of the average price. Even though the poor benefit from highly progressive rate structure for residential/commercial users, tariffs could be restructured to force the heavy users, who are also wealthier, to pay more. In addition, rates do not vary with regard to time of day, e.g., peak load versus non-peak demand, but cost of meeting peak demand without outages is obviously higher than the average cost per KWH.

10. False Price Signals. Artificially low prices for energy resources lead users to act as if these resources were not scarce, leading to overconsumption of energy and no less importantly to a lowered efficiency of the capital plant. Some portion of this plant would have to be replaced if energy prices were raised to levels dictated by national opportunity cost, i.e., market prices. Energy audits provide indications of the substantial savings of energy that would ensue if higher (international) energy prices were instituted not only from improved housekeeping regarding energy usage but also from investments at plant level that have relatively short pay-back periods (less than three years).

11. The Cost of Excessive Consumption. Egypt's per capita energy consumption is about 150 % higher than in countries with similar income per capita. Even though the gain from higher petroleum product prices would be transitory in regard to its impact on Egypt's balance of payments (due to depletion of petroleum reserves), the current annual cost is about $ 900 million foreign exchange earnings foregone due to higher domestic consumption of petroleum products. The annual fiscal and fiscal-like revenues that could be generated by increasing domestic energy prices to international levels is on the order of $ 2.0 billion. This amounts to about 5 % of GDP, and as an annual flow it would make a significant impact on the domestically-financed public sector deficit (which is on the order of

10-12 % of GDP). If half this flow were kept by the producing companies (EEA and ECGP) to fund expansion and renovation of plant to produce and distribute energy, for projects in energy conservation, and to subsidize energy use by the poor, the remaining revenue would still cover as much as one-fourth of the domestically-financed public sector deficit and could make an important contribution to a monetary program to restore price stability.

12. Dialogue on Electricity Prices. AID Mission dialogue with Egyptian authorities and Economic Office involvement in that dialogue has a substantial history with contributions by Jerome LaPittus, Charles Richter, Peter Gajewski, David Dod, and Paul O'Farrell. These contributions include detailed proposals on how to increase electricity tariffs to levels reflecting economic costs in ways that consider political and social concerns. Each proposal or program has differing impacts on various important macroeconomic and socioeconomic objectives, which are: fiscal resources, export earnings, a signal of final electricity prices, dislocations caused higher prices, minimization of injury to the poor, and minimization of political backlash. At a superficial level the first three appear to be best served by rapid (1-2) year adjustment and the last three by gradual (5-10) adjustment. However, a superficial view is likely to give higher marks to gradual adjustment and might ignore the substantial role that higher energy prices can play in reducing the monetized fiscal gap and inflation. Our experience in policy dialogue and the timid response by Egyptian authorities suggests that AID should continue to set annual increases in real terms of electricity tariffs as a condition for continued support.

13. The Day of Reckoning. A day of reckoning, when Egypt has to import petroleum, is approaching. In that more dismal future, consumers of energy will have to pay higher prices for energy without any recapture of the related revenues by the government. Moreover, any subsidies to consumers will have to be financed from other tax revenues. It would be better public policy to confront consumers with the true costs of energy products earlier rather than later not only so that they can reduce consumption earlier but also because they have more financial resources to make investments to reduce energy intensity now than they will have in the future.

14. Suggested AID Stance. AID has provided substantial resources to expand Egypt's electricity supply. However, it should not be assumed, therefore, that AID bears responsibility for expanding the supply of electricity in the absence of annual rate increases that move meaningfully the coverage of the cost of production. Experience also suggests that AID should push for a more equitable electricity tariff structure and for keeping lifeline rates to the poor. The cost of service study, which AID is supporting, and continued work on peak load pricing will provide EEA with a better analytical base for reforming the structure and adjustment of electricity tariffs.

B. Energy Production and Consumption

1. The Main Resources. Egypt's main energy resources are petroleum, natural gas, coal, and hydropower. As of January 1989, proved petroleum reserves were 480 million metric tons. Proved natural gas reserves were 250 million metric tons oil equivalent (MTOE). Reserves of coal are limited and the only mining project now being considered (at the Maghara Mine in Sinai) would produce 600,000 tons per year (0.4 MTOE) by 1995. Most of the hydropower potential of the Nile River is already being exploited and in normal hydrological years produces about 10,500 GWH (equivalent to 2.6 MTOE of primary energy if such fuel had been used to produce the same electricity) and total potential is about 12,000 GWH. (1)

2. Production of Energy. In 1987-88, total commercial energy production was about 53.0 MTOE. Petroleum accounted for 83 %, natural gas and condensates for 12 %, and hydro-electricity for 5 %. Little increase in hydro-electric power is expected. Following successful petroleum exploration activities, crude oil production in the decade 1976-1986 increased faster than the rate of domestic consumption. Consequently, Egypt became a significant net petroleum exporter, and in 1985-86 such exports accounted for 66 % of all commodity export earnings. In 1987/88 domestic petroleum production amounted to about 44.0 MT, and domestic consumption amounted to 19.0 million MT. Exports of crude petroleum were 23.3 million MT, and net exports of refined petroleum products were 2.0 million MT. (2)

3. Petroleum Development. Egypt has been successful in attracting foreign petroleum companies to explore, develop, and produce oil. Presently, there are some 134 agreements with 50 international oil companies (IOCs) functioning as operators with the Egyptian General Petroleum Corporation (EGPC). The 1987-88 production level of about 44.0 million tons enabled Egypt to supply domestic requirements. However, there is concern that this extraction rate may be a plateau rate which Egypt can, at best, try to maintain until 1995. This negative is clearly pertinent unless additional reserves are found. As a cautionary note, it should be noted that back in 1971 production was 21 million MT and production was declining because fields were petering out. However, Egypt regained control over some fields lost to Israel in the 1967 war and foreign oil companies improved recovery techniques; by 1979 production was 29.8 million MT (600,000 barrels a day). (3)

4. Natural Gas. Natural gas production in 1987-88 was 5.2 MTOE. Major gas discoveries in the Nile Delta, Gulf of Suez, and Western Desert have resulted from oil exploration. By law, associated gas cannot be flared so facilities have been developed to capture, process, and distribute the gas. To date about 85 billlion cubic meters (BCM) have been produced, leaving about 340 BCM of recoverable reserves still in place. In December 1986, the EGPC amended the terms for gas exploration with the IOCs and 30 agreements for oil and gas exploration have been signed with ten IOCs. Several new gas finds have been made in recent years with reserves estimated

at about 160 BCM. In 1988 the "new gas clause" was approved by the Egyptian Parliament and became the basis for a new gas sales agreement between Shell and EGPC linking the price of newly discovered natural gas to international fuel oil prices. New concessionary agreements in late 1988 and early 1989 are expected to increase recoverable gas reserves by upwards of 200 BCM.

5. Pattern of Consumption. Total domestic commercial energy consumption in 1987-88 was approximately 27.0 MTOE, 67 % from petroleum, 24 % (6.4 MTOE) from natural gas and condensates, and 9 % (2.3 MTOE) from hydropower. (4) Total electricity consumption was 33.4 million GWH (million KWH) in 1987-88. (5) Manufacturing industry is the largest consumer of petroleum products and electricity, accounting for close to 45 % of commercial energy consumption in 1987-88. The largest energy consuming subsectors are chemicals and fertilizers, metals, textiles, and cement.

6. Growth of Consumption. Egypt has had a relatively high growth of energy consumption during the 1970s and 1980s. Commercial energy consumption increased at an annual rate of about 11 % per annum from 1974-75 to 1984-85. This high rate of growth was mainly in response to rapid economic growth during this period (8.4 % per year) and also to falling real prices for petroleum products, with a decline of 21 % between 1974 and 1985, and declining electricity tariffs, which fell by about 52 % in the period 1974 to 1985. (6)

7. Projected Situation. It is estimated that primary commercial energy consumption will increase at an average rate of 5 % per annum through the year 2000. At this rate commercial energy consumption will be 37 MTOE by 1995 and 47.5 MTOE by 2000. (7) This rate of growth in domestic energy demand may erode foreign exchange earnings by diverting exportable petroleum to domestic consumption. If consumption continues to grow at 5 % per annum and natural gas production is not expanded rapidly, Egypt could become a net petroleum importer. Growth of energy demand depends upon the rate of growth of economic activity as well as pricing measures. Increased prices can reduce the rate of growth of energy consumption by encouraging increased efficiency in energy use.

## C. Electricity Sector: Basic Information

### 1. The Egyptian Electricity Authority (EEA)

The EEA is a government-owned enterprise regulated by the Ministry of Electricity and Energy which was established in early 1976 as part of a general reorganization of the electric power sector. EEA is responsible for the generation and primary distribution of electrical energy. It is managed by the Chairman of the Board of Directors assisted by five Deputy Chairmen, one for each of the main functional areas--Projects, Operations, Personnel and Administration, Planning and Finance, Economic and Commercial Affairs Department. Geographically, EEA's operations are divided between the Head Office in Cairo with responsibility for over-all planning and coordination and five regional offices or zones with responsibility for operational matters. EEA is judged by external donors to be a highly centralized organization but reasonably well managed. In the last decade EEA's permanent staff has increased at a rate of 3 % per annum and total staff is about 33,000. EEA is using training programs to overcome a shortage of qualified staff, particularly in the areas of engineers, technicians, and accountants with training programs.

2. The Electricity Distribution Authority (EDA)

The EDA was established in 1983 (Law No. 97) to act as a holding company with over-all management and control functions over the seven local distribution companies (EDCs). Shareholdings in the EDCs are held by the EEA and local governments. The EDCs are responsible for preparing their annual budgets and five-year plans and submitting them to the EDA, which consolidates them for all the companies before submitting them to the Ministries of Planning and Finance for approval. The formation of EDA provides a formal channel through which EEA can assemble subsector data necessary for management and planning decisions. One of the major problems for electricity sector planning and management has been the lack of an adequate and coherent accounting and management information system for the subsector as a whole. In 1988 EDA distribution companies had 52,700 and served 9.3 million customers. (8)

3. Generating Plant

As of July 1, 1989, the EEA was operating 25 hydroturbine units in 3 stations, 54 gas turbine units in 18 stations, and 57 steam turbine units in 14 stations. These 35 stations were in the inter-connected system, commonly referred to as the Unified Power System (UPS) serving all the major load centers in Egypt, and 3 stations were outside the UPS. (10) Total installed capacity was 9,264 megawatts or MW (i.e., 9,264,000 KWH), of which 54 % (4,990 MW) was from fuel oil or gas-fired steam units, 17 % (1,561 MW) was from combustion turbine units, and 29 % (2,713 MW) was from hydro units.(9) While the total nameplate capacity of the system is 9,264 MW, on average EEA can dependably produce 7,400 MW due to de-ratings caused by ambient air conditions, water levels of the Nile River, equipment age and maintenance. Thermal generation production has grown rapidly in recent years, increasing from an annual output of 7,202 million KWH in 1979/80 to 28,110 million KWH in 1987/88. In the period 1980-1988 a total of 4,235 MW of thermal capacity was added to the EEA system in steam and gas combustion generating units. A total of 15 power stations were added to the grid of which only 3 were less than 100 MW units. (10) The larger units in this expansion effort include Shoubrah El Kima (981 MW), Abu Kir (620 MW), Attaka (600 MW), Abu Soltan (600 MW), and Mahmoudia (392 MW). Beginning in 1989, EEA is operating two combined cycle generating units at the Talkha station with a rated capacity of 380 MW. The combined cycle units consists of 8-24 MW gas turbines installed in 1979-1980 and 2-50 MW steam turbines installed in 1989. (11) The plant utilizes the waste heat from the gas turbine exhaust to produce steam which drives the steam turbines and these combined units are expected to be the most fuel efficient in the UPS.

4. System Condition

The condition of generating plant is quite varied. The average age of the steam turbine capacity is 10 years, with 1,200 MW of capacity in excess of 20 years of age, and 300 MW in excess of 30 years of age. (12) With the exception of the newer 150 MW and 300 MW units, preventive maintenance has been erratic and often limited to cases where maintenance could be carried out without a complete shutdown for lengthy period. Steam plants are normally base loaded, i.e., operating continuously. In regard to gas turbines, capacity available for operation has been about two-thirds of rated capacity due mainly to ambient air conditions (heat) and equipment failures and refurbishment. During capacity shortages, the gas turbines are operated as base load units. However, system conditions permitting, periodic maintenance has been accomplished in accordance with manufacturers' maintenance schedule and the units are generally operating satisfactorily. In regard to the Aswan High Dam, it can produce 2,100 MW with all 12 units in operation, but the runner (turbine blade) replacement program (financed by AID) has limited output to 10 units. (13) In 1987 and 1988, drought in the Nile catchment of East Africa also caused a temporary reduction in Aswan generating capacity due to a reduction in the water level of the High Dam lake and reduction from the normal (design) head.

5. Transmission System

The EEA's transmission system includes 1,576 kilometers of 500-kv line to connect the hydroelectric plants in the south (Aswan) with the load centers and thermal plants in the northern part of Egypt (Cairo and the Nile Delta), a 220 KV network totalling 3,872 kilometers, serving mainly northern Egypt loads, and a 132 KV network totalling 2,294 kilometers, serving mainly loads in upper Egypt. The 500 KV and 220 KV networks are relatively new having been built in the mid 1960s and expanded in an orderly and well planned fashion. (14) The 132 KV and 66 KV networks and low voltage distribution networks are old and in many instances outdated. The EDA networks have a substation capacity of 13,260 MVA and total distribution line length of 7,438 kilometers. Areas outside the reach of the UPS are supplied from gas turbine and diesel driven generators with a total installed capacity of less than 200 MW. Private generation exists but is negligible, accounting for less than 1 % of the total. Line loss and station use amount to 11.7 % of total production in the EEA network. The combined EEA and EDA networks have station use and line loss amounting to 19.3 % of total production. Some experts believe that a network loss reduction program could reduce these losses by 5 percentage points.

100

## D. Consumption and Prices of Electricity

### 1. Past Growth of Consumption

The total electricity sales of EEA have increased at the following annual rates: 1960-1965, 19.5 %; 1965-1970, 8.3 %; 1970-1974, 5.4 %; 1974-1979, 15.4 %; 1979-1984, 12.0 %; and 1984-1988, 5.0 %. The high rates of expansion in the 1960s can be attributed to initial expansion of the system. Production from the Aswan dam also came on stream in the late 1960s. High growth in the period 1974-1984 can be attributed to: the high rates of economic expansion that occurred during this period (a real increase of GDP of about 9 % per annum fueled by workers' remittances, oil exports, increased Suez canal revenues, and increasing levels of foreign assistance) and the completion of the Nag Hammadi aluminum refinery smelter in 1975.

### 2. Projected Growth of Consumption

The growth of consumption of electricity is sensitive to the rate of economic growth, to movements in the real price of electricity, and to other events emerging from the rough-and-tumble of the real world. For example, recent forecasts of electricity demand include varying assumptions regarding income and price elasticities as well as assumptions concerning reduction of line loss, load management, and sales of electricity to large users--the Kima fertilizer plant and the Nag Hammadi aluminum smelter. The forecasts set out by AID and the World Bank for the next decade or so include projection of annual consumption and of peak demand for electricity and are based mainly upon the growth of industry and agriculture and total GDP. In the World Bank forecast for the period 1987-1997 in its Fourth Power SAR (May 1989) the average electricity/GDP elasticity is 1.46, and in the AID projection (August 1989 Power Sector Support PP) it is 1.48. These electricity/GDP elasticities signify that a 10 % increase in income (GDP) would cause an approximate 15 % increase in demand if other things remained the same. Based upon projected GDP growth of 4.7 % per annum, the World Bank projected that peak demand would grow by 6.0 % annually in the period 1991/92 to 1996/97. For the same time period, based upon a projected GDP growth of 3.7 % per annum, AID projected that peak electricity demand would grow by 5.1 % per annum.

Even though GDP growth is a major influence on the forecasts, government policy can also affect future demand. In the case of Egypt most projections also include the effects of price increases in real terms on demand with the assumption of price elasticities ranging from -0.1 to -0.3. These price elasticities signify that a 10 % increase in price would cause a 1 % to 3 % decrease in demand. Projections have also included price increases on the order of 10 % to 30 % per annum in real terms. In addition to price policy, specific conservation measures could also have an impact on future demand, particularly on peak demand. As examples, conversion of the Kima fertilizer plant from electricity to natural gas feedstock would save about 180 MW of demand. The Nag Hammadi aluminum smelter, which has been judged by experts to be uneconomic at times of low world market prices for aluminum, uses 410 MW of demand. Research to improve load management (shifting peak demand to off-peak periods) in the seven major plants of the cement industry indicate that 106 MW of demand out of an estimated maximum demand of 251 MW could be saved. In addition, over a five year period a 5 % reduction in EEA line loss would be equivalent to peak demand of 370 MW. The total of these low priority uses of electricity, 1,066 MW, amounts to 14 % of effective capacity.

It should be noted that forecasts of future demand that are relevant must cover a substantial periods of time--usually more than five years. Moreover, presumption of substantial accuracy would be inappropriate. For example, at present the key forecast decision is when the 1,200 MW El-Kureimat thermal power plant will come on stream. If construction gets underway in 1991, it could be completed in 1996. As perspective, it can be noted that apart from this plant existing EEA generating projects that are underway will add 2,655 MW of net capacity during the seven year period FY 1989/90 through FY 1995/96. During this period, adverse circumstances, such as a drought affecting output of the Aswan high dam, could bring outages. Given that there are high costs to shortfalls in supply and, as yet, no international interconnection of the Egyptian grid, sound management would keep a margin of reserve capacity

3. The Historical Price Trend

The current average retail price of electricity of 4.0 piasters (about US 1.3 cents) per kilowatt hour is about one-fifth of the latest Mission estimate of the economic cost of electricity (made in 1989), estimated at 19.8 piasters (about US 6.6 cents) per KWH. Subsidization has the effect of increasing domestic consumption beyond what it would otherwise have been. The existing level and structure of electricity tariffs still reflect the historical circumstance of surplus cheap hydroelectric power from the Aswan dam and the period of abundance of petroleum resources in the 1970s. The management of electricity tariffs in the 1980s also reflected a desire to reduce inflationary pressures. Meaningful rate increases did not begin until 1986 with an increase in the average tariff of 35 %, followed by increases of 29 % in 1987 and 30 % in 1989. As is shown in Table I, the EEA wholesale price for electrical energy increased about half as rapidly as the wholesale price index up from 1974 to 1984/85, but at about twice the pace of the wholesale price index from 1984/85 to 1987/88. In 1989 the average price of electricity also increased by more than other prices. The EEA (Egyptian Electricity Authority) recognizes the need for pricing electricity based upon the marginal cost of service to user groups and by time of day, and EEA is moving ahead with the contracting of a study (financed by AID under the 1989 Power Support Project) for an electricity pricing strategy study. This study should be completed in early 1991.

4. The Structure of Tariffs and Sales

Even though the current (1989) average retail price of electricity is 4 pt. per KWH, a range of rates are charged by EEA and distribution companies varying with the category of consumer (industry residential, commercial, government, etc.), by voltage supplied (very high voltage, high voltage, medium voltage, and low voltage), by quantity used, and for firms

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TABLE I: AVERAGE ELECTRICITY PRICES, 1974 to 1987/88

| Year | Sales in millions of KWH | Value in millions of pounds | Average tariff in pts. /KWH | Wholesale price index (1974=100) | Price index electricity (1974=100) |
|---|---|---|---|---|---|
| 1974 | 6895 | 50.2 | 0.727 | 100.0 | 100.0 |
| 1975 | 8308 | 74.3 | 0.894 | 100.0 | 100.0 |
| 1976 | 9662 | 83.3 | 0.962 | 110.2 | 118.6 |
| 1977 | 11489 | 92.0 | 0.800 | 121.7 | 110.0 |
| 1978 | 12722 | 110.3 | 0.867 | 131.6 | 119.3 |
| 1979 | 14546 | 107.3 | 0.738 | 154.1 | 101.5 |
| 1980 | 16114 | 120.4 | 0.747 | 177.1 | 102.8 |
| 1981/82 | 19036 | 145.0 | 0.762 | 205.1 | 104.8 |
| 1982/83 | 21546 | 179.7 | 0.834 | 249.6 | 114.7 |
| 1983/84 | 24630 | 240.2 | 0.977 | 278.5 | 134.3 |
| 1984/85 | 26175 | 288.4 | 1.102 | 317.9 | 151.6 |
| 1985/86 | 28664 | 440.5 | 1.537 | 360.4 | 211.4 |
| 1986/87 | 31213 | 513.5 | 1.645 | 421.0 | 226.3 |
| 1987/88 | 33420 | 735.3 | 2.200 | 488.5 | 302.6 |
| 1988/89 | n.a. | | | | |

NOTE: The average tariff estimations are based on data from the Egyptian Electricity Authority (EEA) and the World Bank. In this table, the average tariff is defined as EEA sales of electricity (operating revenue) divided by the number of kilowatts sold. Final users are charged higher rates to cover costs of the distribution companies.

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by usage (motive power versus lighting). (15) The electricity tariff structure in Egypt is relatively simple in that rates do not vary with regard to peak versus non-peak demand. However, the rate structure discriminates between users in the public and private sectors, with low rates for most public sector firms and high rates for most private sector firms. Currently, large public sector industrial consumers, such as the aluminum smelter at Nag Hammadi and the Kima Fertilizer plant are charged as little as 1.22 pt. and 1.99 pt per KWH respectively. At the other end of the spectrum, private sector firms with foreign partners organized under Law 43 can be charged as much as 20.0 pt. per KWH.

Some 24.4 % of EEA 1988/89 electricity sales were made directly (i.e., not through distribution companies) to firms under special tariffs for very high, high, and medium voltages. (16) Six firms in the very high voltage group accounted for 17.6 % of EEA total sales in 1988/89 including 8.7 % to the Nag Hammadi aluminum plant and 4.6 % to the Kima fertilizer plant. During 1988/89 the average rate charged this group was 1.56 pt. per KWH and the tariff was increased to 1.97 pt as of the 1989 rate increase. EEA direct sales to firms at high and medium voltages in 1988/89 were at an average charge of 2.85 pt. per KWH, and sales to this group amounted to 6.8 % of EEA total sales.

Distribution companies accounted for 76.6 % of sales to final consumers in 1988/89. In 1988/89 their average purchase price per KWH was 1.83 piasters. The composition of sales by the distribution companies was as follows in 1987/88: 34.9 % to industry, 45.1 % to residential and commercial, and 30.0 % to public utilities, government, and other. Residential charges are based on a schedule of marginal rates. (17) After the April 1989 increase, for the first 100 KWH per month, the rate is 1.9 pt. per KWH. For the next 100 KWH the rate rises to 3.2 pt. and for the next 150 KWH the rate is 4.2 pt. The highest rate, for amounts over 4,000 KWH per month, is 14.0 pt. per KWH. Data for 1987/88 show residential consumption to be 28.3 % of final sales with 34.5 % sold to customers in the less than 100 KWH per month category and 80.7 % in the less than 350 KWH per month categories. The very low rates at this level of consumption are meant to subsidize low income households. However, due to the increasing marginal scale, all consumers with higher rates of utilization also benefit from the subsidy at each increment of consumption. Rates for commercial enterprises (stores and offices) are similarly structured. The first 100 KWH per month is billed at 2.8 pt. per KWH and rises to 17.0 pt. for consumption exceeding 4,000 KWH per month. The 1987/88 data show commercial consumers to be only 4 % of total KWH sales with 43.8 % in the 100 KWH per month category and 68 % in categories up to 350 KWH per month. The first 100 KWH per month is billed at 2.8 pt. per KWH, and the rate rises in successive increments to 17.0 pt. per KWH for consumption in excess of 4,000 KWH per month.

For industrial firms, at medium and low voltages, the rate schedule distinguishes between those who contract for more than 500 KW and those who contract for less. Firms that contract for a supply greater than 500 KW for motive power pay an annual fee of LE 28.90 per KW. In addition, they are charged per KWH on a declining scale starting at 5.18 pt. per KWH for the first 1,000 KWH, and the rate declines to 2.37 pt. per KWH after 5,000 KWH. Firms that contract for less than a 500 KW supply for motive power pay no annual fee per KW. However, the rate per KWH starts at 5.67 pt. per KWH and declines to 4.41 per KWH. Firms receiving a medium or low voltage supply pay a separate (higher) rate for electricity used for non-motive uses, e.g. lighting.

5. Price Discrimination

When viewed from the optic of the economic cost of electricity nearly all consumer groups are subsidized. Even so, as compared with an average charge, the rate structure gives a strong subsidy to large state enterprises and to middle income households. There is also significant rate disparity between public and private sector firms, even those producing similar goods, because of differences in the scale of operation or by virtue of the law under which the private firm was organized. Public sector firms are in the very high and high voltage categories or in the medium to low voltage categories but contracting for more than 500 KW. Private sector firms are predominately in the medium to low voltage category which contracts for less than 500 KW or are organized under Law 43 which pays a rate adjustment premium. (18) As examples, an industrial firm contracting for 600 KW and operating two shifts per 240 days a year would pay an average price of 3.12 per KWH. A smaller firm also with two shifts but contracting for 400 KW would pay an average price of 4.47 per KWH. Typically the larger firm would be in the public sector and the smaller one would be in the private sector. If the private sector firm were incorporated under Law 43, its average rate would be 9.63 pt. per KWH. The 4.0 pt. per KWH premium is to eliminate the fuel subsidy provided to EEA because the international status of Law 43 firms eliminates eligibility for subsidy. The combination of the commercial rate schedule and Law 43 status gives rise to rates in excess of 20.0 pt per KWH for commercial firms consuming over 2,000 KWH per month. Reportedly, private sector firms currently pay an average of 14.8 pt. per KWH.

105

## D. The Cost of Electricity

### 1. Accounting Versus Economic Cost

EEA data on costs use an accounting approach to cost rather than an economic approach. Even so, methodologically the accounting approach to electricity pricing is not vastly different from the economic approach. The important difference is that the accounting approach is essentially backward looking to recover sunk costs. (19) The economic approach to pricing is to charge for additional consumption with prices related to the value of resources used or saved. The accounting approach creates the illusion that resources which can be used or saved are as cheap or as expensive as in the past. If the past holds a number of poor projects, the sunk costs of mistakes will overstate costs. Conversely, if input costs are rising, a retrospective approach will understate costs.

### 2. Economic Cost (LRMC)

The LRMC is the average economic cost per KWH associated with a significant replacement of obsolete capacity or the installation of new capacity. The definition of economic cost values fuel, land, labor, and capital at alternative costs, i.e., what they would fetch in other uses within and outside of Egypt. These valuations are often different from those existing in Egypt due to governmental interference over-riding market determination of prices. As is shown in Table II, in recent years there have been several estimates of the long run marginal cost (LRMC) of electricity in Egypt. Most estimates have been in the range of 4.7 US cents per KWH to 6.6 US cents per KWH at the primary point of distribution. At best the LRMC is a moving target reflecting changing fuel prices and availability as well as exchange rate movements. In Table II, differences among estimates reflects in the main fluctuations in the international price of fuel oil and, in some instances, different fuel technologies projected in particular feasibility studies.

The most detailed estimate available at present is one prepared by the EEA which is based upon fiscal year 1988/89 operations. This estimate separates the cost of capacity (i.e., generating plant, transmission and distribution, and payments for personnel and expendibles) from the cost of fuel (including transmission/line loss). In reference to this data, the first column in Table II states the cost per KWH of capacity and the second column states the cost per KWH of fuel and transmission/line loss. The assumed cost of fuel oil used in the EEA estimate is $ 70 per MT as compared with our independent estimate of $ 76.8 per MT for 1988/89. Most of the difference in Table II between Sanghvi's average retail cost LRMC of 6.95 US cents per KWH as compared with 5.1 cents per KWH for the EEA, which amounts to 1.85 cents, is due to a $ 55 per MT difference in the assumed price of fuel oil. In this regard, our examination of the economic/financial cost of electricity based upon performance of the fuel-oil fired, relatively efficient Abu Kir and Abu Soltan generating plants, presented in Annex

106

TABLE II: ESTIMATES OF THE LRMC OF ELECTRICITY
(In US cents per KWH)

Part A. Various Estimates

| Date | Notes | LRMC |
|---|---|---|
| 1981 | Consultant's study for EEA; see Note (A) | |
| | --using domestic fuel prices | 2.84 |
| | --using international fuel prices | 10.94 |
| 1983 | J. LaPittus; see Note (B) | 4.7 |
| 1986 | C. LRichter; see Note (C)--based upon proj. Kureimat plant fired with coal | 5.5 |
| 1989 | A. Sanghvi; see Note (D)--based upon ADB feasibility study for Cario West extension | |
| | --for EEA direct service | 6.6 |
| | --for EDA service | 7.3 |
| 1990 | R. Adler: based upon Abu Kir, Abu Soltan; see Annex Table A--for EEA direct service | 5.3 |
| | --for EDA service | 6.1 |

Part B. EEA Estimates of LRMC for FY 1988/89 Data
(uses fuel oil with a price of $ 70 per MT)

| Item | Capacity Cost | Fuel Cost | Total |
|---|---|---|---|
| Net generation | 0.82 | 2.16 | 2.98 |
| Very high voltage | 1.08 | 2.21 | 3.25 |
| High voltage | 1.48 | 2.30 | 3.78 |
| Low voltage | 2.29 | 2.67 | 4.95 |
| --Average | 2.47 | 2.63 | 5.09 |
| --Average adjusted for $ 120 per MT fuel cost | 2.47 | 4.50 | 6.94 |

Part C. Estimate Based on Natural Gas

| | | | |
|---|---|---|---|
| Net generation at $ 90/MT fuel oil | 1.32 | 2.11 | 3.43 |
| --Implied average retail price | 2.97 | 2.57 | 5.54 |
| Net generation at $ 52/MT equiv. of fuel oil--using natural gas | 1.32 | 1.22 | 2.54 |
| --Implied average retail price | 2.97 | 1.48 | 4.45 |

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Notes:

(A) IBRD memorandum, "Egypt Investment Review, Power Sector Issues" (February 13, 1984), pp. 28-31.

(B) Jerome LaPittus, "Eliminating Cost/Price Distortions Memorandum as Annex L (in USAID/Egpyt Project Paper: Ismailia Thermal Power Plant, Amendment 2)

(C) Charles Richter, "The Energy Problem," (Staff Working Paper, November 12, 1986), pp. 6-8.

(D) Arun P. Sanghvi, "Briefing to AID on Terms of Reference for Electricity Pricing Strategy Study" (March 29, 1989).

Table A, indicates that each $ 10 per MT change in the price of fuel oil creates a 0.29 cent per KWH change in the LRMC (i.e., 0.24 cents per KWH along with a 21 % allowance for transmission/line loss). Thus, 1.60 cents of the 1.85 cent difference between the EEA and Sanghvi estimates arises from differing assumptions of the cost of fuel.

Recent information indicates that a LRMC for electricity based upon utilization of domestic natural gas with a charge equal only to the domestic cost of production of it (rather than upon the cost of heat equivalent fuel oil) would substantially reduce the LRMC of electricity in Egypt. This difference hinges largely upon the fact that it is not economically feasible to export natural gas from Egypt. The equivalent cost for a combination of 80 % natural gas and 20 % fuel oil (which is judged to be the likely combination in the next big generating project in Egypt) is estimated to work out on a heat equivalent basis the same as $ 52 per MT for fuel oil. As is shown in Table II, per source calculation, this would reduce the per KWH cost of generation from 3.43 cents to 2.54 cents and the implied retail price per KWH from 5.54 cents to 4.45 cents. Thus, in purely technical terms, the new LRMC is 80 % of the old one. However, given the vagaries in international price of fuel oil, an average retail price of 4.45 cents is only 64 % of our last "official" estimate of LRMC--6.94 cents per KWH (the Sanghvi estimate) The present average retail price of electricity, 4.1 pt. (US 1.33 cents) is now equivalent to 30.0 % of the LRMC instead of only 19.7 %. Although this is a positive development, this downward revision of the LRMC is not so large as to make attainment of pricing at LRMC a substantially less difficult goal.

3. Fiscal and Solvency Objectives

The fact that users are charged only 20 %, or now 30 %, of economic cost is explained both by GOE maintenance of a low transfer price for fuel supplied by the EGPC to EEA and by less than full recovery of capital and interest charges for the electric power plant. Thus, one can posit two important revenue objectives: (a) an increase in direct fiscal resources via elimination of the fuel subsidy and (b) an increase, or fiscal-like, resources via higher electricity tariffs to cover the non-fuel costs of generating and distributing electrical energy. The review of electricity prices carried out by Sanghvi in early 1989 indicated that the financial cost to EEA of fuel oil (mazout) was US $ 11.62 per MT as compared with $ 125 per MT as the the assumed borderprice and that the financial cost to EEA of gas oil (Solar) was $ 39.83 per MT as compared with $ 165 as the assumed border price. Thus, it appears that subsidy of users of electricity is an intentional policy of the government and financed principally through fuel subsidies to EEA. The direct fiscal resource objective could be achieved through increasing the transfer price of fuels to economic levels. However, present electricity tariffs do not assure long-term solvency, i.e., cost recovery for EEA and EDA system. As is indicated in Table II, the EEA estimate presented in Table II, the cost per KWH of the generation and distribution plant is 2.5 cents. This cost is 86 % more than the present (1990) average retail price of electricity.

4. The Cost of Service Study

At present complete information does not exist for a disaggregation of the economic cost of electric power into its components: the cost of fuel, the cost of capital and depreciation for a substantial expansion to generating plant, and average system costs for transmission and distribution operations. The EEA data presented in Table II and our computation presented in Annex Table A could be improved. Currently the EEA with AID assistance is in the process of contracting a study that will illuminate several issues related to the cost of electrical energy in Egypt related to construction of a new electricity tariffs that will incorporate important social and financial considerations. The specific points to be included in this study are an analysis of the marginal cost structure (LRMC) utilizing economic costs to correct for distortions in the pricing of major inputs, an analysis of the short-run marginal cost structure which would define hourly costs, an assessment of the economic cost of natural gas in the power sector financial analysis of EEA as a stand-alone organization and with the distribution companies, and a review of the load forecast and the least cost expansion program. The major outputs of this study will include (a) a disaggregation of economic costs for peak load demand and non-peak load demand, (b) inclusion of distribution system expansion and line losses into economic cost, and (c) the formulation of a pricing strategy based upon the marginal cost structure with proposed adjustment of these tariffs to incorporate social and financial considerations. We expect that this study will be completed in early 1991.

5. The Pace of Adjustment

At best it will take several years of increases in the real price of electricity before the average price is brought up to the level of LRMC. Assuming annual increases of 20 % in the real price of electricity, starting from a base at which the average price is only 20 % of the LRMC requires about 9 years and starting from a base at which the average price is 30 % of the LRMC requires 6.5 years. These calculations as percent of the LRMC are shown in Table III.

TABLE III

ELECTRICITY PRICE AS PERCENT OF LRMC AND YEARS REQUIRED TO REACH THE LRMC

| End of Year | Base equals 20 % of LRMC | Base equals 30 % of LRMC |
|---|---|---|
| 1 | 24 | 36 |
| 2 | 29 | 43 |
| 3 | 35 | 52 |
| 4 | 42 | 62 |
| 5 | 50 | 75 |
| 6 | 60 | 90 |
| 7 | 72 | 108 |
| 8 | 86 | |
| 9 | 103 | |

F. Negative Economic Effects

The importance of energy prices to resource allocation and damage or help to the economy of these prices is on a par with the exchange rate and interest rates. The Government of Egypt has been promising and planning to increase electricity tariffs since the early 1980s, but fear of political backlash has produced a timid effort. Low energy prices have several negative effects: (a) the inducement of utilization of energy-intensive technologies in production processes, (b) too much consumption with an attendant burden on national balance of payments, and (c) negative impacts on fiscal income and on the income of state energy enterprises. Additional negative impacts can also flow from the status of electricity as a natural monopoly.

1. A Natural Monopoly

The distribution of electrical energy is a natural monopoly. That signifies that in the absence of state regulation a privately-owned distribution company could charge what the traffic would bear. Among other things, this means not selling at a uniform price but attempting to capture as much revenue as possible under the demand curve. In addition, these firms are less inclined to contain their costs than is typical for firms in a competitive market structure because costs are passed through into prices. For this reason the usual mechanism to assure equitable pricing and cost containment where electric utilities are privately owned is a regulatory body. Such legally established bodies undertake surveillance of utilities to see that prices are related to costs, that costs are contained, and that the resulting profits allow an adequate return on capital. However, even with good, equitable regulation, the cost of system failures is also high for users. In some instances this gives rise to a tendency for privately-owned electric utilities, in the absence of close regulatory scrutiny, to overforecast demand, thereby overbuilding expensive power plants at ratepayer expense. Thus, if anything, for privately-owned electric utilities there is a tendency to overproduce and overprice. In Egypt, in contrast, the case is reversed in regard to pricing. In effect, strong political incentives operate on managers to avoid "brownouts" but as with most state-owned enterprises divorced from the discipline of prices determined in markets, incentives to assure cost recovery are weak. As is noted above, available evidence suggests that consumption is not only subsidized by fuels supplied to EEA at extremely low prices but also in the form of inadequate return on capital.

The lack of a market test or constraint is made worse by politically-oriented pricing with subsidies to favored public sector firms and tax-like tariffs imposed upon the politically weaker private sector firms. Moreover, the electricity tariff structure has become distorted and has little basis in economic or accounting costs. In policy dialogue with the GOE, AID has emphasized the structure as well as the level of energy prices. AID has strongly supported correction of tariff disparities which are not justified by cost differences. In 1986 tariff increase there was a tendency by the GOE to raise electricity tariffs by approximately equal percentages for all classes of users. If continued, this procedure would widen enormous absolute disparities between rates assessed on private as compared with public sector consumers. The increase in rates in April 1987 (with an average of increase of 29 %) raised the rates for industry and large residential and commercial consumers by 40 % or more. The increase in rates in March 1989 (with an average increase of 30 %) raised the industrial rates by 66 % even though the increase for highly subsidized plants was low. Even after the March 1989 increase in rates, the the charge per KWH for very high voltage customers was only 28 % of the charge for private commercial customers and the rate for the Kima fertilizer plant was 11.6 % of the highest commercial rate class. These differences smack of unfair competition and have little basis in either economic or accounting costs.

2. Falsification of Price Signals

Prices form the basic information system used by households as well as industrial, commercial and other users concerning the relative scarcity of energy products. Even if one asserts that some conceivable non-price rationing system might be substituted for a pricing system to allocation distribution energy in Egypt, a discretionary or non-price allocative system does not exist. Artificially low prices lead users to act as if energy resources were not scarce, leading to overconsumption of energy (as is discussed later) and to a lowered efficiency of investment. That is, part of the waste consists in inappropriate selection of energy-related technology. With low energy prices, the process of investment as related to energy use becomes less efficient as more energy-intensive technology is installed. The problem is revealed by indications of excessive use of energy per unit of output and of high domestic resource cost in the industrial sector. The World Bank study of Egypt's domestic resource cost (published in 1983) indicated that for 20 out of 25 state enterprises examined in metals, chemicals, paper, and transport equipment the domestic resource cost (cost of primary factors as well as intermediate inputs valued at economic, or shadow, prices) was in excess of the value of their output valued at economic prices. Moreover, in 8 of these same 25 firms there was negative value-added. The role of cheap energy prices is suspected in these cases. Moreover, low energy prices are clearly responsible in the cases of the Nag Hammadi and Kima firms.

Even so, the use of energy-intensive technology throughout the economy is likely to be the greater waste. This occurs because energy prices become embodied in physical plant that is less energy-efficient than that which would be selected by the correct energy prices. So, some portion of investment through a broad spectrum of the economy has to be viewed as wasted because it embodies technology that is too energy intensive and cannot be sustained in the face of likely increases in energy prices. The amount of such waste is only revealed in the event of a sudden increase in electricity and other energy prices to levels of economic cost. In that event the sunk capital of firms that are grossly energy inefficient and cannot be rescued financially has to be written off and other firms have to make new investments to reduce energy consumption in order to survive. In conclusion, the penalty for falsification of energy price signals signifies that a portion of national investment resources would have to be used to correct for cheap energy prices. That is, introducing the higher market prices for energy would reveal a capital loss.

Indications of this capital loss or need for new investment are revealed by several energy audits at plant level conducted under the AID grant to the Organization for Energy Planning in the Energy Policy Planning Project (0123.1). Table III presents economic/financial data from ten such plant energy audits. Importantly, these data indicate the annual cost of energy at domestic prices converted to U.S. dollars (at the exchange rate at the time of the audit) and the annual cost of this same energy at international prices. At international prices, energy cost in Egypt is a multiple of the domestic cost, and ratios of 2 to 6 are usual. Energy audits at the plant level by competent engineering and technical experts found energy savings that could be obtained with low-cost housekeeping improvements and also with more expensive alterations of machinery and processes. In regard to the latter, possible energy-saving investments were compared with the international cost of energy saved, and payback periods were calculated. Possible investments with payback periods exceeding five years were discarded. As is shown in Table III, in 6 of the 10 plants energy savings meeting this criteria were more than 25 % of energy utilization. In all instances average payback periods were less than 3 years, suggesting rates of return (IRRs) on the associated energy-saving investments of over 15 %. Apart from the Misr Co. for Aluminum (Nag Hammadi), where there appears to be no alternative to an energy-to-output coefficient set by a technological process, the total energy savings meeting the investment criteria noted above amounted to 28 % of energy usage and would require an investment of $ 12.6 million. Table III also indicates that if energy prices were moved to the international level, the cost of energy would increase by about 230 % (from $ 11.4 million to $ 37.9 million) so there would be strong incentive to undertake energy-saving investment.

The cost of increase energy prices would also be passed through into product prices. Inasmuch as data on gross costs and sales were not available in most of the audit reports, quantification of the inflationary pass-through from higher energy prices is speculative. Some audit reports noted that the cost of energy for the plant was small--clearly less than 5 % of total cost and more probably on the order of 2 %, e.g., food processing/canning, essential oil and soap, detergents, pharmaceuticals.

In these cases a 230 % increase in energy costs would add from 4 % to 7 % to final product costs. Even though the sample of firms audited is too small to serve as a statistically-valid sample, one interpretation is that a 20 to 30-fold expansion of this sample would approximate the situation of Egypt's manufacturing sector. If so, it suggests that total investment on the order of $ 200-400 million would save $ 200-300 million annually in energy (valued at international prices).

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TABLE IV

ENERGY USE AND COST, FEASIBLE ENERGY SAVINGS, INVESTMENT AND PAYBACK

| Plant/Firm name | Energy in MT of Oil Equivalent: Present Usage | Feasible Savings | Saving (in %) | Cost of Energy Domestic Prices ($ 000) | International ($ 000) | Cost of Investment in US ($ 000) | Pay-back period (years) |
|---|---|---|---|---|---|---|---|
| Nasr Company for Preserved Foods | 6,103 | 2,044 | 33.5 | 760 | 1,710 | 830 | 1.9 |
| MISR Company for Aluminum | 768,149 | 21,823 | 2.8 | 33,071 | 129,000 | 1,210 | 1.0 |
| Egyptian Copper Works Company | 15,837 | 5,402 | 34.1 | 489 | 2,291 | 1,607 | 2.1 |
| RAKTA Gen. Co. for Paper Industry | 68,360 | 21,886 | 32.0 | 1,370 | 9,451 | 3,712 | 1.3 |
| Cairo Oil & Soap Company | 5,325 | 639 | 12.0 | 38 | 158 | 125 | 0.9 |
| Egyptian Starch,Yeast & Detergent Co. | 7,330 | 2,129 | 29.0 | 167 | 1,027 | 1,089 | 2.9 |
| Egyptian Co. for the Sugar Industry | 57,838 | 16,065 | 27.8 | 4,228 | 4,994 | 1,850 | 2,5 |
| Nasr. Co. for Coke & Chemicals. | 73,807 | 38,030 | 51.5 | 690 | 5,005 | 3,008 | 0.7 |
| Nasr. Pharmaceutical Company | 9,267 | 1,487 | 16.0 | 235 | N.A. | 95 | 2.0 |
| MISR. Chemical Company | 95,700 | 7,858 | 8.2 | 3,455 | 13,300 | 247 | 0.3 |
| Total | 1,107,716 | 117,363 | 10.6 | 44,503 | 166,936 | 13,773 | |
| Total ex-Aluminum | 339,000 | 95,540 | 28.2 | 11,431 | 37,936 | 12,563 | |

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Source: Several energy audit reports prepared by RCG/Hagler Bailly, Inc., by Foster Wheeler USA Corporation, and by Arthur D. Little in cooperation with the firms listed above in cooperation with the Office of Energy Planning, and A.I.D.

3. Excessive Consumption: Balance of Payment Losses

An indication of the overconsumption of energy in Egypt consists in the fact derived from the World Development Report, 1989 that Egypt consumed 588 Kg. per capita of oil equivalent in 1987 as compared with 237 Kg. per capita for 16 other low income countries. (20) This relationship was also noted by Dod in 1983. (21) These facts suggests that movement to international prices would reduce domestic consumption by as much as one-third. As noted earlier, Egypt's domestic consumption (1987/88) amounted to 27.0 million MTOE (metric tons of oil equivalent). Thus, an over-all reduction of of domestic energy demand would free up 9.0 million MTOE in the form of petroleum. The opportunity cost of low domestic energy prices is currently worth about US $ 900 million (with crude petroleum at $ 14 per barrel or $ 100 per metric ton). Depending on the fiscal pass-through from the EGPC (which amounted to $ 53 per MT in 1987/88), fiscal opportunity cost of such high consumption with low prices is on the order of $ 500 million annually. However, the permanence of the additional B/P earnings is open to question because domestic demand would also continue to grow and erode the exportable surplus. Moreover, the wisdom of additional petroleum exports depends also on future world petroleum prices. Thus, if one expects substantially higher world prices and no increase in proved reserves, reduced extraction might be the preferred decision.

4. Foregone Fiscal Revenues: Low Petroleum Product Prices

Apart from additional fiscal resources that would be generated directly by increased export of state-owned petroleum, increased domestic prices of petroleum products and electricity would also generate fiscal resources or fiscal-like resources (i.e., revenues to the EGPC and EEA). Our existing estimate work (CDSS Update) indicates that petroleum product prices (excluding sales to EEA) would have to be increased by about 220 % to bring them to world market equivalents. The volume of these fiscal resources is not the same as the volume of implied subsidies received at present by consumers. That is, if prices were increased, there would be a movement along a demand curve and the quantity sold would be reduced. The shape of demand curve over the relevant range is denoted as the elasticity of demand. During the 1970s aggregate price elasticities of demand for energy products were commonly estimated at -0.15 for the U.S., implying that a 10 % increase in price would reduce volume sold by 1.5 %. However, as the lagged impacts of large energy prices of the price shocks of 1973-74 and 1979-80 have emerged, economists estimates of long-run price elasticities have risen to as high as -0.30. Gouda Abdel-Khalek calculated demand elasticities for sales of petroleum products in the Egyptian market based upon data for the period 1960-1981 and found a short run price elasticity of -0.151, a long-run price elasticity of -0.517, and a short-run income elasticity of 0.256. (22) However, these estimates were derived from a period of falling real prices and the author cautions that they would not apply automatically to a situation of rising prices. Estimated domestic sales of petroleum products (excluding EEA) in 1989/90 are equivalent to $ 714 million. Assuming a 30 % decline in volume with a 200 % increase in real prices (a -0.15 price elasticity) would create the following situation for domestic sales of petroleum products: total sales revenues of $ 1.5 billion, $ 0.5 billion as EGPC sales revenue, and $ 1.0 billion as additional fiscal revenues. Obviously, if price increases were spread out over several years, the immediate impact would be considerably smaller.

5. Foregone Fiscal Revenue: Electricity

The revenue effects of higher electricity prices can be obtain from projections already contained in the Mission economic analysis for Power Sector Support grant of August 1989. (23) In the baseline case, without any increase in real prices, electricity sales were projected to grow by 7.2 % per annum during the period 1986/87 to 1991/92, and, of course, sales revenues would also increase this growth rate. In constructing a case reflecting an aggressive policy of increasing prices, we assume a 20 % per annum increase in real electricity prices (an approximate 150 % increase over the 5-year period), a -0.1 price elasticity of demand (i.e., a 1 % reduction in quantity demanded for each 10 % increase in price), and a 90 % reduction in electricity sales to the Kima fertilizer plant (due to conversion to natural gas feedstock). With this aggressive pricing scenario, sales volume would grow from 26,579 million KWH in 1986/87 to 30,540 KWH, an annual growth rate of 2.8 %. EEA sales revenue in 1986/87 approximated US $ 246 million. Without an increase in electricity tariffs, these revenues would have grown to $ 350 million in 1991/92. In the aggressive price scenario set out above, they would grow to US $ 703 million in 1991/92, an increase of about $ 457 million in 1986/87 prices or about $ 500 million in 1990 prices. It should be noted that this estimate of possible fiscal-like revenues is based upon attainment of a price that is about half of the standard, oil based LRMC. For that reason, reaching 80 % of this LRMC would double this amount. Our finding also approximates that obtained by Richter in his 1986 study. He found an LE 2.0 billion (approximately $ 1.0 billion) increase in EEA sales revenues for 1992/93 as compared with a base period of 1986/87. His projection incorporated a -0.1 price elasticity of demand and rate increases of 18 % per annum in real terms to reach the full level of international prices in 1992.

In summary, the annual fiscal and fiscal-like revenues that could be generated by increasing domestic energy prices to international levels is on the order of $ 2.0 billion. This amounts to about 5 % of GDP, and as an annual flow it would make a significant impact on the domestically-financed public sector deficit, which is on the order of 10-12 % of GDP. For example, if half this flow were kept by the producing companies (EEA and ECGP) to fund energy-related production costs and investment, the remaining revenue would still cover as much as one-fourth of the domestically-financed public sector deficit.

## G. A Review of Policy Dialogue

### 1. Current Status of Dialogue

Reduction of the electricity subsidy is an important topic on the economic policy agendas of AID, the World Bank, and the International Monetary Fund. Over the years the AID Mission has presented several concrete programs to reform electricity prices to GOE officials; these proposals are discussed herein. In 1986 the GOE indicated both to the World Bank and to AID that it intended to bring the domestic prices of energy products to the levels of world prices by the end of the 5-year plan, that is, from 1987 to June 1992. This goal would have required five annual price increments on the order of 34 % each. Later, AID was informed that there would be slippage of a year or two in meeting this goal. Based upon the low (29 % nominal increase) in electricity prices of May 1987 and the lack of any increase in 1988, AID and the World Bank decided to halt support for new power generation. AID policy was spelled out in the CDSS statement, "Given the critical importance of pricing to remove distortions, USAID will not provide any further funding for physical improvements in the sector (rehabilitation or new generation) in the absence of significant price increases." In March 1989 the GOE increased electricity tariffs by an average of 30 % and the structure of rates was also improved. The GOE also reaffirmed a commitment to increase electricity tariffs to the levels of world prices by June 1995. In August 1989 AID decided to go forward with a $ 133 million Power Sector Grant. In 1989 the GOE agreed to increase its energy prices and electricity tariffs to international levels by June 1995. Realistically, the main focus of external donors is upon the near term annual increases in tariffs.

### 2. A Longer History

AID concern about low energy prices date from the 1970s. A covenant was placed in the 1976 project agreement for the Ismailia Steam Power Plant (263-0009) specifying that within three years (from 1976) electricity tariffs should be set at a level high enough to produce an annual return of 9 % on the fixed assets. However, the covenant was not complied with. In 1979, another agreement, the Shoubrah El Kheima Thermal Power Plant) called for a minimum 5 % return in 1980 and a 9 % return in 1983 and thereafter. The GOE also agreed to hold periodic consultation with AID concerning power rates. In 1981 the GOE indicated that it would move energy prices to international levels in a period of five years. (24) In the 1980s AID has made several proposals to increase electricity tariffs with the aim of removing the large implicit subsidy in the selling prices of electrical energy. It was hoped that a greater appreciation within the GOE on the magnitude of the subsidy would produce internal pressures to raise prices. However, with time, it appears that both the concept of long run marginal cost (LRMC) as well as the sheer magnitude of the required increase in electricity prices have posed significant obstacles to enactment of higher prices. As is noted earlier, the average retail price would have to be increased by a multiple of over three to reach economic cost.

3. The LaPittus Proposal

In July 1983, Jerome LaPittus proposed a system to eliminate cost/price distortions in electrical energy. (25) Mr. LaPittus stated that the shadow price of electricity at that time was about 4.0 pt. per KWH and he noted that this price was necessary to provide an adequate return on investment and pay a world market price for fuel oil (mazout) as compared with a current 0.9 pt. per KWH average retail price. He noted also that aluminum and fertilizer producers benefitted from exceptionally low prices and that households and other firms had also made substantial capital investments in energy-intensive production processes. He judged that sharp increases in electricity tariffs would bring large "write-offs" of past investments and that such losses could be minimized by a slow but certain adjustment to a new, higher electricity tariffs. His specific proposals were as follows:

(a) Establish a subsidy account in the EEA for each electricity consumer. The size of the subsidy account would be equal to the difference between the old and new prices of electricity multiplied by the volume of electricity consumed in the base year.

(b) Each user would pay for electricity at the new and much higher price, i.e., the shadow price stated above. Payment of electricity bills would be made, in part, by a debit to the subsidy account and in part by cash.

(c) The amount of subsidy would decline each year, say, by one-tenth over a ten year time period and, therefore, would be phased out in the eleventh year.

(d) The Central Government would provide EEA with a budgetary subsidy to fund the customer subsidy account and EEA would begin to pay the EGPC the opportunity cost (world market price) of fuel oil.

(e) It was also recognized that the shadow price of electricity would have to increase each year as a function of domestic inflation and exchange devaluation. The proposal did not include an adjustment of the subsidy to compensate for inflation.

The merit of the subsidy account approach is clear. Users are made aware of the new and much-higher price for electricity immediately. Moreover, the long phase-in period would be used by customers to make energy-saving investments. The subsidy would be up-front rather than buried in the price structure; in short, prices far below economic cost would not continue to distort investment decisions.

4. The Richter Proposal

The proposal put forth by Charles Richter in 1986 (26) entailed the following specific proposals:

(a) Acceptance by the GOE and EEA of a long-run marginal cost (LRMC) framework for determining electricity tariffs based on the cost of providing the service, including the capital costs of system expansions as well as the variable cost of producing electricity.

(b) Raise all electricity tariffs by 40 % immediately (approximately the inflation rate of last year plus 20 %). Residential users consuming less than 100 KWH monthly could be subject to rate increases limited to the inflation rate (about 20 %).

(c) The establishment of a floor rate of 4 piasters (40 milliemes) per KWH immediately for uses except those consuming 100 KWH or less per month.

(d) The creation of a ceiling rate up to 10 % higher than the LRMC determined tariff, at which no user would be charged unless all were so charged with the exception of low income households. The objective of the ceiling was to narrow the discrimination practiced against private sector users of electricity.

(e) The raising of electricity tariffs by 18 % annually in real terms from July 1987 to July 1992; that is rate increases equal to 18 % plus the rate of inflation. The only exception would be limited to the low income households consuming less than 101 KWH per month; the tariffs for this group would be increased at the same annual rate as general inflation.

5. The Proposal for Reduced Pass-Through

This proposal, presented in early 1988, entailed a plan to increase all energy prices (except for electricity consumption by low income groups) to unsubsidized levels, but would temporarily avoid a pass through of the pricing effects of the increase to some users. (27) The essentials of this plan were as follows:

(a) All residential electricity tariffs, except for the first 80 KWH of electricity per month would be charged the estimated economic cost--13.2 piasters per KWH as of 1988. Residential tariffs currently over this rate would remain at their present levels.

(b) In order to protect the purchasing power of low income households, the tariff on the first 80 KWH per month of residential consumption would remain heavily subsidized. (By lowering the upper band of subsidized residential sales to 80 KWH, the subsidized segment would encompass 60 percent of residential sales as contrasted with 70 percent with a boundary at 100 KWH).

118

(c) For other users, EEA and the electricity distribution companies would be responsible for collecting or accounting for the increased electricity tariffs. It was anticipated that a portion of the new revenues would be used to put the EEA on a sound financial basis.

(d) In addition, a substantial portion of the increased real and accounting revenues would be placed in a special "energy adjustment fund." The proceeds of the energy adjustment fund would be applied selectively to both public and private sector enterprises. This fund would be used to assist firms to maintain existing levels of production and employment. Recipient firms would be required to account for the higher energy costs as current expenses while the receipts from the energy adjustment fund would be treated as a balancing item after the calculation of profits and losses. Although rapid declines in the profitability of public sector companies could threaten affected employees with reduced bonuses, special adjustments should be considered to avoid decreases in their pay arising from higher energy costs.

The principal benefit of a reduced pass-through scheme is that dislocations of great concern to the GOE would be avoided. That is, electricity prices could be increased with no immediate decline in production, income, and employment. However, the higher prices would appear explicitly on the books of affected entities, ensuring that their profitability, or lack thereof, fully reflected the economic cost of electricity inputs. In this manner, the signals conveyed by higher prices would be strong signals to increase productivity and productive resources would eventually be used more efficiently.

This idea was presented and discussed by the staff of the Economics Office with officials of the GOE, the EEA, and the World Bank, as well as the AID Mission Director and American Ambassador in late 1987 and through the first half of 1988. However, electricity tariffs were not increased during 1988.

6. A Proposal for International Price Parity

A proposal to use international price comparisons was presented by the Chief of PDS/E, Peter Gajewski, to the Minister for Cabinet Affairs, Dr. Atef Mohamed Ebeid in May 1988. (28) In essence this proposal would increase all energy prices to unsubsidized levels except for consumption by low income groups, by the aluminum industry, by the fertilizer industry, and by the cement industry. Inasmuch as competitors to these latter industries in other countries usually benefit from undercosted hydroelectric and gas energy, electricity tariffs for these industries would be kept low not as a temporary plan but as a permanent one. In aggregate, consumption of low-income consumers and these industries amounts to about 50 percent of total usage.

This plan included the following elements:

(a) The GOE would accept the task of increasing the unsubsidized electricity tariff to 13.2 pt. in 1988/89 prices by the end of the fiscal year 1994/95.

(b) The price for low income users, which was estimated to be consuming about 15 % of electricity, would be kept at 2.0 pt.to 3.0 pt. per KWH (in 1988/89) as part of the social safety net.

(c) Target rates per KWH to be obtained by the end of fiscal year 1994/95 were 5.0 pt. for aluminum, 8.0 pt. for fertilizer, 8.0 pt. for cement, and 10.0 pt. for all other public sector industries. The estimated consumption in billions of KWH was as follows: 3.5 billion for aluminum, 2.8 billion for fertilizer, 0.7 billion for cement, and 7.0 billion for other public sector industries. The low income and these subsidized public sector industrial users accounted for about 50 % of total use.

(d) The remaining 50 % of users would have prices raised to 13.2 pt. (in 1988/89 prices) over the seven year adjustment period.

At bottom line, this program allowed gradualism, significant price distortions, and a token price target.

7. A Rapid Ajustment Program

Recently, we understand that foreign experts have suggested a rapid pacing of increases in electricity tariffs to the GOE with nominal annual increases on the order of 75 % per annum with a maximum four-year time horizon. The key objective in this approach is the generation of fiscal revenues.

## H. An Evaluation and Conclusions

### 1. The Dimensions of Adjustment

An optimal plan for adjustment of electricity tariffs cannot be framed without reference to the macroeconomic objectives sought by the government, including reduction of domestic and external deficits. The more plausible and economically orthodox objectives include (a) increased fiscal resources along with the macroeconomic goal of reducing of aggregate demand, (b) increased export earnings from an increase in petroleum export earnings, (c) a clear signal of final electricity prices so as to orient new investment in energy savings technology, (d) minimization of the pain of increased unemployment causes by factory closures related to bankruptcy caused by higher electricity tariffs, (e) minimization of misery caused to low-income households by higher electricity tariffs, and (f) minimization of the political backlash of sharply higher electricity tariffs. The optimal adjustment plan has to be framed in terms of the weighting of each of these objectives.

a. Increased fiscal resources. The trade-offs to fiscal resources increased by removal of the energy subsidy include (1) continuation of large fiscal deficit which is a basic element generating inflation and exchange devaluation, (2) reduction of the deficit by means of cutbacks in fiscal expenditure, or (3) reduction of the deficit by means of increasing other taxes. Inasmuch as most economic adjustment programs entail the pain of additional taxes, it can be argued that increased energy prices (and the fiscal-like revenues of EEA and EGPC) would substitute for increases of other taxes--including new taxes with unproven track records.. Even if one excludes fiscal resources generated by increased petroleum exports (because those exports might be transitory), as indicated in section (F) if electricity and petroleum product prices were moved to the international opportunity cost levels, fiscal (and fiscal-like) resources would increase by $ 2.0 billion and would approximate 5 percent of GDP. This action would reduce aggregate demand due to the reduction of household purchasing power by the full amount of the fiscal extraction. Herein it is recognized that higher energy prices are the same as an increase in taxes, e.g.,about the same as a national sales tax. The important related objectives are to reduce absorption (aggregate demand), real income, imports, and inflation rapidly even if increased recession and unemployment result. The key argument is that higher electricity tariffs would substitute for new taxes that would also be unpopular, and difficult to legislate. The Richter and rapid adjustment programs serve this purpose well, and any adjustment taking longer than five years can be considered as too slow.

b. Reduced domestic consumption of petroleum. This objective is served best by increasing the prices of petroleum products. The substitution of fuel oil in the generation of electric power by increased utilization of natural gas should also be maximized. Electricity tariff increases would be of lesser importance.

c. A signal of the final price of electricity. An increase in electricity tariffs in the once-and-for-all mode or clearly announced as in the LaPittus proposal would be effective. However, continuing inflation would work against these proposals. Since inflation has continued, consumers would feel betrayed once tariffs were raised beyond the 4.0 pt. level proposed by LaPittus.

d. Minimization of disruption. The minimization of increased unemployment from factory closures related to bankruptcy caused by higher electricity tariffs could be served by a gradual phasing in of the increase through several years. However, to the extent that costs of energy-sensitive products can be pushed through to the retail level, such

121

bankruptcies would be limited. Clearly some bailout provisions are need for firms that produce very energy-intensive outputs, e.g., cement, aluminum. In these cases, the state should formulate clear criteria for continuation of subsidy as compared with for the cost of closedown so that it would not pay more in subsidies than would be needed for an equitable closedown.

e. Minimization of the misery of the poor. The most important legitimate mechanism for minimizing the impact of increased energy prices on the poor is to have a low electricity tariff on the first 80 to 100 KWH per month. Thus, some provision for reduced pass-through is necessary. This argument does not extend to the users of more substantial amounts of electricity. Paul O'Farrell completed a paper on the rate structure of residential sales in 1988 which explored three options (compression of rate increments, 3-month consumption rate increments, and a fixed rate per consumption group) for reducing the substantial entailed in the increasing marginal tariff structure but also protecting the poor. (29) Some 60 % of all households have monthly consumption of less than 100 KWH, account for 28 % of residential demand, and consume about 3,100 million KWH annually. Considering this group as genuinely poor, and maintaining the present tariff for only this group (U.S. 0.6 cents per KWH) would require an annual subsidy of about $ 120 million. However, poor households also use kerosene for cooking and heating. A ration stamp program to subsidize consumption by the poor of kerosene, butane, and natural gas would also have a cost. For example, present subsidies implied by low domestic market prices approximate $ 550 million and one could well suspect that one-third of this subsidy ($ 180 million ) goes to the poor and should be retained.

f. Minimization of the political backlash. On the surface it would appear that strongly increased fiscal resources, reduced consumption of petroleum, and a suitable signal of the final price of electricity would be best served by a rapid (1-2 year) increase in energy prices and that minimization of disruption and misery of the poor would be best served by a gradual (5-10 year) increase. Even though sharply higher electricity could bring political backlash, much depends on the macroeconomic situation in which such action intrudes. If sharply higher electricity prices and petroleum product prices were an integral part of an economic stabilization program, rapid adjustment might be entirely digestible. That is, if national income and employment were rising and real incomes were steady or increasing and if, in that context, the increase in electricity tariffs were the major element in a program to reduce the fiscal deficit, then consumer political backlash might be minimal. On the other hand, if per capita national income were in secular decline and had already declined by, say, 15 % from a few years ago, an additional cut of about 5 % in real income could produce political backlash. The wisdom of rapid adjustment also depends on the availability of other policy measures to close the domestic and external gaps. Gradualism in raising electricity tariffs coupled with gradualism in raising other prices simply pushes up inflation and is, at best, based on the assumption that people will not recognize a reduction in real income because it has taken place slowly. At the same time gradualism assures that the energy sector will make a small contribution to provision of fiscal resources needed to close the fiscal gap and restore price stability.

2. Program Accountability

The verdict of history is apt to be unfavorable to AID's heavy investment in electrical energy in Egypt in the 1980s due to the failure of Egypt to move to more realistic pricing in a shorter period of time. Based upon the evidence reviewed herein, the Economics Office made repeated and detailed presentations and efforts to persuade Egyptian policymakers. Even though there are few serious policymakers in Egypt or in AID who do not agree that a substantial increase in electricity prices is necessary, the adjustment effort has been constrained. The constraint does not reside as much in complacency, or in substantial uncertainties regarding facts and analysis of the energy sector, as in a limited and incoherent macroeconomic policy. The analytical fault appears to be lie in placing too much reliance upon price controls as a policy of curbing inflation but, at the same time, ignoring the inflation generated by domestic banking system finance of public sector deficits. From this analytically untenable view, increasing electricity tariffs becomes a problem causing inflation rather than a solution providing revenue to reduce inflation.

3. Annual Policy Packages

Experience suggests that AID should continue to push for an annual increase in real terms of electricity tariffs and to set minimum conditions of rate levels and structure for continued support. AID should also push for a more equitable tariff structure and for keeping lifeline rates to the poor. AID should also continue to push the cost of service study and for the introduction of peak load pricing so that the EEA would have a better analytical base for the structure and adjustment of electricity tariffs. The question of sunset status for firms unable to adjust to higher rates should also be addressed. Even though AID has provided substantial resources to expand electricity supply, it should not be assumed, therefore, that AID bears responsibility for maintaining an adequate supply of electricity under all circumstances.

4. The Day of Reckoning and Beyond

The recent announcement by the Minister of Petroleum and Mineral Wealth that Egypt's petroleum reserves would last only ten years gives official recognition to the possibility that Egypt may have to import petroleum in a not-too-distant future. Consumer subsidies for electricity and petroleum products will then become explicit. It would be better public policy to confront consumers with the true costs of these products earlier rather than later because they have more financial resources to make investments to reduce energy intensity now than they will have in the future. In that more dismal future they will have to pay higher prices for energy without any recapture of revenues by the government. The evidence presented here does not favor the use of commands to reduce energy consumption as a substitute for higher prices of energy products. Moreover, nearly all of the investments that would help conserve energy--the refitting of plants that waste energy, the cogeneration of electricity, the reduction of line/distribution loss, the installation of solar water heaters, and the reduction of peak load demand--would be enhanced by higher prices. Indeed specific action programs in these areas using public resources or tax incentives are unlikely to workable unless energy prices are increased.

FOOTNOTES

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25. Jerome LaPittus, op. cit.

26. Charles Richter, op. cit.

27. USAID/Egypt, memorandum entitled, "Energy Pricing Proposal," (February 24, 1988).

28. USAID/Egypt, memorandum entitled, "Technical Version, Power Pricing Management Program" (undated, but apparently in early 1988); also memorandum entitled "Chronology and current status of the proposal for a limited pass-through of energy price increases" (undated, but covers date from October 21, 1987 to April 7, 1988).

29. "Residential Electricity, op. cit.

ANNEX TABLE A: AN ESTIMATE OF THE ECONOMIC COST OF ELECTRIC POWER
(Estimates are in US cents per KWH)

| | EEA Customers | Distribution Co. Customers |
|---|---|---|
| Fuel cost (based on fuel oil)<br>--based upon the 1987/88 operation of Abu Kir and Abu Soltan plants in which 1.0 Kg. of fuel oil produced 4.2 KWH | 2.87 | 2.87 |
| Station use and Line Loss<br>--amounted to 11.7 % for EEA sales and 19.3 % for EEA and DCs. | 0.34 | 0.55 |
| Interest cost and depreciation<br>--based upon projected $ 800 million Kureimat plant with output 1,200 MW & 10 % interest charge & 20 year plant life | 1.08 | 1.08 |
| Operating Expenses of EEA<br>--base upon 1987/88 data on EEA operating costs--excludes fuels, lubricants, and depreciation | 0.20 | 0.20 |
| Operating Expenses of Distribution Co .<br>--based upon 1987/88 data on DCs operating costs--includes wages, services, and transfer expenditures | | 0.60 |
| Assumed Cost EEA Transmission Line Investment<br>--no basis for assumption | 0.40 | 0.40 |
| System Expansion Charge<br>--An 8 % growth in peak load requires a Kureimat size plant every 2.5 years & the up-front financial cost is $ 320 million. Retained earnings here are assumed to cover 40 % of cost of investment. | 0.40 | 0.40 |
| TOTAL | 5.29 | 6.10 |

## ANNEX A: NOTES ON ESTIMATION OF THE AVERAGE COST OF ELECTRICITY

1. Fuel cost (based on fuel oil). The Abu Kir and Abu Soltan plants were built in the 1980s. Data for each plant in 1987/88 are as follows: (a) Abu Kir (thermal) 3,383.6 Million KWH using 796.6 MT of fuel oil and (b) Abu Soltan 3,266.2 Million KWH using 832.5 MT of fuel oil. Thus, Abu Kir produced 4.24 KWH per KG of fuel oil and Abu Soltan used 4.16 KWH per KG of fuel oil. With an international price of fuel oil at $ 18 per barrel would signify $ 120.6 per MT. The corresponding cost per KWH is $ .02844 at Abu Kir and $ .02899 at Abu Soltan, and the average is US 2.87 Cents..

2. Station use and line loss. EEA produced 37,844.6 MKWH in 1987/88 and sold 33,420.4 MKWH; thus EEA station use and line loss was 11.7 % of total production. The distribution companies purchased 25,366.4 MKWH and sold 22,452.4 MKWH. For distribution company sales the relevant sale number is the combined sales of EEA to distribution companies (22,452.4 MKWH) and to other customers (8,103.1 MKWH); this was 30,555.5 MKWH, and the line loss and station use amounted to 19.3 % of total production. Charges for these losses are taken on the 2.87 cent per KWH fuel cost.

3. Interest cost and depreciation. The capital cost of the projected gas-fired version of the Kureimat power station approximates $ 800 million. The rated capacity of this station is 1,200 megawatts, i.e., 1,200,000 KWH. The system load factor is 70 % at present, calculated as average production versus peak load. At 70 percent of rated capacity this station will generate 20,160,000 KWH per day or 7,257.6 million KWH per year. Over the life of the plant invested capital would amount to $ 400 million as the average capital stock and a 10 % interest charge would amount to $ 40 million annually. This number divided by annual production of 7,358.4 million KWH would amount to US 0.54 Cents per KWH. Assuming a 20 year plant life would also cause a $ 40 million annual depreciation charge; again equal to US 0.54 Cents per KWH. It can be argued that the depreciation charge should be used to maintain a plant of this size or to expand the system; in our view if outside capital is hired, then a depreciation charge or sinking fund is appropriate. However, system expansion is a different matter and it is argued below that a portion of such expansion should be financed by EEA.

4. Operating Expenses of EEA. Exclusive of fuels, lubricants, and depreciation, EEA expenses amounted to LE. 163.55 million in 1987/88. Against sales of 33,420.4 million KWH this amounts to 0.48 piasters or about US 0.20 Cents per KWH based upon a 1987/88 exchange rate of LE. 2.38 = US $ 1.00.

5. Operating Expenses of Distribution Co . The costs of the Distribution Companies in 1987/88 were as follows:

| | in L. E. | in US $ |
|---|---|---|
| Wages | 143.918 | 60.47 |
| Services | 29.851 | 12.54 |
| Transfer Expenses | 161.538 | 67.87 |
| --Total | 335.306 | 140.88 |

The $ 140.88 million divided by 22,452 million KWH yields US 0.6 Cents per KWH.

6. Assumed Cost EEA Transmission Line Investment. This charge amounts to $ 132 million per year by EEA for all investment in installations other than electric power stations.

7. System Expansion Charge. It is generally impossible to place the cost of expansion of electrical distribution systems solely on new users. System expansion requires a charge upon existing users. An 8 % growth in peak load requires a Kureimat size plant every 2.5 years; and the equivalent up-front financial cost is $ 320 million. This approximates 1.0 US cents per KWH; the assumed charge here is 40 % of that. A full charge would be appropriate if EEA did not use external funds.

# CAPACITY NEED ANALYSIS

## A. Load and Energy Forecast:

The peak load and energy forecasts in the 1200 MW Thermal Power Plant Feasibility study were based on EEA's then current forecasts which incorporated econometric and end-use modelling. The EEA "low case" forecast projected load growth in three different stages: (1) a period of growth at 7% through 1990; (2) load growth of 5.4% through 1996; and (3) the period beginning in 1997 and extending beyond 2000 during which annual load growth averaged 3.7%. The most recent EEA forecast presents a more optimistic projection of load growth averaging 6.5% through 1996 followed by a period of growth averaging 6.2% through the year 2000.

A more recent load forecast has been prepared by the IBRD. This forecast incorporates pricing and GDP growth assumptions and pricing elasticities that effect demand. The pricing assumptions were based on the GOE's program to increase electricity prices to their economic price by FY 98. IBRD forecast of electricity demand growth is characterized by three different stages of growth: (1) a very low growth stage (2.5 percent annual growth) through FY 91 during which electricity prices increase rapidly and economic growth stagnates; (2) a second stage from FY 92 through FY 97 during which the Egyptian economy is forecast to rebound even with real price increases being sustained and the growth in electricity demand averages 5.7 percent annually, and (3) a third stage after FY 97 when electricity prices are at their economic value and the growth in electricity demand averages 10 percent annually.

The IBRD forecast beyond FY 97 may be optimistic considering the long term impact of sustained price increases, but the extent of this lag cannot be forecast since there is no previous experience in any country with the long term impact of sustained prices increase far exceeding the rate of inflation. The implementation of energy conservation programs, beyond the induced conservation induced by the electricity pricing, and improvements to the electric power system which would reduce system losses could further reduce the peak load. These three load forecasts are compared in Table F-1.

TABLE F-1

COMPARISON OF ENERGY FORECASTS
PEAK DEMAND - MW

| | 1990 EEA | 1989 Feasibility Study Low Case | IBRD |
|---|---|---|---|
| 1990 | 7,386 | 7,892 | 6,944 |
| 1991 | 7,858 | 8,429 | 6,993 |
| 1992 | 8,365 | 8,885 | 7,371 |
| 1993 | 8,924 | 9,370 | 7,778 |
| 1994 | 9,516 | 9,873 | 7,915 |
| 1995 | 10,152 | 10,397 | 8,385 |
| 1996 | 10,809 | 10,939 | 8,891 |
| 1997 | 11,480 | 11,354 | 9,435 |
| 1998 | 12,176 | 11,781 | 10,406 |
| 1999 | 12,940 | 12,220 | 11,494 |
| 2000 | 13,735 | 12,671 | 12,714 |

Similar forecasts of annual energy requirements, assuming no reduction in system energy losses, and no appreciable change in the load factor, are summarized in Table F-2. The IBRD forecast incorporates the pricing and GDP growth assumptions evolving from the GOE's program to increase electricity prices to their economic price by FY 98.

TABLE F-2

COMPARISON OF PEAK LOAD FORECASTS
ENERGY-GROSS GENERATION $10^6$ MWhr

| | 1990 EEA | 1989 Feasibility Study Low Case | IBRD |
|---|---|---|---|
| 1990 | 43.4 | 46.1 | 41.9 |
| 1991 | 46.9 | 48.6 | 42.2 |
| 1992 | 50.6 | 50.9 | 44.6 |
| 1993 | 54.7 | 53.4 | 47.1 |
| 1994 | 59.1 | 55.9 | 48.0 |
| 1995 | 63.8 | 58.6 | 50.9 |
| 1996 | 68.9 | 61.3 | 54.1 |
| 1997 | 74.4 | 63.4 | 57.5 |
| 1998 | 80.3 | 65.6 | 63.5 |
| 1999 | 86.8 | 67.8 | 70.2 |
| 2000 | 93.7 | 70.1 | 77.8 |

The following assessment of the need for future generating capacity will be based on the IBRD load forecast.

B. Generating Capacity:

The generating capacity installed on the Egyptian Unified Power System totals 10,694 MW. This generating capacity consist of 2,713 MW in hydro generation, 5,298 MW in steam capacity and 2,683 MW in gas turbine capacity. The actual capacity available to meet the system load is substantial less due to deratings caused by hydraulic head limitations on Aswan I, ambient air conditions which limit the gas turbine output and the aging of many gas turbine and steam plants. EEA's installed and available capacity is summarized in Table F-3.

EEA can dependably generate 8000 MW to meet system load requirements, and has 2100 MW of capacity under construction, to be completed by mid 1995. With the existing capacity and completion of capacity under construction, on a timely schedule, EEA should be able to dependably meet system demands through 1995. EEA is contemplating the construction additional generating capacity at Talkha (220 MW), Assuit (300 MW), Sidi Krir (600 MW), Ayun Mousa (1200 MW) and Zafrana (1200 MW). Of this contemplated generating capaciity, only the Assuit unit could be operational by 1995 if financing were secured this year.

C. Interconnections:

The Egyptian electric power system is not interconnected with other power systems in neighboring countries. The Governments of Egypt and Jordon have completed a feasibility study to connect their electric power systems and financing for additional consultant services, equipment and construction services is being financed by the Arab Fund. This initial tie at 500 kV is expected to lead to the eventual interconnection of other Arab countries including Syria, Iraq, Saudi Arabia and Kuwait and eventual ties with the European network through Turkey.

The country's long term plans include the possibility of importing low cost hydroelectric power from elsewhere in Africa and recently the principal focus has been on resources in Zaire. Zaire has an undeveloped hydro potential well in excess of 30 Gigawatts (30,000 MW) with the potential annual production of more than 240 billion kWhr which could be produced without a large dam. This power output is more than twice Egypt's estimated peak demand in the year 2000. Preliminary talks have been held between the officals of the two countries and an interconnection study of the two networks is planned which could include other counties that the transmission lines would cross.

Egypt is also exploring with Libya the interconnection of their systems and the eventual interconnection of the networks of other countries along the north coast of Africa with the European network through Spain and Italy.

D. Reserve Capacity:

In addition to the generating capacity required to meet customer demands, EEA must have available sufficient reserve capacity to cover generating capacity either out of service for maintenance or forced out of service due to equipment breakdowns. The Egyptian power system is not presently connected to other electric power systems. Therefore, EEA must maintain the necessary reserve capacity to meet both scheduled mainteance and unscheduled breakdowns. The amount of available reserve capacity directly contributes to the reliability of the power system and the ability to meet customer demands. For the Egyptian power system, an available reserve equivalent to 20 percent of the peak demand is considered reasonable.

A summary of the present status and proposed electrical interconnection(s) between Egypt, Arab and African countries is included in Attachment 1 to this Annex F.

E. Need for Capacity:

Table F-4 summarizes the capacity schedule and capacity deficiency (or surplus) through 2000. Even if all of the contemplated generating capacity were to be constructed and placed in operation by 2000. EEA would still have a capacity deficit of 1500 MW in 2000.

The generating capacity to be financed by the project will enter service in mid 1996 and early 1997 and will provide sufficient capacity to permit EEA to operate their system reliably and meet customer demands.

Even if the peak load grows at a lower rate and/or conservation and loss reduction programs result in a lower than forecasted load, the generating capacity to be financed by this project will be effectively utilized to displace much higher operating cost capacity or allow EEA to retire a portion of the 600 MW of generating capacity that will have been in service for more than 30 years. This capacity consists of 23 steam turbine generators units with associated oil fired boilers ranging in size from 12.5 MW to 60 MW and is the highest operating cost capacity on the EEA system.

F. Conclusions:

Egypt's energy requirements are expected to respond to the increases in electricity prices by a period of stagnent peak load and energy growth, followed by several years of modest growth as the economy first adjusts to pricing realities and then rebounds as the economy enters a period of rapid growth. Egypt's available generating capacity, when coupled to capacity under construction, will be adequate through 1995. The generating capacity to be financed by this project will enter service at appropriate times to assure the continued reliable operation of the electric power system and to meet customer demands. Additional generating capacity being contemplated by EEA, if contracted for on a timely schedule, could be constructed and ready for operation to meet the additional load requirements occuring after 1997. Any combination of lower growth rates, customer conservation or system energy loss reduction would allow EEA to curtail the operation of their highest operating cost generating capacity and subsequently retire many of their smaller, oil fired units that will have reached the end of their economically useful life.

TABLE F-3
EGYPTIAN ELECTRICITY AUTHORITY
EXISTING GENERATING STATIONS
(March 31, 1990)

| Plant | Units | Capacity (MW) | | | | Fuel** |
|---|---|---|---|---|---|---|
| | Type | No. | MW | Design | Available | Burned |
| **Upper Egypt Zone** | | | | | | |
| High Dam | Hydro | 12 | 175 | 2100 | 1750 | - |
| Aswan Dam I | Hydro | 7 | 46 | | | - |
| | Hydro | 2 | 11.5 | 345 | 170 | - |
| Aswan Dam II | Hydro | 4 | 67 | 268 | 180 | - |
| Assiut | Steam | 3 | 30 | 90 | 85 | M |
| | | 28 | | 2803 | 2185 | |
| **Cairo Zone** | | | | | | |
| Cairo North | Steam | 2 | 10) | | | M |
| | Steam | 1 | 20) | | | M |
| | Steam | 2 | 30) | 100 | 70 | M |
| Cairo South | Steam | 4 | 60 | 240 | 189 | M |
| | Gas Turbine | 3 | 115 | 345 | 227 | |
| Cairo East | Gas Turbine | 2 | 23 | 46 | 19 | NG/S |
| Cairo West | Steam | 4 | 87.5 | 350 | 237 | M |
| El Tebbin | Steam | 3 | 15 | 45 | 32 | M |
| El Tebbin | Gas Turbine | 2 | 23 | 46 | 25 | NG/S |
| Helwan | Gas Turbine | 5 | 24 | 120 | 76 | NG/S |
| Heliopolis | Gas Turbine | 3 | 12.5 | 37 | 10 | NG/S |
| Shoubrah El Kheima | Steam | 4 | 315 | 1260 | 1260 | NG/M |
| Wadi Hof | Gas Turbine | 3 | 33 | 99 | 70 | S |
| | | ---- | | ----- | ------ | ---- |
| | | 38 | | 2688 | 2215 | |
| **Delta Zone** | | | | | | |
| Talkha | Steam | 3 | 12.5) | | | M |
| | Steam | 3 | 30) | 128 | 53 | M |
| Talkha | Cobined-Cycle | 10 | 150 | 300 | 261 | NG/S |
| Damanhour | Steam | 2 | 15) | | | M |
| | Steam | 3 | 65) | 225 | 123 | M/NG |
| Damanhour | Gas Turbine | 4 | 25 | 100 | 78 | NG/S |
| Kafr El Dawar | Steam | 4 | 110 | 440 | 212 | M |
| Mahmoudia | Gas Turbine | 4 | 50) | | | NG/S |
| | Gas Turbine | 8 | 24) | 400 | 198 | NG/S |
| Damietta | Gas Turbine | 6 | 135 | 810 | 375 | |
| | | ---- | | ----- | ----- | |
| | | 47 | | 2403 | 1300. | |

**USAID,DR/UAD:JPH:5/18/90**

| Plant | Units Type | No. | MW | Capacity (MW) Design | Available | Fuel** Burned |
|---|---|---|---|---|---|---|
| Alexandria Zone | | | | | | |
| Abu Qir | Steam | 4 | 150 | 600 | 569 | NG/M |
| | Gas Turbine | 1 | 15 | 15 | 0 | NG/S |
| El Max | Gas Turbine | 2 | 14 | 28 | 0 | NP |
| Siouf | Steam | 2 | 26 | | | M |
| | Steam | 2 | 30) | 112 | 0 | M |
| Siouf | Gas Turbine | 1 | 26) | | | NG/S |
| | Gas Turbine | 6 | 33) | 224 | 107 | NG/S |
| Karmouz | Gas Turbine | 2 | 12.5 | 25 | 11 | NP |
| | | --- | | ----- | ----- | |
| | | 20 | | 1004 | 762 | |
| Canal Zone | | | | | | |
| Abu Sultan | Steam | 4 | 150 | 600 | 587 | NG/M |
| Ataqa | Steam | 2 | 150 | | | |
| | Steam | 1 | 300 | 900 | 840 | NG/M |
| Ismailia | Gas Turbine | 1 | 20 | 20 | 21 | NG/S |
| Port Said | Gas Turbine | 3 | 20 | 60 | 18 | NG/S |
| Shabab | Gas Turbine | 3 | 33 | 99 | 75 | NG/S |
| Suez | Steam | 4 | 25 | 100 | 44 | M/C |
| Suez | Gas Turbine | 1 | 17 | 17 | 0 | S |
| | | --- | | ----- | ----- | |
| | | 20 | | 1796 | 1585 | |
| | Total | 153 | | 10694 | 8047 | |

**Fuel Burned
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NG - Natural GAs
M - Mazout
S - Solar
NP - Naptha
C - Coal

EEA Annual Reports of Electric Statistics
EEA Monthly Operating Reports

USAID, DR/UAD:JPH:5/18/90

TABLE F-4
Egyptian Power System
Capacity, Load and Capacity Deficiency Forecast

| | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Installed Capacity - MW** | | | | | | | | | | | |
| Combusion Turbines | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 | 2,683 |
| Steam Turbines | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 | 5,298 |
| Hydro Turbines | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 | 2,713 |
| Subtotal - MW | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 | 10,694 |
| **Under Construction - MW** | | | | | | | | | | | |
| Dammanhour 1 X 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Assuit 1 X 300 | | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Abu Qir 1 X 300 | | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Damietta 3 X 120 | | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Talkha 1 X 220 | | | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| Cairo West | | | | | 300 | 600 | 600 | 600 | 600 | 600 | 600 |
| Cairo South 1 X 115 + 1 X 55 | | | 115 | 170 | 170 | 170 | 170 | 170 | 170 | 170 | 170 |
| Dammanhour 1 X 55 | | | | | | 55 | 55 | 55 | 55 | 55 | 55 |
| Mahmoudia 2 X 55 | | | | | | | | | | | |
| Subtotal - MW | 300 | 1,260 | 1,595 | 1,650 | 1,950 | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 | 2,305 |
| **TOTAL INSTALL CAPACITY - MW** | 10,994 | 11,954 | 12,289 | 12,344 | 12,644 | 12,999 | 12,999 | 12,999 | 12,999 | 12,999 | 12,999 |
| **Capacity Derating - MW** | | | | | | | | | | | |
| Combustion Turbines | 1,194 | 1,194 | 1,194 | 1,194 | 1,204 | 1,434 | 1,434 | 1,434 | 1,434 | 1,434 | 1,434 |
| Steam Turbines | 840 | 780 | 780 | 780 | 780 | 880 | 880 | 880 | 880 | 880 | 880 |
| Hydro Turbines - High Dam | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 |
| Aswan Dam | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 | 263 |
| Subtotal - MW | 2,647 | 2,587 | 2,587 | 2,587 | 2,597 | 2,927 | 2,927 | 2,927 | 2,927 | 2,927 | 2,927 |
| **CAPACITY AVAILABLE TO MEET LOAD MW** | 8,347 | 9,367 | 9,702 | 9,757 | 10,047 | 10,072 | 10,072 | 10,072 | 10,072 | 10,072 | 10,072 |
| Peak Load - MW | 6,944 | 6,993 | 7,371 | 7,778 | 7,915 | 8,385 | 8,891 | 9,435 | 10,406 | 11,494 | 12,714 |
| Reserve (20%) | 1,389 | 1,399 | 1,474 | 1,556 | 1,583 | 1,677 | 1,778 | 1,887 | 2,081 | 2,299 | 2,543 |
| Total Required Capacity MW | 8,333 | 8,392 | 8,845 | 9,334 | 9,498 | 10,062 | 10,669 | 11,322 | 12,487 | 13,793 | 15,257 |
| Capacity Deficit MW | (14) | (975) | (857) | (423) | (549) | (10) | 597 | 1,250 | 2,415 | 3,721 | 5,185 |

# Present Status of Proposed Electrical Interconnection Between Egypt, Arab and African Countries

Electrical energy plays an important role in the development of countries, for this reason most of the developed countries pay great attention to supply electrical power to their consumers with a high degree of reliability and for the lowest cost .

The philosophy of electrical interconnection between different countries and the advantages (which will be mentioned in detail here after) are properly fulfilling this target , and many countries have already beneficiated from this philosophy. We can mention in this respect Scandinavian countries, Western and Eastrn European countries.

## ADVANTAGES OF ELECTRICIAL INTERCONNECTIONS

Electrical interconnections between countries have many advantages and benefits which can be classified into economic and technical as follows :-

- Economic advantages of interconnection :

  1. Saving in the investment costs due to :

     a. reduction of the reserve margin as a result of interconnection.

b) Using larger generating units and thus benefitiating from the economy of size and economy of usis hydro power resource.

c) Joint ownership of large plants or regional power plants.

2. Savings in the operation costs :

a) Using the differences in production costs of each system.

b) Taking advantage of daily, weekly and seasonal load diversity .

c) Reduction in the spinning reserve.

d) Improvement in the overall availability and reliability of the interconnected system.

-. Technical advantages of the interconnection :-

a) Higher availability and reliability of the power systems.

b) Better frequency and voltage regulation.

c) Ability to schedule and carry-out preventive maintenance programs and thus improve the availability.

d) Provide emergency assistance in case of large system faults.

e) Taking advantage of fuel diversification in the different interconnected countries.

As Egypt has a significant geographical location since it lies in the center way of three continents ( Asia Africa, Europe), its central position interconnects African Arab countries to Asian Arab countries and can effectively contribute in interconnecting their electrical systems.

Due to the advantages of electrical interconnection; Egypt has considered in view realising a broader pan Arab electrical interconnection, and in the long run the interconnection of the huge hydro resources of Africa in Zaire to the common European Electrical network .

In the frame of Arab electrical interconnection, the first effective step started by studying the possibility of electrical interconnection between Egypt and Jordan.

The techno economical feasibility study which have been carried out by E.D.F. (Electricity de France)jointly with Egyptian and Jordanian experts prooved the feasibility of such project.

Among different schemes of interconnection deeply studied from technical&economical point of views the study recommended the following scheme of interconnection.

1. 21 Km of 500 KV A.C single circuit overhead line with 3X500 $mm^2$ conductors from New Suez substation to west of Suez Canal near the entrance of Ahmed Hamdi Tunnel under the Canal.

2. 2 Km of 500 KV A.C single circuit undergroud cable consisting of single cores each of 1000 $mm^2$ copper conductors, to be installed from the terminal tower of the 500 KV overhead line west of Suez Canal near the entrance of Ahmed Hamdi Tunnel and through Ahmed Hamdi Tunnel in the allocated location for this cable up to the terminal tower of the 500 KV O.H.T.L. East of Suez Canal.

140

3. 20 Km, 500 KV A.C single circuit O.H.T.Ls from East of Suez Canal to the site of Oyoun Mousa thermal power plant in Sinai.

4. 250 Km of 500 KV A.C single circuit O.H.T.Ls with 3X500 $mm^2$ conductors from Oyoun Mousa Site through Sinai up to Aqaba Gulf south of Taba.

5. 500/400/220 KV substation south of Taba including four cells 500 KV, three cells 400 KV, five cells 220 KV, one transformer 500/400 KV, 500 MVA , two transformers 500/220/20 KV 150 MVA each and two reactors one 500 KV, 100 MVAR and the other 400 KV, 100 MVAR.

6. 12 Km of 400 KV A.C single circuit consisting of 4 single cores each 1000 $mm^2$ copper conductor (one core as spare) submarine cable for crossing Aqaba Gulf, starting from south of Taba substation west of Aqaba Gulf up to the 400 KV overhead line terminal tower East of Aqaba Gulf.

7. 10 Km of 400 KV A.C double circuit overhead line with 2X500 $mm^2$ conductors from Aqaba Gulf cable crossing up to Aqaba thermal power station.

8. Two reactors, one 500 KV, 140 MVAR at Oyoun Mousa or Suez substation and the other 400 KV, 100 MVAR at Aqaba T.P.S.

Effective steps have been taken in order to start the execution of the project, the Arab fund have approved the financement and allocated a loan of 176,72 MUS $ for this purpose, the foreign compoment of which is amounted to 150,16 MUS $ and the local compoment to the equivalent of 26,56 MUS $ in local currency.

A highly experienced international consultant in execution of such projects and especially the deep submarine cable is appointed for the supervision of the project, the contract award is expected by mid February 1990.

The following step was to extend the electrical interconnection to involve more Arab countries and studying the possibility of such interconnections .

Some Arab countries have started to study interconnection of their electrical systems which in turn will lead to a common Arab electrical network.

Actually the following studies are carried out :

1. Study of interconnection of the five countries(Jordan Iraq, Syria, Egypt, Turkey)

   In this respect, a joint technical commitee have been organised from the representatives of the five countries to follow up the progress of the interconnection study.

   The commitee have prepared the terms of reference of the study. A consultant is already appointed to under take the study jointly with experts of the five countries .

   This study is financed by the Islamic bank & the Arab fund through a grant of 610 000 US $.

2. Study of interconnection of Mashrek Arab countries

Other studies for electrical interconnection between Arab gulf countries and Arab countries lying East to the Red Sea are also prepared, and includes each of the following countries: Iraq, Syria, Lebanon, Jordan, Kuwait, Saudi Arabia, Bahrain, Arab Emirates, Oman, South & North Yemen, Katar and Egypt.

Supervison of the study will be the responsibility of a technical committee from the experts of member countries involved in the study. This study will be financed through a grant offered by the Islamic Bank in Jeddah, and the Arab Fund, in Kuwait .

The study will consider the interconnection of neighbouring countries as one group. The final study will consider the interconnection of these groups :

- 1st group : includes Jordan, Syria, Lebenon and Iraq.
- 2nd group : Saudi Arabia
- 3rd group : Association Board of El-Gulf countries Kuwait, Bahrein, East of Saudi Arabia, Katar, Arab Emirates & Oman.
- 4th group : The republics of North Yemen and South Yemen.
- 5th group : Arab Republic of Egypt

3. The interconnection studies between Maghreb (North African) Arab countries and Egypt

To complete the interconnection studies between the Arab countries. Several studies are now being carried to interconnect electrical systems of the Maghreb (North African) Arab states.

Electrical interconnection study between Morocco, Algeria and Tunisia.

Interconnection of the electrical systems of these countries is under study now noting that an electrical interconnection already exists between Algeria Morocco and between Algeria Tunisia-In the mean time Morocco is studying an electrical interconnection between Morocco system and common European network through Tanga Gulf in perspective of interconnecting pan Arab network to common European network.

Study of electrical interconnection between Tunisia and Lybia.

This study financed from the Arab fund is finalysed at present the recommendation of this study will be taken into consideration in the future interconnection between Egypt & Lybia.

Study of electrical interconnection between Egypt & Lybia

It has been agreed upon in December 1989 between the representatives of the energy sector of the two countries to start the techno economical studies for the interconnection.

4. Study of electrical interconnection between Egypt, Zaire, Sudan and central Affica.

In order to achieve the interconnection between Arab and European countries we have to benefitiate from the huge hydro resources of Africa in Zaire which will be the main factor to achieve such target, in this frame a protocol have been signed between Egypt & Zaire in the energy sector, follwed by a sisit from Electricity Authority of Zaire (SNEL) to discuss the possibility of cooperation between the two countries (Egypt and Zaire) in the field of electrical energy.

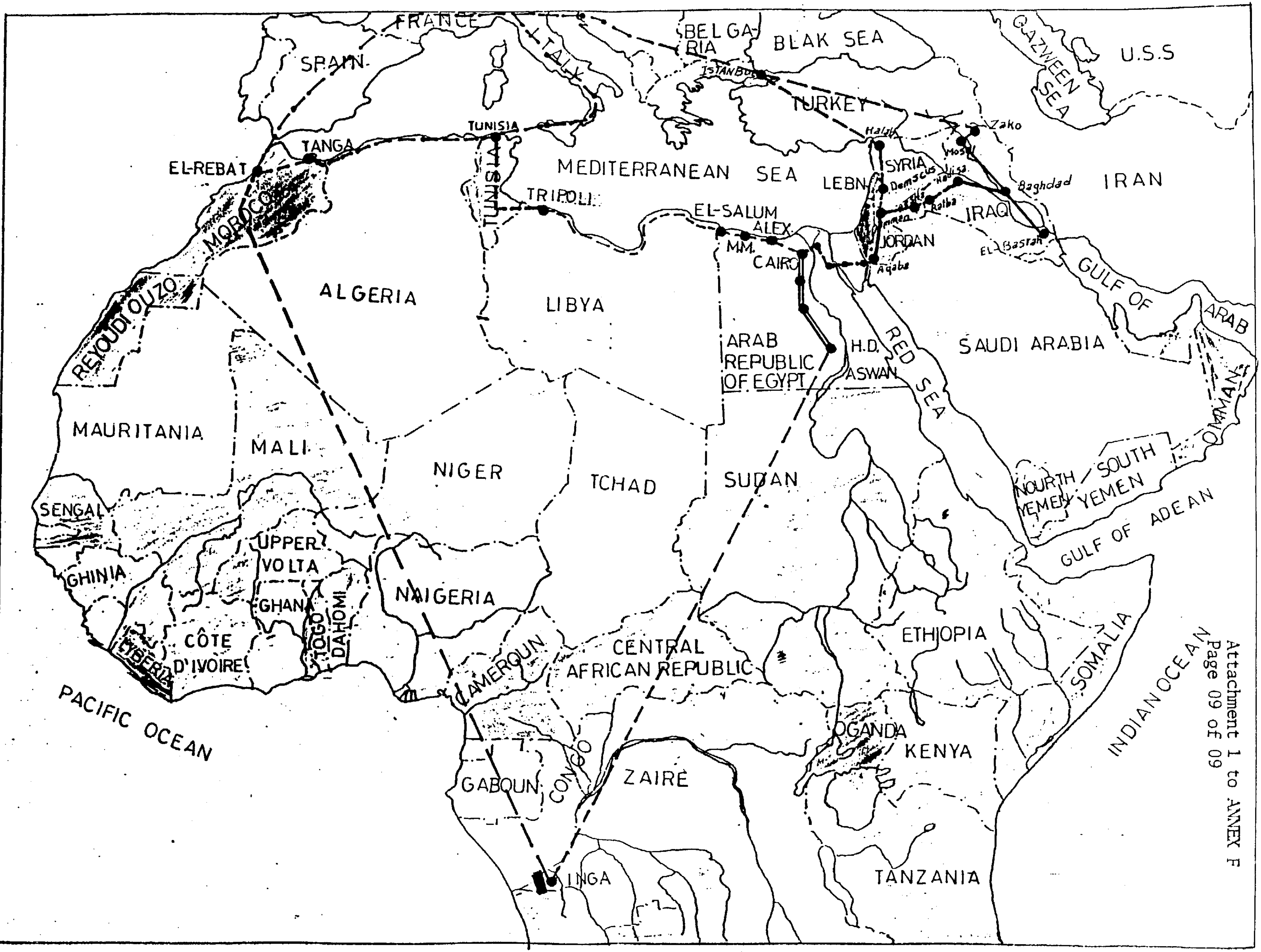
144

The Republic of Zaire has huge hydro power resources of about 774 000 GWH yearly. A considerable amount of these resources is located at Inga Site, Southern of the river Zaire. The installed capacity of Inga (I and II) hydro-power plant is about 2400 MW a big portion of which is not yet consumed. This capacity, after development of existing sites can be raised to reach 40000 M.W. and can be exported to other African countries through electrical interconnections; for this purpose several meetings have been held between the representatives of Zaire (SNEL) & Egypt (EEA) to explore the feasibility of power interconnection between the two countries, the African development Bank has preliminary approved financing of the study and the terms of reference have been already prepared.

The proposed right of way for this interconnection is starting from Zaire towards East to central Africa, Sudan, and Egypt. Through the ministry of exterior Egypt has contacted the involved countries in this project which have aprooved their total cooperation starting from the feasibility study up to the execution stage.

A high technical committee will be formed from the concerned utilities and will be responsible for managing and directing the study ..

The attached map shows the three envisaged axis for electrical interconnection with the common europen network benefitiating from the advantages of electrical interconnections and the huge hydro resources in African.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ALGERIA
LIBYA
SAUDI ARABIA
ARAB REPUBLIC OF EGYPT
H.D. ASWAN
RED SEA
OMMAN
MAURITANIA
MALI
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TCHAD
SUDAN
NOURTH YEMEN
SOUTH YEMEN
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TOGO
DAHOMI
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LYBERIA
CAMEROUN
CENTRAL AFRICAN REPUBLIC
ETHIOPIA
SOMALIA
INDIAN OCEAN
PACIFIC OCEAN
CONGO
ZAIRE
GABOUN
OGANDA
KENYA
INGA
TANZANIA

# TECHNICAL ANALYSIS

## A. GENERAL:

The technical justification for the proposed El-Kureimat project component is based on the availability of a site of sufficient area adjacent to highways and the Nile River since large heavy equipment deliveries are involved, substantial quantities of water are required for condenser cooling and consideration of all technical aspects associated with the design, construction and operation of the facilities including the availability and transportation of natural gas and oil to fuel the plant and the necessary transmission line to deliver the electrical energy to the Unified Power System.

The technical justification for the proposed National Energy Control Center project component is based on the need to increase the data processing capability of the Center, using existing computer technology, so that operatng decisions can be made based on timely data that has been collected and analyzed. A consultant will assist the EEA in the preparation of hardware and software specifications and oversee all technical aspects associated with the design, manufacture, computer replacement and operation of the Center including software applications necessary to supervise and control the Unified Power System.

## B. EL-KUREIMAT:

### Site:

The El-Kureimat site is located in the Beni Suef Governorate on the east bank of the Nile River 95 Km (59 miles) south of Cairo and 3 Km (2 miles) south of the village of El-Kureimat and just downstream of Kureimat Island.

The area is part of the limestones North Galala Plateau, a desert environment ranging in elevation from 330 meters to 1,275 meters above sea level. Wadis drain into the Nile River from the west slope of the plateau. The river bank in this reach of the Nile (El Wasta to Beni Suef) is generally steep, consisting of small sand hills. Croplands are limited to small flood plain areas on the east bank. Desert lands above the east bank are not irrigated. The 860,000 square meters site of the proposed thermal power station is located immediately above the river flood plan. Small oases occur about 1 Km south of the site. The site consists of two district topographical and geological zones: a rocky limestone plateau set back from the Nile and a lowlands adjacent to the river.

The lowlands encompass land formerly subjected to flooding prior to the construction of the High Dam at Aswan. In the proposed plant area, the lowlands consist of approximately 12 to 16 meters of fine alluvial sand of medium density. Underlying the sand is a thin layer of limestone and a thick zone of calcareous marl, which extends across the entire site. The marl is of medium hardness and strength. Within the marl are bands of claystone, or mudstone, which are rocklike in nature but exhibit the properties of a swelling clay upon saturation with water. With depth, the frequency of these stones decreases until the entire moral zone is homogeneous. The total thickness of these bands does not exceed 3 meters.

If the plant were to be built on the plateau, shallow foundations at grade would be satisfactory. The dense sands and gravels at the ground surface provide adequate bearing for the heavy structure loads and provide a suitable zone to relieve swelling pressure in the deep mudstone lenses in the unlikely event that they were to become saturated. Some grouting of voids in the limestone may be required if subsequent investigations reveals cavities in the limestone hard marl. Deep foundations to bedrock would be required if the plant were to be built on the lowlands. The piles or caissons would extend through approximately 2 to 3 meters of fills; so that their length would vary between 15 to 20 meters.

The desert plateau is located to the east of the lowlands, approximately 20 meters above the normal river elevation. Several small east-west drainage wadis cross the site. The upper zones of the plateau consist of residual soils, formed by the weathering of the limestone rock found near to surface. These soils are very dense, and consist of calcium based sands and gravels to pebbly weathered limestone. In the wadis, the weathered soils have been eroded, sot hat the underlying limestone is near the surface. The limestone zone is continuous across the site, and varies in thickness between 10 to 25 meters. A thin weathered zone has been encountered in the borings at the bottom of the limestone, indicating past subterranean water movements. This zone generally consists of weak limestone and stiff clay.

An estimate of the climatic variables for the El-Kureimat site are based on meteorological data collected at Helwan which is approximately 65 Km. north of the site. The Helwan data furnish wind speed, wind direction temperature and humidity summaries that are considered generally representative of the El-Kureimat site.

The 25-year Helwan data base indicates a prevailing northerly wind at the site (40 percent from the north quadrant) with a secondary maximum of winds from the east quadrant (23 percent) followed by westerly winds (18 percent) and their southerly winds (12 percent) on an annual basis. The northerly winds are exceptionally persistent during the summer months, occurring approximately 63 percent of the time. Calm and variable winds occur approximately 7 percent of the time annually, maximizing during the fall months. Wind speeds are generally light to moderate with an annual-average speed of approximately 4 meters/ second (8.9 miles/hour) and rarely (0.05 percent of the time) exceed 18 meters/second (40 miles/hour).

The temperature data indicates a maximum monthly average temperature at 28°C (82°F) in July and a minimum monthly average temperature of 12°C (54°F) in December. Summertime high temperatures average 36°C (97°F) while winter lows normally reach 8°C (46°F). The annual average temperature is 21°C (54°F) in December. Summertime high temperatures average 36°C (97°F) while winter lows normally reach 8°C (46°F). The annual average temperature is 21°C (70°F) with record high and low temperatures of 47°C (117°F) and 1°C (34°F) respectively.

Rainfall at El-Kureimat is estimated to average 13 mm per year occurring mostly during the winter months. Relative humidity is estimated to remain fairly constant throughout the year maximizing at 59 percent in December and reaching a low of 40 percent of the possible sunshine is received during the year.

Occurrences of severe weather in the area are rare. Sand storms with visibilities less than 1000 meters (.62 miles) occur on average only 4 days per year while occurrences of rising sand (visibilities greater than 1,000 meters -.62 miles) average 25 days per year. Fog occurrences with visibilities less than 1,000 meters are infrequent, occurring on fewer than 22 days, per year. The frequency of thunderstorms is estimated at less than 2 per year. Snow and sleet are extremely rare.

The El-Kureimat site lies in a region of low earth quake incidence with anticipated maximum ground acceleration of 0.08 to 0.10 G's. All structures would be designed to comply with Uniform Building Code seismic risk zone 1.

Access to the site is by highway or river. From Cairo to Tebbin (30 Km) there is a four-lane road 15 meters wide. From Tebbin to the village of El-Kureimat (60 Km) there is a two-lane road 7.5 meters wide with paved shoulders, 2.5 meters wide on each side. From

El-Kureimat village to the El-Kureimat site (5 Km) there is a two-lane road 7.5 meters wide. The site can be reached by barge from Alexandria and Cairo. Barges are limited to a draft not to exceed 1.8 meters.

A 66 KV transmission line crosses the Nile River approximately 3 Km north of the site and an 11 KV distribution circuit passes the site adjacent to the road.

TECHNICAL ANALYSIS:

The thermal power station consist of two identical 600 MW steam turbine-generating units with their unit accessories including condensers, pumps, feedwater heaters and common circulating water, fuel storage and transmission connection to the Unified Power System. The proposed physical arrangement of the two unit stations on the site incorporating the slide-along concept is shown on Exhibit G-1. The station is arranged for an optional third unit.

The various aspects of the station are summarized below:

The two-unit station arrangement includes a completely enclosed control room complex and turbine building, and open boiler. The main power plant and switchyard are located near the river, while the mazout storage tanks are located on the higher plateau to the south and east of the plant.

Station Arrangement:

The two-unit station arrangement incorporates the slide-along concept. The arrangement of Unit 2 will be a duplicate of Unit 1 except for the control room complex, which is common to both units. Unit 3, which is an option, would be a slide-along duplicate of Units 1 and 2 except for the Unit 3 control room.

All equipment locations will be identical and therefore all piping and duct work will be duplicated, including the pipe stress analysis effort. The common control complex causes some able tray routing differences between the two units.

The turbine generator shaft centerline is arranged perpendicular to the boiler-to-sack centerline.

Control Room Complex:

The control room complex will contain the control, electronic equipment, computer, DC equipment, switchgear, and battery rooms. The control room will be on the operating floor level contiguous with the auxiliary bay of the unit. The electronic equipment room will be on the mezzanine level below the control room with the computer room adjacent to the control room. An instrument shop will be located on the mezzanine level. The medium voltage switchgear and battery rooms will be on the ground floor.

Boiler:

a. Arrangement:

Each boiler is arranged with the drum located at the front and the forced draft fans and air heaters at the rear.

b. Boiler:

The drum-type boiler will be designed to generate steam at 180 bar and 538°C at the superheater outlet, and reheat the steam to 538°C. The dual fuel boiler will be a natural circulation, pressurized furnace design and will be arranged to be fired with either natural gas or mazout (residual oil). Natural gas will be used for ignition. Steam soot blowing will be utilized for back pass cleaning. A furnace flue gas recirculation system will be provided with each unit to control the heat absorption pattern of the boiler under varying operating conditions.

c. Mazout Handling Equipment:

The mazout system in the boiler area for each unit will include a day tank with heaters and burner pumps. Steam will be used for atomization.

d. Air Heaters:

i. Regenerative:

Each unit will have two regenerative type air preheaters to preheat the combustion air to each boiler.

ii. Steam:

Steam air heaters will be provided in the discharge of each forced draft fan. The heaters will provide cold-end protection for the regenerative air heaters. The tube bundles will be removable from the steam-air heater casings in the duct work.

151

e. Fans:

i. Gas Recirculation:

Two half-capacity, single speed, motor driven, inlet vane controlled gas recirculation fans will be provided for each boiler and will be located on the ground floor of the boiler area.

ii. Forced Draft:

Two half-capacity, single speed, motor driven, inlet vane controlled forced draft fans will be provided for each boiler and located at ground level to the rear of the boiler. The fans will draw from the boiler air intake chamber.

f. Chimney:

A single-flue chimney will be provided for each unit. The chimney will be 152 meters tall concrete shell with a steel liner. The chimney will be provided with international warning lights and a caged ladder.

Turbine Building:

a. Arrangement:

The shaft of the turbine generator centerline will be parallel to the boiler drum with all accessory equipment located in an enclosed turbine building of concrete block siding.

b. Steam Turbine Generators:

Each unit has a tandem compound, four flow, single reheat turbine generator, designed to operate at 3000 rpm. The unit nominal rating will be based on steam conditions of 175 bar and 538°C at the turbine inlet and 538°C at the reheat inlet. Expected net unit output will be approximately 600 MW.

Generator output will be 3 phase, 50 Hz, 20 KV, 0.85 PF. The generator stator is to be cooled by hydrogen; however, if found economical during final design, it will be cooled by hydrogen and water.

152

c. Condenser:

A two-shell, single pressure zone, single pass, divided waterbox condenser will be provided for each unit. The condenser will be arranged transverse to the turbine generator shaft. Tube withdrawal space and a tube cleaning system will be provided. Condenser tube material will be 90-10 copper nickel and there will be a 5-minute hot well storage capacity.

d. Condensate Pumps:

Three one-half capacity, motor-driven, vertical multistage pumps will be provided for each unit. Condensate pump withdrawal access will be provided through the operating floor, utilizing the turbine room crane.

e. Condenser Vacuum System:

Two full capacity, motor driven, air removal pumps will be provided. They are sized to evacuate the condenser shell and turbine spaces to a pressure of 127 mm Hg in approximately 60 minutes.

f. Feedwater Heaters:

Seven stages of uncontrolled steam extraction for feedwater heating will be provided for each unit, consisting of four horizontal low pressure heaters, a deaerating heater, and two horizontal high-pressure heaters.

One full-size deaerator and deaerator storage tank with five minute storage capacity will be provided for each unit. The deaerator will provide feedwater heating and removal of dissolved gases in the condensate flow.

The low-pressure heater drain arrangement has the fourth point heater drain cascading to the fifth point heater. The fifth point drain is pumped into the condensate system. The sixth and seventh point heater drains are dumped to the condenser. For the high pressure heaters, the drains are cascaded to the next heater and ultimately to the deaerator.

g. Boiler Feed Pumps:

i. Turbine Driven Pumps:

Two half-capacity, turbine-driven, multistage boiler feed pumps will be provided for each unit and will be located on the operating floor. A speed reducer and booster pump will be provided on the front end of the turbine drive.

Each feed pump turbine will be arranged to exhaust to the condenser via a right angle exhaust duct.

ii. Motor-Driven Pumps:

A 60 percent capacity, motor-driven, start-up boiler feed pump will be provided for each unit on the ground floor in the auxiliary bay. The pump will operate at variable speed through a hydraulic coupling to the motor.

h. Miscellaneous Equipment:

Two full-size component cooling water heat exchangers and cooling water pumps will be provided for each unit on the ground floor.

Four one-half capacity service air and four one-half capacity instrument air reciprocating air compressors with receivers will be provided for each unit. The service air compressors will be on the ground floor in the service building and the instrument air compressors and dryers will be located on the ground floor of the turbine building.

i. Turbine Room Crane:

A common turbine area bridge crane will be provided for both units. The crane's 90 ton capacity is based upon the heaviest piece to be lifted during the operating life of the plant.

j. Lubricating Oil Tanks:

A turbine lubricating oil tank will be provided with each turbine and will be supported from the mezzanine level floor framing. Each tank will be provided with two full capacity lube oil coolers. Lube oil will be supplied to the bearings of each turbine from a shaft driven pump, and two AC and one DC motor-driven pumps, with associated controls.

A lube oil purifier for each unit will be below the turbine oil tank on the ground floor. Curbing will be provided around the oil tank area and purifier to contain the oil in case of tank leakage.

Clean and dirty lube oil storage tanks will be provided for each unit and, together with space for drum storage, will be located outside the turbine room wall and from the yard into the storage rooms.

K. Condensate Water Storage Tanks:

The two 160,000 gal condensate storage tanks, one for each unit will be located alongside the turbine buildings of their respective units.

l. Water Treatment:

i. Potable Water:

The potable water treatment system will utilize water from the Nile River. The components include chlorination, clarification, and filtration which provides for service water. This water will then be disinfected by chlorination to obtain potable water.

ii. Makeup Water Treatment:

The makeup water treatment system will consist of pretreatment, including clarification, and demineralization. The 800 gpm system will be common for the station and will be housed in the service building adjacent to Unit 1. The common demineralized water storage tank and common service water clarifier will be located outdoors adjacent to the service building.

iii. Condensate Polishing:

A full flow condensate polishing system will be on the ground floor in the auxiliary bay of each unit adjacent to the boiler. The equipment provided consists of four mixed-bed demineralizers, three of which are capable of handling the full condensate flow while the fourth is being regenerated or is on standby.

m. Wastewater Treatment:

The wastewater treatment system will consist of: (a) lined equalization ponds (waste holding ponds) for receiving all non-sanitary plant wastewater consisting of floor and equipment drainage, makeup demineralizer regeneration wastewater, boiler blowdown, clarifier underflow, boiler washing wastes, and boiler chemical cleaning wastewater, (b) an oil/water separator for removal of floating oil from floor and equipment drainage prior to the equalization pond, (c) chemical feed systems including acid, caustic, and polymer for conditioning the discharge of the equalization pond, (d) a clarifier system for precipitation of the suspended solids and metal hydroxides from the equalization pond discharge, and (e) a sludge dewatering system for concentrating the underflow from the clarifier system. The treater clarifier effluent will be directed to the condenser cooling water discharge line.

n. Emergency Diesel Generator:

There will be one emergency diesel generator, approximately 750 KW capacity, located in a building adjacent to the control building to provide the plant with emergency power. This power is provided for safe shutdown and communications, emergency lighting, circuit breaker controls, battery and chargers and shutdown cooling equipment.

o. Auxiliary Boiler:

The auxiliary boiler will be a packaged unit operated on natural gas. It will be rated at 130,000 lb/hr of steam and located in the service building adjacent to the boiler area.

p. Black Start Capability:
The start up electrical demand is on the order of 12 to 16 MW for one unit. This demand includes the following major components; motor driven boiler feed pump, condensate pumps, mazout pumps, gas recirculation fan, forced draft fans, circulating water pumps, air compressors, condenser air removal pumps, and controls.

Black start capability will be provided from a gas turbine rather than a group of diesel generators. The installed cost of 12 to 16 MW of diesel generator capacity would be at least twice that of gas turbine capacity. Since high fuel utilization efficiency and quick start capability (on the order of 10 to 20 seconds) are not required for black start capacity, the lower cost gas turbine is generally preferred for this service.

q. Start up:

The plant will be designed with a motor driven boiler feed pump which enables start up to proceed without interruption until sufficient extraction steam is generated to power the turbine driven boiler feed pumps. This normal start up is accomplished with offsite power.

## Fuel Handling Areas:

a. General:

Facilities will be provided to meter and reduce the pressure of natural gas, the primary plant fuel. Facilities will also be provided to receive, store, and transfer mazout as the alternate fuel. Natural gas will also be used as the burner ignition and auxiliary equipment fuel.

b. Oil Receiving:

Mazout will be received at the plant via a pipeline. Unloading pumps will draw the oil from the pipe line and send it to the storage tanks.

c. Mazout Handling Equipment:

The mazout handling system will consist of pipeline, unloading transfer pumps, tank storage for 21 days and earthen containment dikes, tank heaters, reboilers, secondary heaters, day tank, burner pumps, strainers, valves, piping, instrumentation and a foam fire protection system.

Three mazout unloading/transfer pumps will be available to transfer mazout from the four on-site mazout storage tanks to each unit's mazout day tank, from the off site supply pipeline to the on-site storage tanks, and from one on-site tank to another.

Filling of a unit's day tank will be controlled from the control room by opening and closing the day tank filling valve, the storage tank suction heaters and transfer pumps operate automatically during the filling procedure.

Mazout will be delivered from the day tank by three, half-capacity burner pumps. When the boiler is operating on mazout the burner pumps will discharge through three, half-capacity, burner oil heaters to the burners.

A fuel oil additive system will be provided for each unit to inject additive into the mazout to the discharge side of the burner heaters. The amount of additive injected will be proportional to the mazout burned.

Circulating Water System:

Two 60 percent capacity vertical, wet pit circulating water pumps will be provided for each unit and normally will operate together to supply fresh water from the River Nile to the main condenser. The pumps will be located in the circulating water pumphouse structure downstream of the trash racks and travelling water screens. The travelling water screens (four for each unit) will be 3 meters wide and 11 meters high. Chlorine solution will be injected into the circulating water intake flow at the screenwell to control the growth of marine organisms.

Each of the four pumps (two per unit) will discharge into a reinforced concrete cylinder pipe (a separate line for each pump) within the intake structure. Each pipeline will split into two lines at the turbine building. Four separate flow paths will be provided through the single zone, two-shell, single pass condenser for each unit.

The condenser discharge lines will be manifolded into two lines leaving the turbine building. The lines will carry the discharge water to the seal pit structure where it will be discharged behind a weir. The water will pass over this weir and be discharged through concrete pipe to the river. The seal pit will insure that the discharge pipe is submerged, regardless of river level, thereby preventing air intrusion.

Component cooling water will be drawn from the circulating water stream, pass through the component cooling water heat exchangers and into the seal pit. Service water, fire protection water, and make up raw water systems will be provided. These systems will receive makeup water from two vertical pumps (for each unit) and strainers located at the intake structure.

Service, Maintenance and Administration Buildings:

The service, maintenance, and administration buildings will be of a reinforced concrete frame construction with a concrete block or brick exterior.

The service building will include the following areas: office area, auxiliary boiler area, water treatment area, water laboratory, compressor and electrical equipment.

The compressor and electrical equipment area of the service building houses the service air compressors, receivers, and motor control centers. The air intake silencer/filters will be located on the roof.

The auxiliary boiler area will house the auxiliary boiler and miscellaneous associated equipment. The auxiliary boiler will be rated at 130,000 lb of steam per hour.

The water treatment area will include the filters, demineralizer system, sump pumps, and other process equipment. The clarifier for the water treatment system will be located out-of-doors adjacent to the water treatment area of the service building.

Adjacent to the service building will be the two story maintenance building. This building will include a machine shop and welding shop with bridge crane, electrical shop, instrument shop, first aid room, loading dock with dock leveler, tool room and storage.

A single story lunch and locker room building will be adjacent to the maintenance building. This structure includes locker, shower and toilet areas, and a fully equipped lunch room.

The administration building will include the administrative offices, training rooms and other facilities. These areas will be air conditioned.

Yard Area:

General:

The plant site will be provided with paved roads for access to the site and to major areas and structures within the site. Paved parking lots will be provided adjacent to the service building and the administration building. Paved parking areas or aprons will be provided at other major structures for maintenance vehicles. The plant site will be surrounded by a site boundary wall with a guard house at the main gate.

Wherever possible, all outside piping in the main plant area will be above ground. All sanitary drain lines in the plant will be underground and convey sanitary waste to the colony treatment facility.

Other yard structures will include a warehouse and biocide storage area adjacent to the circulating water intake structure.

Ponds:

The waste holding ponds (equalization ponds) will consist of two 50 percent capacity earth ponds. Each pond will hold about 800,000 gallons. The ponds will be lined with a synthetic liner to minimize leachate from the ponds.

Site Boundary Wall and Guard house:

The station site will be enclosed by a wall. The boundary wall will include motor operated and/or manually operated entrance gates. A concrete block gate house will be located adjacent to the main gate and in the center of the main plant access road. The gate house will be provided with; restroom facilities; communications equipment, including extension to the plant page-party public address system; public telephones; HVAC system; and a closed circuit TV camera to allow monitoring of the entrance from the control room

Structural Features:

Construction of the units features a functional design utilizing standard structural components and materials. The foundations will be constructed of reinforced concrete, with walls, piers, and footings founded on piles, with the ground floor consisting of a reinforced concrete slab. The superstructures, consisting of turbine rooms, boiler areas, auxiliary bay, and control room complex, will be constructed of concrete block. Floors will be supported by steel framing with either reinforced concrete slabs on metal decking or grating. Platforms will be provided for access to valves, motors, and equipment. The enclosed turbine buildings and control room complex will be constructed of concrete block, brick, or precast concrete panels. The roof of the plant consists of a concrete slab. Two passenger/ freight elevators, one for each unit, are provided in each boiler structure.

Building Service Systems:

Fire Protection Systems:

Sprinkler systems will be provided for areas below the turbine generator operating floor, and the lube oil storage rooms.

Water spray systems will be provided for the turbine lube oil equipment, hydrogen seal oil unit, boiler feed and booster pump turbine lube oil equipment, the main power transformer, and normal and reserve station service transformer.

Hose stations will be provided in the plant will be yard structures. One fire water storage tank and two fire water pumps will be provided for each unit to supply water to the fire hose stations in the plant and to the hydrants in the yard areas. One of the fire water pumps will be motor driven, the other will be diesel engine driven. A fixed foam generating system will be provided for the mazout and solar storage tanks and day tanks.

Halon Protection Systems:

Halon systems will be provided for the control building switchgear, electrical equipment, and computer rooms.

Fire Detection Systems:

Automatic smoke detection systems will be provided where required and are part of the fire protection system.

Air-Conditioning:

Air conditioning will be provided for the control, electrical equipment and computer rooms. Office areas in the service, administration, and maintenance buildings will also be air conditioned.

Ventilation:

Several separate supply air systems will be provided for the turbine area, each with an air handling equipment assembly consisting of outside and return air dampers.

Electrical Equipment:

Generator Leads:

An isolated phase bus duct will carry the generator output to the main unit transformers. The bus will be continuous welded and forced air cooled. The normal station service transformers and potential transformer cubicle will be fed by isolated phase, self cooled tap buses. Spare cooling equipment will be provided for the isolated phase bus.

Main Unit Transformers:

One full-size, 3 phase, 50 Hz, 775 MVA FOFA (Forced oil and air cooled) 65°C rise transformers will be provided for each unit.

Station Service Transformers:

Two split secondary normal station service transformers will be provided to supply power to station auxiliaries when the power plant is operating. A total of two, approximately half size, split secondary reserve station service transformers will be provided to supply the two units during start up and when the plant is not operating. These transformers can also be used while the plant is operating if a normal station service transformer is out of service.

Switchgear:

The medium voltage in-plant distribution level will be 6.0 kV. Four 6.0 kV buses will be supplied for each unit and will be located on the ground floor of the control building unit. The 6.0 kV buses will feed large motors and 380 V load centers.

380 V Load Centers:

Four double ended load centers will be provided for main station auxiliaries.

Plant Switchyard:

The 500 kV switchyard design is based on installing a gas insulated system (GIS). This will consist of a double bus, double breaker arrangement housed in the 500 kV switchgear building. There will be a bay for each of the two generating units. There will be three bays for outgoing lines. One transmission line will deliver energy to the New Tebbin substation, and the other two lines will cross the river to tap into the eastern-most 500 kV circuit between Samalut and Cairo. In addition there will be a bay with two breakers feeding a 500 kV/220 kV bank of autotransformers. The bank of transformer will consist of four single phase autotransformers connected such that one may act as a spare and be readily connectable to the buses. The 500 kV switch yard arrangement will consist of twelve 500 kV sulfur hexifloride (SF-6) insulated power circuit breakers along with surge arresters, instrument transformers, wave traps and carrier coupling equipment all sufficient to provide a complete installation.

The 220 kV switchyard design is based on installing a gas insulated system consisting of a breaker and one-half arrangement housed in the 220 kV switchgear building. There will be one circuit via underground oil filled cable back to the plant to the reserve station service transformers for Units 1 and 2. Disconnect switches will be provided at the plant to isolate each transformer. SF-6 power circuit breakers will be provided for two circuits that will cross the river to the 220 kV switchyard in Fayoum. These lines will be installed with this project in order to provide start-up for the plant and supply load in the Fayoum sector. In addition two lines are planned to Beni Suef in the future and space allocation will be provided in the 220 kV switchyard. The 220 kV switchyard arrangement will consist of nine 220 kV SF-6 power circuit breakers, pot heads, surge arresters, wave traps, and carrier coupling equipment.

A common control house will be provided for both 500 kV and 220 kV facilities. It will house the breaker power supplies, relay panels, and all supervisory control and data acquisition (SCADA) equipment necessary to reliably control the lines. The relay house will be insulated and air conditioned. Communications equipment will also be provided to link the plant with the National Energy Control Center (NECC).

Communication System:

An intraplant communication system consisting of a page party/public address system with a multitone generator will be provided. Raceways and junction boxes will be provided for public telephone facilities. The system will be designed for proper acoustical performance.

Grounding and Cathodic Protection:

All equipment and structural steel will be connected to the station grounding system, as required, so that the steel will essentially extend the ground system.

An integrated, coordinated cathodic protection system, responsive to actual field conditions, will be provided for underground metallic piping and tanks, metallic pilings, station grounding system, condenser water boxes, and heat exchangers.

Plant Simulator:

The Plant Simulator will be a tool for operator training and will consist of the following:

* An operator's control panel which will be similar to the plant main control board.

* A digital computer which simulates the actual operating characteristics of the plant equipment and systems.

* An instructors station which will be used to manipulate the digital computer's plant response.

The function of the plant simulator will be to provide operator training before and after plant start-up.

Instrumentation and Control:

General:

Instrumentation and control systems including all components will be of a standard design proven in similar applications. The main plant control systems will use state-of-the-art microprocessor based, centrally located and operated. These systems will communicate over and share a common plant data highway to the maximum extent practical. Operator interfaces can be via CZRT's or via hardwired devices mounted on the main control board.

All field instrumentation will be specified for specific climatic conditions. Transmitter inputs and control system outputs will in general be electronic. Control valves, and simple local control loops will be pneumatic.

Local area control systems and operating panels will be provided for water treatment, wastewater treatment, fire protection/detection and other miscellaneous systems and equipment. These local area systems will be connected to the plant data highway.

Control Room Equipment:

A common control room will be provided for both units. The control systems for each unit will be independent. Operator stations, alarm indications and operating data displays which are vital to the generation of energy or plant safety will be located in the main control room.

Each boiler/turbine generator unit will be provided with a computer based data acquisition system in order to assist the plant operators in efficient supervision of the unit and provide records of operation.

Boiler Control Systems:

The boiler control system will include: Feedwater flow control, Combustion control (gas, mazout and air), Steam temperature control, Air heater temperature control, Gas recirculation control, and Interfaces to the Burner Management System.

The Burner Management System will provide safe operation of burners and ignitors from the main control room provided with the Burner Management system:

* Furnace Safety System
* Purge and boiler monitor
* Fuel gas control
* Solar oil control
* Mazout control
* Interfaces to the boiler control system

a. Turbine - Generator Control Systems:

Control and protection systems for the turbine generator units will be provided by the manufacturer. Operating and monitoring functions are provided to roll, synchronize, load and protect the machines.

b. Balance of Plant Equipment:

Control and monitoring for the balance of plant equipment, including the major electrical power systems will be incorporated into the other major control systems. Electrical metering and protection panels will be provided for the major electrical equipment. Electrical protection for medium and low voltage equipment will be provided within switchgear or motor control centers.

Circulating Water Supply:

The power station, consisting of two 600 MW units will require a maximum cooling water flow of 40 cubic meters per second. A third 600 MW unit would increase cooling water requirement to 60 cu. meters per second. Current controlled seasonal river flows passing the site are between 75 million cubic meters per day (868 cubic meters per second) and 140 million cubic meters per day (1620 cubic meters per second). Since the power station water usage is non consumptive (less than one percent loss), there is a sufficient quantity of water available from the Nile River.

Fuel Supply:

The gas supply required to operate the plant 100 percent on natural gas is 9 million Standard Cubic Meters (MSCM) per day. The Petroleum Pipeline Company plans to supply El-Kureimat with natural gas from the Gabal El Zeit gas production field. The pipeline will be sized to supply 100 percent of the natural gas requirements.

The mazout oil supply required to operate the plant 100 percent on mazout is 5,760 metric tons (tonnes) per day. A 14-inch heavy oil pipeline passes the El-Kureimat site from the Mostorod refinery to Beni Suef and Upper Egypt. The station will provide on-site storage capacity for a 21 day supply.

Power Transmission:

The El-Kureimat site is located sufficiently distant from the load centers in Cairo and the Delta to make bulk energy transmission at 220 kV impractical. However, it is quite convenient to 500 kV connection points. It further serves to close the 500 kV loop around Cairo if connection is made with the Cairo-Samalut 500 kV lines. By extending a loop from one of the Cairo-Samalut 500 kV lines through El-Kureimat and adding El-Kureimat to New Tebbin 500 kV line, a three line 500 kv outlet configuration is achieved. Local area support will be provided by looping the double circuit line from Beni Suif to Fayoum through El-Kureimat. One 500 MVA, 500/220 kV transformer was included at El-Kureimat to incorporate the 220 kV transmission.

165

Both El-Kureimat generators will be connected to the 500 KV. Since there are three 500 KV lines out of El-Kureimat, the loss of any one does not overload the others. The transmission scheme for El-Kureimat will require 150 kilometers of 500 KV line additions and six line positions on 500 KV busses.

Operations and Maintenance Staffing and Training:

To operate and maintain the generating facilities, in excess of 500 employees will be assigned to the two unit plant, 156 employees for operations, 195 employees for maintenance, 48 for technical support, 65 for security and 36 for administrative management and support.

EEA will be required to commence training of the staff sufficiently in advance of the first unit start up so that the staff will be available at the appropriate times to participate in plant start up and initial operations and to handle the range of administrative affairs required. The operating staff will be trained using classroom instruction, simulator instruction and on-the-job study instruction and hands-on experience. A Covenant will be included in the Grant Agreement to assure that training of additional operation, maintenance and administrative staff will be initiated to assure trained and qualified personnel at the appropriate time. The consultant's staff will provide start up, operation and maintenance support as required.

Employee Community:

A community for the El-Kureimat plant employees will be located adjacent to the north eastern boundary of the power plant site. The area required for the community will be approximately 450,000 square meters. Based on the staffing plan, 418 housing units will be required consisting of 14 villas and 414 apartments. The community will include telephone, telegraph and post office; police and fire departments; hospital; mosque; primary school; nursery; administration building; commercial center; guest house; and recreational facilities. Electricity for the community will be provided initially from distribution facilities passing the site and a future supply from the power station. Distribution within the community will be underground. Potable water will be supplied from the station water treatment system. Sanitary drainage would consist of septic tanks and a wastewater treatment system for each neighborhood to reduce the amounts of solids and suspended materials. Gralvity sewer lines will be used to minimize the number of pumping stations, an a compact wastewater treatment unit. The effluent from the compact wastewater tretment unit would be chlorinated and then used to irrigate the green areas of the colony and power station. The telephone exchange system would be provided and interconnected with the national telephone system through appropriate channels in coordination with the Arab Republic of Egypt National Authority for Telecommunications.

C. National Energy Control Center:

Site:

The National Energy Control Center is located in the Dispatch Building in Embaba, adjacent to the Cairo West thermal power station. The wing of the building containing the control center was constructed in the early 1980's and incorporates the necessary environmental control and redundant power supply facilities essential for a large computation center. Their is sufficient space available in the computer room to permit an orderly computer replacement.

Computer System:

The National Energy Control Center is the a central point for monitoring the operation of the Egyptian power system. From this center operating decisions are made to achieve optimum economy of operation and to insure the reliability and security of the power system which includes the generating stations and bulk power transmission facilities.

The heart of the Center is the computer systems that acquire and analyze data collected from the system. The computer system consists of four CYBER 18 computers interconnected in a quad to assure full redundancy of both communication control processors (CCP's) and master control processors (MCP's). The two front-end communication control processors (CCP's) interface to the microwave and carrier communication channel adapters to control the polling and data acquisition from remote stations. One CCP is defined as the primary processor and is normally responsible for the control and monitoring of the data acquisition, data conversion, limit checking, and state changes functions. The secondary CCP is configrued as a backup to the primary CCP and is normally assigned to an idle state. The secondary CCP assumes the functions assigned to the primary CCP if the primary CCP fails.

The remaining pair of quad computers and the master control processors (MCP's) interface directly to the local data acquisition equipment. The MCP also handles the interfacing to the man/machine subsystem and application programs for functions such as automatic generation control (AGC), economic dispatch control (EDC), and load frequency control (LFC), etc.

A communication link consists of a dual process interface controller (dual PIC), a channel adapter, and a modem/line switch. There is a maximum of eight channel adapters per dual PIC and eight communication lines per channel adapter. Commuications to the remote terminal units (RTU) from the CCP's are accomplished through communication lines via a primary channel adapter/modem pair and a secondary channel adapter/modem pair. If an RTU communication fails on its primary pair assignment, the RTU is automatically reassigned and scanned on its secondary pair assignment. Since this requires more message traffic on the secondary pair assignment, the scan period of the failed RTU and those on the secondary pair assignment can be degraded.

The NOVA computers serve as man/machine subsystem processors to reduce the CYBER 18 Input/Output (I/O) burden. The NOVA system performs I/O control and provides data translation, display formating, initial data entry validation, and initial operator input command processing. In addition, formating, typing and status information of currently displayed dynamic data is held and maintained in the associated NOVA. This facilitates efficient CYBER 18 access for processing display activity.

Such a configuration for the computer system was selected to provide better overall availability for reliable operation of the UPS with minimum interruption of service due to hardware failures.

The CYBER 18 computers, each equipped with 53 K words of main memory, acquire data from the remote stations and perform automatic generation control functions and provide the man/machine interface as well as control of the data link to the Cyber 173 processing systems. Each Cyber 18 computer has a disk system having a bulk memory capacity of 4.4 million words.

The CYBER 173 central processing computers, each equipped with 98 K words of main memory, and peripherals perform the network analysis function that includes economic dispatch calculations, state estimation, security analysis and operation planning and scheduling functions. Each Cyber 173 computer has a disk system having a bulk memory capacity of 2800 million bits.

The man/machine interface comprises three identical dispatcher consoles. Each console is equipped with three color video generators (CRT display controllers), three color CRT's, control panels, alphanumeric key board, light pen cursor control, console logger, analog recorder and telephone communication switchboard and associated voice recorder.

Other man/machine interfaces include a dynamic mimic system diagram board, recorders, digital displays, system data loggers, and a number of remote consoles for planning function.

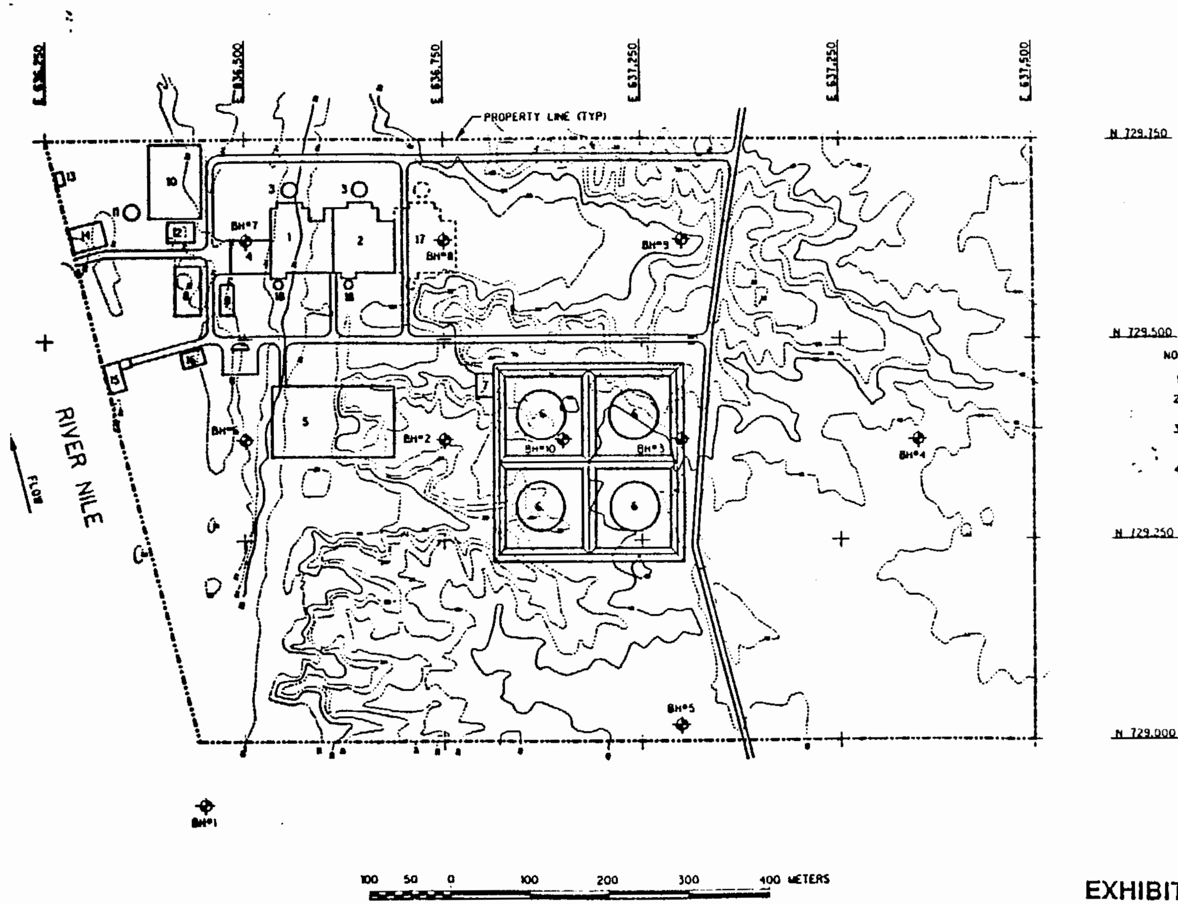
168

The computer system was designed to acquire and process data from a maximum of 60 stations. The EEA is presently monitoring 59 stations and plans to expand the system to cover more than 100 station by 1995. To expand the data acquisition and processing capacity of the NECC, the Cyber 173 and Cyber 18 computers and periperals must be replaced with central processors of greater capacity. The change in central processors will require changes in interfacing and protocols for the data being transmitted from the remote stations. The original 39 remote terminal units must be replaced and the remaining remote terminal units must be modified to comply with the required data protocols. Communication channels, both microwave and power line carrier, must be modified to receive the reformated data.

The expansion of similar control systems has been accomplished in other electric utility control centers around the world. EEA staff will be trained to operate and maintain this equipment.

18453-DY-2A-2

1. UNIT NO. 1
2. UNIT NO. 2
3. STACK
4. SERVICE BUILDING
5. SWITCHYARD (500 & 220 KV)
6. MAZOUT STORAGE TANKS (21 DAY SUPPLY)
7. MAZOUT PUMPHOUSE
8. MACHINE SHOP
9. LUNCH AND LOCKER ROOM BUILDING
10. WASTE HOLDING POND
11. WASTE HOLDING POND CLARIFIER
12. WAREHOUSE
13. CW DISCHARGE STRUCTURE
14. BARGE SLIP
15. CW INTAKE PUMPHOUSE
16. ADMINISTRATION BUILDING
17. FUTURE UNIT
18. CONDENSATE STORAGE TANK




NOTES:

1. SCALE = 1:5000
2. COORDINATES SHOWN ON GRID SYSTEM ARE IN METERS
3. VERTICAL CONTROL IN METERS IS BASED ON MEDIAN SEA LEVEL DATUM OF THE MEDITERRANEAN SEA IN ALEXANDRIA, EGYPT.
4. CONTOUR ELEVATIONS ARE IN METERS.

ANNEX G
Page 24 of 26

# EXHIBIT II-1-6

| | | |
|---|---|---|
| 2 | FOR FINAL REPORT | |
| 1 | ORIGINAL ISSUE FOR DRAFT REPORT | JEH |

SITE ARRANGEMENT - LOWLANDS

KUREIMAT UNITS 1&2 - GAS/OIL FIRED
1200 MWe FEASIBILITY STUDY
EGYPTIAN ELECTRICITY AUTHORITY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

DRAWING NUMBER 18453-DY-2A-2

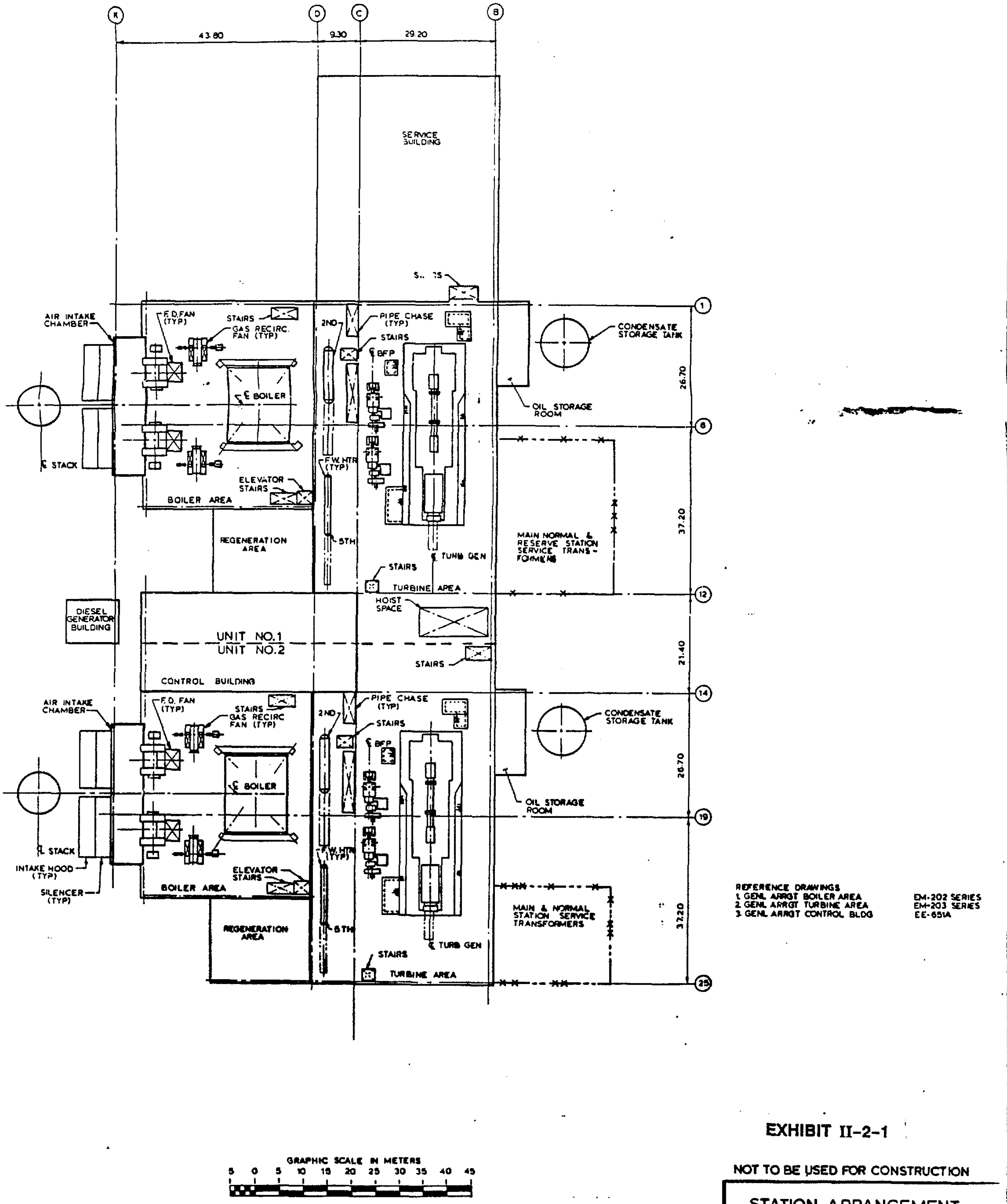



EXHIBIT II-2-1

NOT TO BE USED FOR CONSTRUCTION

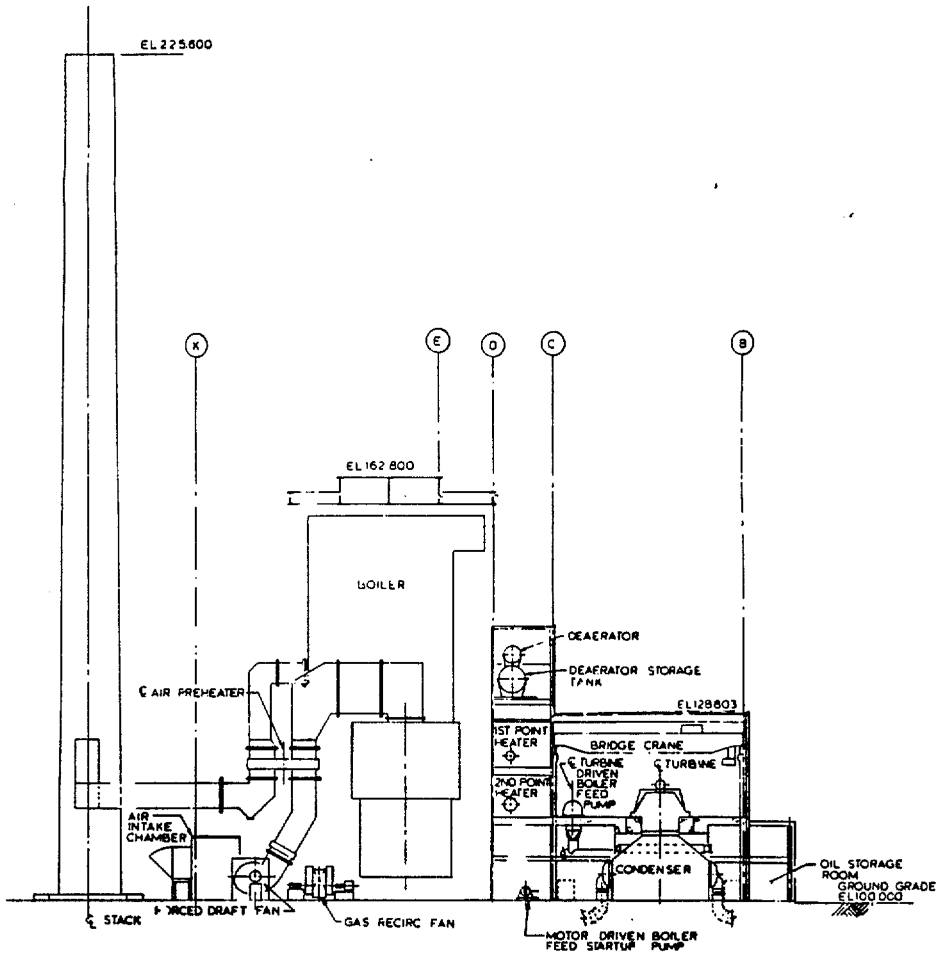
STATION ARRANGEMENT

KUREIMAT UNITS 1&2 - GAS/OIL FIRED
1200MWe FEASIBILITY STUDY
EGYPTIAN ELECTRICITY AUTHORITY

STONE & WEBSTER ENGINEERING CORPORATION
BOSTON, MASS.

18453 -EM-201A - 1

ORIGINAL ISSUE




GRAPHIC SCALE IN METERS
5 0 5 10 15 20 25 30 35 40 45

| ISSUE 4 | DESCRIPTION | CHECKED | ISSUE 3 | DESCRIPTION | CHECKED | ISSUE 2 | DESCRIPTION | CHECKED | ISSUE 1 | DESCRIPTION | CHECKED |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CORRECT | | | CORRECT | | | CORRECT | ORIGINAL ISSUE ISSUED FOR STUDY | | CORRECT |
| | | APPR DATE | | | APPR DATE | | | APPR DATE | | | APPR DATE |

# FINANCIAL ANALYSIS

## A. SOURCES OF PROJECT FUNDING

The total estimated costs of the Project, consisting of design, engineering, procurement, installation and start-up of two 600 MW steam turbine generating units at the El-Kureimat site and the upgrading of the National Energy Control Center (NECC), is US Dollars 795 million and L.E. 604 million.

Funds for the project will be provided by AID, a group of bilateral and multilateral financing agencies and the GOE.

AID, in its financing, will consider each unit as a discrete element of the project, funded and carried out independently from the other. The upgrading of the NECC will be funded entirely by AID with local currency requirements provided by the GOE.

Out of the total estimated cost of the El-Kureimat plant, AID will fund $200 million of the foreign exchange costs in two increments, each in the amount of $100 million. Funding for the second increment by AID will be contingent upon the GOE's implementation of further energy price reforms. Funds in the amount of $15 million covering the foreign exchange cost of upgrading the NECC will be provided to the project either in FY 90 or FY 91 subject to availability of funds. Funding by other bilateral and multilateral financial agencies will amount to $580 million. Therefore the total funding that will become available to the project through AID and foreign financing in the form of grants and loans is sufficient to meet the project's foreign exchange requirements.

The bilateral and miltilateral financing commitments for El-Kureimat have been confirmed by the GOE Minister of Electricity.

A Requirement Precedent to Initial Disbursement of Grant funds for El-Kureimat will require evidence of financial commitments from other donors for El-Kureimat in the form of signed letters from each financier. A Requirement Precedent to Disbursement of Grant funds for El-Kureimat equipment will require evidence of full foreign exchange financing for El-Kureimat in the form of signed financing agreements. The GOE will finance all local currency costs associated with the project including in-kind contributions. The Grant Agreement will contain a Requirement Precedent to Initial Disbursement requiring the GOE to provide evidence that the local currency needs for this project has been budgeted and will be available for timely expenditure by the EEA.

The sources of project funding are summarized in Table H-1.

Table H-1
Source of Project Funding
($ or L.E. in Millions)

| Foreign Exchange | | | Local Costs | | |
|---|---|---|---|---|---|
| AID | Other Donors | Total | Other Donors | GOE | Total |
| $215 | $580 | $795 | 0 | L.E. 604 | L.E. 604 |

The US Dollar cost of the project will be provided to the GOE as a Grant. A Requirement Precedent to Initial Disbursement will require that the Grant proceeds for the consultant services be passed to EEA as a grant with the balance for equipment and commodities passed to EEA as a loan.

B. UTILIZATION OF PROJECT FUNDS

The proposed $215 million in AID funds will be used to finance consultant services, equipment and contingency. The total foreign exchange value of the consultant services, equipment and construction services has been estimated at $693,670,000 and consists of 21 procurement packages. In view of the number of financiers involved in funding the project, a contingency element is critical in providing flexibility in modifying element ceilings in order to fully fund specific commodity packages that will be supplied on a world wide basis to meet the procurement regulations of the various financiers.

AID funding for the first unit at El-Kureimat will finance engineering design services, preparation of specifications and bid documents for the plant, assistance in equipment and construction service procurement through contract award and one or more packages of equipment for Unit 1. AID will fund these elements in the amount of $100 million, subject to availability of funds.

174

AID funding, to be provided in a subsequent tranche following another electricity price increase, will finance the balance of consultant services for the construction of the plant and will include scheduling, expediting, construction management, project management, startup assistance, initial operation and maintenance support and the companion packages for the second unit previously financed for the first unit. AID would fund these elements in the amount of $100 million.

AID will provide up to $15 million for the up-grading of the National Energy Control Center (NECC).

AID is the only financier of the foreign exchange requirement for upgrading the NECC component, with local currency provided by the GOE.

The utilization of AID funds for the project is summarized in Table H-2 below:

Table H-2
Planned Utilization of AID Project Funds
($-million)

| | El Kureimat | | | | Grand |
|---|---|---|---|---|---|
| | Phase I | Phase 2 | Total | NECC | Total |
| Tech. Service | 15.0 | 35.0 | 50.0 | 3.0 | 53.0 |
| Equip./Commodities | 76.0 | 58.0 | 134.0 | 10.0 | 144.0 |
| Audit & Evaluation | 0.07 | 0.05 | 0.12 | 0.03 | 0.15 |
| Contingency | 8.93 | 6.95 | 15.88 | 1.97 | 17.85 |
| | 100.00 | 100.00 | 200.00 | 15.00 | 215.00 |

## C. FINANCIAL VIABILITY

Two methods were used to evaluate the financial viability of the proposed project: a project financial analysis and a system financial analysis. The project financial analysis sought to establish the feasibility of the proposed project on the basis of its ability to produce a reasonable financial rate of return on average net plant. The system financial analysis measured the long term feasibility of the project in terms of its impact on overall EEA system earnings and rate of return.

The results of both analyses showed that the proposed project can provide an adequate rate of return for a wide range of natural gas/fuel supply scenarios, given reasonable increases in EEA's revenues, based on increases in electricity prices, over the life of the plant.

Both analyses confirmed that the proposed project is financially viable.

# ECONOMIC ANALYSIS

## A. Plant Size, Site, and Fuel

Size of Unit: In 1984 AID funded a feasibility study for a 1,200 MW thermal power plant in Egypt. This study was contracted by the EEA and performed by the Stone & Webster Engineering Corporation and completed in December 1985 and presented to the EEA in January 1986. Natural gas was not considered a viable fuel at that time because forecasts of natural gas availability in 1985 indicated that no gas would be available for a 1200 MW power plant installed in the period 1991-1993. This study indicated that a 1,200 MW steam power plant consisting of two 600 MW generating units was the economically preferred size as compared with other available size units.

A subsequent study by Stone & Webster was funded by AID and contracted by the EEA in 1988 and completed in July 1989. This second study is titled: "Ministry of Electricity and Energy, the EEA, 1,200 MW Gas/Oil Thermal Power Plant: Engineering/Economic Feasibility Study for El-Kureimat, Final Report", and is cited hereinafter as the Stone & Webster study. Part I of this study examines plant type, size, location, and fuel and is summarized in the following paragraphs.

Fuel Alternatives. The early 1988 approval of the Egyptian Parliament to provide incentives to foreign petroleum companies to explore for and develop natural gas has given rise to optimism about the future supplies of natural gas that may be available for power generation and other purposes. The Stone & Webster study evaluated the future quantities of natural gas that may be available to the EEA in the mid-1990s, and based on assumptions of gas availability, then determined the least cost 1,200 MW generating plant addition for the EEA in that period. The Stone & Webster study examined the gas supply and gas pricing questions. The study concluded that natural gas would probably be available for a 1,200 MW power plant in the mid-1990s. Three scenarios of gas availability were developed, and low availability scenarios led to the conclusion that some gas would be available for a 1,200 MW plant, but that full requirements would only be met by restricting supply to other units. For this reason dual-fired (gas/fuel oil) and tri-fired (gas/fuel oil/coal) were considered as well as single-fired units.

Generation Expansion Analysis. The generation expansion analysis focused on defining the least cost project to meet a 1,200 MW capacity deficiency in the period fiscal years 1994/95 through 1995/96. After review of key variables and risk analysis, it was concluded that the least cost project was the installation of two 600 MW gas-fired Rankine cycle units. The alternative expansion plans that were considered are ranked by cost in Table 1. Due to concern about the availability of natural gas, the second ranked plant, two 600 gas-fired Rankine cycle units installed in 1994 and 1995 and burning oil until 1997 were selected.

Table I-1
Ranking of Six Alternative Generating Plants

| Rank | Plant Description | Expected Values of Present Worth Costs (US $ Millions) |
|---|---|---|
| 1 | 2X600 MW gas-fired Rankine cycle units installed in 1994 and 1995 | $ 12,507 |
| 2 | 2X600MW gas-fired Rankine cycle units installed in 1994 and 1995, and burning oil until 1997 | $ 12,519 |
| 3 | 2X600 MW gas-fired combined cycle units installed in 1994 and 1995 | $ 12,524 |
| 4 | 2X600 MW oil-fired Rankine cycle units installed in 1995 and 1996 | $ 12,562 |
| 5 | 2X600 MW gas-fired Rankine cycle units delayed to 1995 and 1996 | $ 12,601 |
| 6 | 2X600 MW coal-fired Rankine cycle units installed in 1994 and 1995 | $ 12,764 |

Plant Sites. Five potential power plant sites were compared quantitatively and qualitatively using four different combinations of fuel alternatives. The economic criteria used to develop cost data were as follows: (a) the real discount rate set at 10 % per annum; (b) all cost components are expressed in millions of mid-1988 U.S. dollars; (c) costs originally developed in Egyptian

178

pounds were converted to U.S. dollars using an exchange rate of L.E. 2.3 per U.S. dollar; (d) the assumed economic life of a power plant is 30 years; (e) capital costs represent the total present day installed costs and do not include escalation, interest during construction, taxes, or duties; and, (f) operation and maintenance costs represent the present value of such expenses incurred throughout the anticipated economic life (30 years) of the project.

Site-generic Plants. Two types of site-generic power plants were examined: (a) a traditional steam plant in which fuel is burned in a boiler to produce steam which is passed through a turbine-generator, causing rotation of the generator to produce electric energy, with the steam being exhausted into a condenser where the steam is condensed into water which is returned to the boiler to again be converted to steam, (conventional Rankine cycle), and (b) a combined cycle plant employing a gas turbine which compresses air which is then heated by the injection and burning of fuel with the heated air expanding through a turbine-generator causing rotation of the generator (Brayton cycle) with the turbine exhaust discharged through a boiler to produce steam which is then passed through a second turbine-generator causing rotation of the generator to produce electric energy with the steam being discharge to a condenser where it is condensed and returned to the boiler to again be converted into steam (Rankine cycle). The site-generic steam plant included fuel handling facilities, steam generator and auxiliaries, precipitator and ash handling equipment (in the case of coal), and the steam turbine cycle. The site generic combined cycle plant included industrial type combustion turbines, a three-pressure heat recovery steam generator for each combustion turbine, and a non-reheat condensing steam turbine cycle. The site-specific facilities not included in the site generic steam plant or combined cycle included fuel supply facilities from the fuel source to the plant fence, the water supply and discharge facilities from the water source to the plant fence, power transmission facilities from the plant fence to the grid tie-in, infrastructure requirements including site preparation, housing and community facilities for the labor force, foundations, and environmental control facilities. These "site-specific" facilities provided the basis of the site selection analysis. All differential site-specific costs were classified as either capital or operating costs and were grouped in five categories as follows: fuel supply, water supply, power transmission, infrastructure, and environmental control.

A Comparison of Site-Specific Costs. A summary of the total site-specific costs are presented in Table I-2. Four potential fuel combinations were considered. The costs presented in Table I-2 are based on the power plant operating on the "primary fuel" and having all equipment in place to operate on the "secondary fuel(s)." The "gas/oil facility" incurs both the gas supply and oil supply capital costs but only the gas supply operation and maintenance costs. Given the accuracy of the cost estimates developed in the site-selection analysis, the difference between the Cairo North and Kureimat sites using 600 MW gas/oil fired units can be considered as negligible. The base differential cost analysis showed that Cairo North and Kureimat were the preferred sites for gas, oil, and gas/oil plants.

Table I-2
Total Site-Specific Costs
(Millions of U.S. Dollars)

| Power Plant Fuel Primary/Secondary | Cairo North | Gamasa | Mit Ghamr | Ataka | Kureimat |
|---|---|---|---|---|---|
| Gas only | 293.2 | 465.4 | 332.4 | 331.4 | 301.6 |
| Oil only | 273.7 | 481.0 | 328.2 | 329.4 | 296.8 |
| Gas/Oil | 296.7 | 487.9 | 344.3 | 336.3 | 308.9 |
| Coal/Gas/Oil | 669.8 | 587.8 | 724.8 | 400.7 | 421.6 |

Sensitivity and Risk Analysis. Sensitivity analysis tests for site assessment were also considered. Increased costs were assigned based on the the characteristics of each site. Specifically, capital and O & M cost components of fuel transportation were increased by 10 to 20 % for gas and oil. Water supply costs at each site were increased form 5 to 15 %. Power transmission costs were increased from 10 to 30 %, and infrastructure costs were increased from 5 to 20 %. The results of applying the full impact of the variation in each of the key factors to each site resulted in the following total evaluated costs for each site:

| Site | Millions |
|---|---|
| Cairo North | $ 431.4 |
| Gamasa | 636.2 |
| Mit Ghamr | 478.7 |
| Ataka | 459.2 |
| Kureimat | 419.5 |

Risk analysis was also used to assess the uncertainty of the estimated evaluated costs for each site. This analytical tool allows one to define the least cost site alternative as the one having the lowest expected net present value. Probabilities were assigned to the base economic values and to the results derived through sensitivity analysis. Expected net present values for each site were as shown in Table I-3.

Table I-3
Expected Net Present Values for Each Site, Using Gas/oil and Tri-fueled Alternatives

| | Gas/Oil Alternative | Tri-fueled Alternative |
|---|---|---|
| Cairo North | 357.0 | 690.2 |
| Gamasa | 517.7 | 650.4 |
| Mit Ghamr | 394.9 | 745.6 |
| Ataka | 349.5 | 432.1 |
| Kureimat | 320.0 | 501.7 |

Recommendations. Based on the analyses performed, which are summarized herein, the installation of a 2 by 600 MW Rankine cycle power plant, primarily fired by natural gas, at the Kureimat site was recommended.

## B. Economic Analysis of the Kureimat Plant

Cost-Benefit Procedure. The objective of the economic analysis of the El-Kureimat plant was to assess its economic viability from a national viewpoint. The analysis summarized here, which was performed by Stone & Webster, as cited earlier, follows the guidelines for project appraisal using cost-benefit analysis as recommended in HB 3. As is universally recognized by practitioners of economic cost-benefit analysis, several adjustments to financial analysis must be undertaken to ascertain economic costs and benefits, as is described herein. Egyptian local market prices used in the financial analysis do not reflect true economic costs and benefits due to institutional and administrative constraints and are adjusted to reflect true economic costs and social objectives by means of so-called shadow prices. A second type of adjustment relates to the difference between financial and economic costs. Financial costs occur as the financial resources are repaid, but economic costs occur as the resources are spent. For this reason depreciation, which is a non-cash expense rather than an actual use of resources, is excluded from costs in economic analysis. Moreover, embedded costs that reflect expenditures made prior to the project and unrelated to it (such as electrical distribution system expenditures) should be excluded since they are not a cost or a benefit produced by the project. In addition, taxes and subsidies, which bring a divergence between local market prices and true economic costs, are also excluded from economic analysis. The general procedure of cost-benefit calculation is as follows:

(1) All costs and benefits are valued at their shadow prices, i.e., at their true economic and social values.

(2) All costs and benefits are spread over time (with credits for salvage value).

(3) The net benefits for each year are calculated by deducting costs from benefits.

(4) The economic internal rate of return (EIRR) is calculated on the net benefit stream.

(5) The EIRR is compared with the social rate of return.

(6) The project is accepted if its calculated EIRR exceeds the social rate of return.

The EIRR. The results of the analysis indicate that the proposed El-Kureimat plant, when evaluated at the appropriate shadow prices, has an EIRR in excess of the appropriate social interest rate. In the base case the plant EIRR is 12.65 %. The Stone & Webster study suggests that the appropriate discount rate for Egypt is 6 %. We would opt for a higher minimum cut-off for the EIRR of 10 %. However, it should also be noted that the functioning of shadow pricing in the analysis of the project produced a significant increase in project economic costs as compared with project financial costs.

The Base Case. The base case represents usage of the best estimates of all inputs. The projection period covers the period from fiscal year 1988/89 through fiscal year 2007/08, a 20 year period. The plant was assumed to come on stream in the seventh year. Electric power losses were assumed to decrease from the present 18.1 % to 15 % by 1999/2000. Fuel prices were assumed to increase by 2.7 % per annum in real terms (constant prices). The shadow price of electricity was set at 12.316 piasters per kWhr (4.65 US cents). The useful life of all capital assets is assumed to be 30 years; therefore a remaining salvage value equal to 50 % of capital investment is used in the last year of the analysis because 15 years of operations have elapsed. Data are stated in 1988 constant prices and foreign exchange cost is converted to Egyptian pounds at a rate of LE 2.3 per U.S. $ 1.00. The summary statment of costs and benefits of the base case is included as Table I-4.

Sensitivity Analysis. Various sensitivity tests were performed in the Stone & Webster analysis to ascertain the new EIRR with variations in important assumptions. The results are summarized as follows:

| | EIRR |
|---|---|
| Base case (20 years) | 12.654 % |
| 30 Year Analysis | 13.083 % |
| Electricity Line Loss constant (at 18 % ) | 11.775 % |
| Shadow price of electricity: 20 % higher | 17.548 % |
| : 22 % lower | 6.011 % |
| International fuel price: 2.3 % p.a. real increase | 13.100 % |
| : 6.3 % p.a. real increase | 6.115 % |
| Capital cost: 15 % above estimate | 10.871 % |
| : 75 % above estimate | 6.380 % |
| Foreign exchange rate (terms of trade): | |
| 1.0 % Per annum improvement | 14.269 % |
| 2.8 % per annum deterioration | 6.163 % |

The sensitivity analysis indicates that the proposed Kureimat plant, when evaluated at the appropriate shadow prices, has an EIRR in excess of 10 %. Moreover, increasing the price of electricity by 20 % would compensate singly for most of the uncertain but negative influences that could affect the project, e.g., a higher than expected 6.3 % average per annum real escalation of the international price of fuel, capital costs 75 % higher than estimated, and a 2.8 % annual deterioration of the terms of trade. The operation of shadow pricing which was incorporated into the base case analysis also can be viewed as evidence that the EIRR was estimated conservatively. This work merits further examination.

Shadow Prices. Even though the exchange rate in Egypt has been largely de-regulated, the prices of most locally produced goods and services contain distortions. In deriving shadow prices, the Stone & Webster analysis uses the work of John M. Page, Jr. (Shadow Prices for Trade Strategy and Investment Planning in Egypt, World Bank Staff Working Paper No. 521, August 1982). The operational guidelines are as follows.

Traded goods are valued directly at border prices; that is the import price including insurance, freight, and other costs plus transportation costs to the power plant, and export goods are also valued at (FOB) prices. This procedure assumes that Egypt is a small enough part of the international market so that sales to or

183

purchases from the world market will not affect the tradable goods. Non-traded goods and goods not traded internationally are adjusted by the following ratios (as multiples of Egyptian domestic price shown in parenthesis): skilled labor (1.12), unskilled labor (0.40), plant material costs (3.066), transmission material costs (2.358), colony capital material costs (3.773), and other capital costs (0.0965). Total local cost stated in economic shadow prices is substantially higher than in market prices, as is shown in Table I-5.

Table I-5
Schedule of Local Capital Costs
(In millions of LE in constant 1988/89 prices)

| | Skilled Labor | Unskilled Labor | Materials | Total |
|---|---|---|---|---|
| A. In Market Prices | | | | |
| Power Plant | 27,791 | 17,866 | 158,821 | 214,478 |
| Transmission | 42,770 | 42,770 | 57,027 | 142,567 |
| Fuel-Transportation | 7,111 | 1,938 | 1,541 | 10,590 |
| Colony | 7,648 | 8,264 | 26,271 | 42,183 |
| Other | 4,635 | 0 | 5,057 | 9,692 |
| --Total | 99,955 | 70,838 | 248,717 | 419,510 |
| In Economic Shadow Prices | | | | |
| Power Plant | 42,326 | 7,146 | 486,866 | 536,338 |
| Transmission | 47,903 | 17,108 | 134,469 | 199,480 |
| Fuel Transportation | 7,964 | 775 | 3,634 | 12,373 |
| Colony | 8,565 | 3,306 | 99,119 | 110,990 |
| Other | 5,191 | 0 | 4,880 | 10,071 |
| --Total | 111,949 | 21,189 | 729,048 | 869,251 |

The US dollar equivalent of local capital costs is $ 182.4 million stated in market prices and $ 377.9 million when stated in shadow or economic prices. By way of comparison, the total cost of foreign goods in total capital costs (not shown in the table) is LE 1,562.4 million, and this is $ 679.3 million as converted to US dollars. In summation, the total capital cost of the project measured in market prices is $ 861.7 million but when measured in shadow prices it is $1,057.3 million. That is, valuation of capital cost in shadow prices is 22.7 % higher than in market prices.

The Shadow Price of Fuel. The shadow price of fuel was based on the border price of crude oil sold by or delivered to Egypt as an indicator of the price of Mazout (fuel oil). Fuel oil prices were escalated in real terms (constant 1988 prices) by about 3.0 % per annum over a 20-year period from 1988/89. The specific assumption for fuel oil/natural gas in current market prices in the financial analysis was that the local cost of Mazout and natural gas would increase by 33.72 % per annum for the 8 years beginning in fiscal year 1989/90 through 1996/97 to reach a level of about LE 286.3 per metric ton and thereafter by about 8 % per annum. (The latter is the sum of the annual increase in world fuel oil prices of 3 % and world inflation of 5 %.) Unlike coal transportation, gas supply into the plant involves only fixed operation and maintenance (O&M) costs and the capital costs of pipeline construction. O&M costs per million cubic feet of gas are considered negligible and fixed O&M expenses are included with plant operation and maintenance costs.

Treatment of Benefits. Project benefits consist in the increase of net sales of electricity produced by the El-Kureimat plant. To estimate total benefits, the physical volume of electricity sales is multiplied by the shadow price of electricity. Stone & Webster utilized Page's economic accounting ratio for electricity to derive a shadow price. That is, the weighted average electricity tariff of 30.9032 milliemes per kWhr in 1987/88 was multiplied by Pages accounting ratio of 3.321 to obtain a shadow price of 102.63 milliems per kWhr. With further adjustment to account for inflation, a shadow price of 123.16 milliemes per kWhr was set for 1988/89. This is equivalent to 4.65 US cents per kWhr and compares favorably with the EEA's estimate based on 1988/89 data (and an assumed shadow price of fuel oil of $ 70 per metric ton) which indicated 5.09 US cents per kWhr as the system long-run marginal cost (LRMC) of electricity. In addition, the EEA with AID assistance is contracting expert services to refine estimates of LRMC.

What Price? Our expectation is that the El-Kureimat plant will be the lowest cost producer of electricity in Egypt, and this gives rise to a philosophical problem. Negotiations with the GOE concerning electricity pricings has aimed at increasing electricity prices to cover the LRMC of producing electricity. Moreover, even though one may find several estimates of LRMC, as is indicated in the paper surveying the economics of electrical energy in Egypt (see Annex E), within limits the LRMC is quantifiable. However, using the LRMC as the shadow price of electricity for purposes of cost-benefit analysis is not acceptable. Importantly, in cost-benefit analysis, an assumption that the cost of providing a good is equal to the value of the good should not be made because that would clearly sidestep the whole problem of determining whether benefits exceed costs. (See, for example, Peter G. Sassone and William A. Schaffer, Cost-Benefit Analysis, A Handbook, Academic Press, 1978). The essential question is where to set the administered price of electricity from the perspective of customer benefit. Several considerations are relevant. How much would

185

customers be willing to pay in order to avoid electricity rationing and brownouts? What rate of return should the government seek on large-scale generating plants? It is likely that the price that most customers would be willing to pay for electricity would be substantially higher than the LRMC of electricity and also high enough to give a 10-15 percent EIRR on most least cost expansion of projects for generation and distribution of electricity in Egypt. At present the average price of electricity is on the order of 28-38 % of the LRMC, but for purposes of economic analysis the assumed price reflecting benefit should be higher than the LRMC. In summary, there is little merit to a shadow price of electricity that would just equal the economic cost of the most efficient generating plant and which would unduly prejudice ancillary investments in electric power generation and distribution.

One 600 MW Unit. Even though we judge that the probability of the GOE not undertaking additional policy reforms and thereby jeopardizing the financing of the second unit is low, not exceeding 20 percent, the economic feasibility of the Kureimat project would be adversely effected by such an event. Some facilities constructed in the El-Kureimat project are for joint or common use, and if the second 600 MW unit is not built, the cost per kWhr from a one-unit plant would be increased by the fact that these facilities would be over-dimensioned. Data on plants previously financed by USAID/Egypt with two units suggests the cost of one unit plus the common facilities amounts to from 55 percent to 68 percent of the total plant cost. In regard to the El-Kureimat project, our estimate of a worst case scenario is premised on fully procuring 9 of 21 procurement packages related to common or jointly used facilities as follows: structural piling, civil work, structural steel, water & wastewater treatment systems, the colony (housing), the UPS connection, simulator training, gas transportation, and the switchyard. These facilities amount to 30.7 percent of total cost, and signify that the maximum cost of one 600 MW would be 65.35 percent of total cost of two 600 MW units. On a kWhr basis, the increase in economic cost would be 30.7 percent and would be equivalent to an increase in capital cost of this amount. Based upon the sensitivity analysis presented above, such event would reduce the EIRR to 9.7 percent. If the event of not proceeding with the second 600 MW unit were known well in advance, then the design of facilities deemed common above, would undoubtedly be adjusted to one unit, and over-all costs would be reduced, thereby increasing the EIRR above 9.7 percent. In a contrasting analysis, if the event of not proceeding with the second 600 MW unit were not known in advance, then the GOE (the EEA) would likely use other resources to compelte the second 600 MW unit due to the lowered marginal cost of that additional facility and the EIRR would be somewhat lower than the original 12.65 percent due to a lengthening of the construction period.

Conclusions:

AID support for increased power generation is warrented since the GOE has undertaken a substantial increase in electricity pricess in 1990, and an objective of this Project is to encourage the elimination of the high level of implicit subsidies in this sector.

Based on analyses of least cost alternatives for providing additional electric generating capacity to come on stream in the mid-1990s, which included sizing of generating units, fuel alternatives, a comparison of site specific costs for five sites, and sensitivity and risk analysis, the installation of two 600 MW steam turbine-generators with individual boilers, primarily fired by natural gas, at the El-Kureimat site was recommended.

An analysis of the El-Kureimat plant using cost-benefit procedures indicated that the proposed plant when evaluated at appropriate shadow prices had an economic internal rate of return of 12.65 percent. Moreover, critical assumptions for the analysis were conservative, including a valuation of capital cost in shadow prices that was 22.7 percent higher than in market prices and a shadow price for electricity that was below the EEA's estimated long-run marginal cost of electricity for the average customer.

# SOCIAL SOUNDNESS ANALYSIS

The September 1989 Project Paper contained a detailed Social Soundness Analysis, the validity of which is not diminished by the addition of this component to the Project.

## A. Socio-Cultural Feasibility:

The Socio-cultural impacts of this Project, as amended, continue to be positive due to the continuing economic reforms in the electricity pricing structure. These reforms are encouraging proper economic decisions by all customers which will bring about more effective use of Egypt's energy resources. These reforms will also encourage the formulation of electricity rate structures based on the economic cost to serve users thereby minimizing preferential rates for special interest groups. Finally, these reforms will result in the addition of efficient generating capacity based on least cost alternatives to assure customers of a reliable power supply.

The May 1990 rate increase continues the pattern established with the March 1989 rate increase of correcting the price inequity by further implementing rate structures based on actual cost to serve the various types of customers and giving special attention to the low income Egyptian energy consumers.

The generating capacity being financed by this component of the Project will burn natural gas to the maximum extent available and will therefore minimize the emission of airborne contaminants and meet applicable U.S. air quality, water quality and noise standards.

## B. Spread Effects:

The additional generating capacity to be financed by the component of the Project will utilize standard technology presently in use at many existing thermal power stations in Egypt. The EEA's operations staff have effectively operated similar steam turbine plants to generate electric energy for years and the larger size units being introduced through the Project are only a natural progression in the development of the power system and should present no unusual problems. The operation staff to be assigned to the El-Kureimat station will be trained to operate the new equipment, thus building on their present skills. A maintenance staff will be assigned to the El-Kureimat thermal power station to service the equipment. This staff, composed of experienced maintenance personnel and supplemental by other specialists will be trained to service the modern equipment and control systems.

C. Benefit Incidence:

The construction of the El-Kureimat thermal power station being financed by this component of the Project will offer both short-term and long-term employment opportunities which will directly enhance the economy of the area surrounding the thermal power station. Due to the distance from Cairo, the plant personnel will be relocated and a new community will be established. The new community will offer a living environment less congested and polluted than would be otherwise found in most other areas of Egypt. The development of this new community will attract supporting commercial, business and service industries.

To the extent that the construction of the El-Kureimat thermal power station contributes to the continuity and efficiency of energy services to customers, it will benefit all persons utilizing electrical energy from Egypt's Unified Power System.

D. Conclusions:

The design of this proposed Project amendment is compatible with the socio-cultural environment in which it is to be introduced. The thermal power station being financed by this Project amendment will build on technology previously introduced in Egypt which has been operating successfully for a number of years. Host country personnel will be trained as part of the project to operate and maintain the new facilities. The proposed project, when implemented, should result in the direct and indirect benefits being distributed throughout Egypt. This component of the Project does not discriminate against women.

# MANAGERIAL/ADMINISTRATIVE ANALYSIS

The September 1989 Project Paper contained a detailed Managerial/Administrative Analysis of the Ministry of Electricity and Energy and the implementation agency, the Egyptian Electricity Authority (the EEA). The validity of this analysis has not diminished by the addition of this component to the Project.

## A. Organization:

This project will be implemented by the Egyptian Electricity Authority. All decisions involving commitment of project funding must be approved by the EEA's High Purchase Committee, Board of Directors and Chairman with the concurrence of the Minister of Electricity and Energy. The EEA has effectively managed a number of complex power generation projects financed by groups of bilateral and multilateral financiers including those proposed for this project.

## B. The EEA Project Management:

Day to day implementation will be the responsibility of the Deputy Chairman for Projects. We anticipate that the EEA will establish a Project Team which will report to the Deputy Chairman for Projects. The Project Team will have the authority to make day-to-day decisions and approvals.

The Project Team will be composed of a project manager, project engineer, financial specialist, environmental specialist and a senior representative of the Upper Egypt operational zone. Upon completion of the project, the team members will either be integrated into the station staff or continue to provide the EEA with enhanced project management expertise.

The station, upon completion, will be operated by the Upper Egypt Zone (which includes all bulk power supply facilities between Cairo and Aswan). The Upper Egypt Zone has effectively managed the operation and maintenance of a complex system of generation and transmission facilities that include: installed generating capacity of 3135 MW (2745 MW in hydro turbine capacity and 390 MW in steam turbine capacity); 1576 Km of 500 KV, 164 Km of 220 KV and 2195 Km of 132 KV transmission lines and 5905 MVA of transformer capacity.

C. Operation and Maintenance:

To effectively operate and maintain the El-Kureimat thermal power station, the EEA will assign appropriate levels of operations, maintenance and administrative staff. These employees will be selected from the EEA's operating plants. Since the EEA is currently operating more than 60 steam turbines in 15 stations, the addition of El-Kureimat should not adversely affect the EEA's current operations and the EEA should have no problem assigning knowledgeable and qualified personnel to operate and maintain these units.

The operation and maintenance personnel selected will receive refresher training on power plant fundamentals appropriate for their assignment, i.e. operations or maintenance, to bring the respective personnel to the same levels of basic knowledge. Subsequent training will consist of formal training programs conducted by the various equipment supply contractors. Foreign exchange costs for this training will be included in each contract financed by the project financiers. Local currency costs, including overseas air transportation, will be provided by the EEA. The equipment supply contractors will be responsible for conducting the formal training programs at the contractors and/or subcontractors manufacturing plants and on-site in Egypt. The EEA's project engineer will coordinate the design of all training programs.

A covenant will be included in the Grant Agreement which will provide that the EEA select operational, maintenance and administrative staff for the El-Kureimat thermal power station, and will commence comprehensive training programs sufficiently in advance of the station start-up so that: the operations and maintenance personnel will be on-site, trained and fully qualified to operate and maintain the generating facilities when they are placed in service; and that the administrative personnel will be on-site, trained and fully qualified to manage all administrative matters at the appropriate time.

D. USAID:

The Power Systems Group within the Office of Urban Administration and Development has monitoring responsibilities for all projects in the electric power sector and has developed an excellent working relationship with all levels of the EEA. The assigned personnel are experienced in the design, construction, operation and maintenance of electric power systems, the management and administration of electric utilities and the implementation and monitoring of projects involving the EEA. With the addition of another engineer with extensive electric utility experience (selection in October 1990) this Group should provide sufficient AID monitoring support throughout the life of this Project.

E. Conclusions:

The EEA has many years of extensive and successful experience in the construction, operation and maintenance of steam turbine generating facilities. The proposed components to be financed by this Project amendment are designed to build on this experience. The EEA has demonstrated its capability to effectively manage the implementation of similar complex power stations financed by a group of bilateral and multilateral financiers. The available DR/UAD staff, once strengthened by the addition of an engineer, should be sufficient to provide the necessary AID monitoring support. Accordingly, these components of the Project are judged to be administratively feasible.

# ENVIRONMENTAL ANALYSIS

## A. GENERAL:

This component of the project will incrementally finance the installation of two 600 MW steam turbine generating units at the El-Kureimat site and the upgrading of the computer hardware and software systems at the National Energy Control Center.

## I. EL-KUREIMAT THERMAL POWER STATION:

## B. ENVIRONMENTAL ASSESSMENT:

The USAID Environmental Procedures describe a process to ensure that environmental factors and values are integrated into the USAID decision making process. Since power plants are one of the types of projects which normally have a significant effect on the environment (22 CFR 216.2(d), (ix)), an Environmental Assessment is required.

The scope of the Environmental Assessment was determined by an Environmental Scoping Meeting held in Cairo in 1985 and a subsequent Scoping Document. This document and meeting provided the opportunity for USAID and representatives of the Egyptian Government Agencies to express opinions on the scope of the Environmental Assessment. The Environmental Assessment was prepared to cover the scope of the assessment in accordance with the contents and form described in 22 CFR 216.6 (c). A Requirement Precedent to Initial Disbursement of Grant funds for El-Kureimat will require the commitment of the implementing agency to design the plant, select equipment and oversee construction of plant in compliance with USEPA Environmental Standards and Egyptian Standards where more rigorous.

## C. LAND USE:

The site for the thermal power station is located on the east bank of the Nile River, approximately 95 Km south of Cairo and is owned by the EEA. The El-Kureimat site is characterized by a subtropical desert climate with very hot summers, mild winters, and dry sunny conditions. There is a prevailing northerly wind (40%) with a secondary maximum of winds from the east (23%) and west (18%) and south (12%). Wind speeds are generally light to moderate with an average wind speed of about 4 meters per second (9 miles per hour). The plant site proper is essentially devoid of native vegetation. Few if any plants or animals exist on the site. Any displaced flora and fauna can repopulate in similar nearby desert areas.

construction and operating activities will also force any animals living on the site to find similar habitats in the adjacent desert. There are no known archaeological or cultural items on or in the immediate vicinity of the site. However, if during the course of site preparation and excavations such items are found, immediate notification will be given to the appropriate GOE officials to permit investigation and proper disposition.

Adverse effects during construction will include fugitive dust from on-site traffic and construction activities and temporary and acceptable noise levels. Dust can be reduced by appropriate abatememt and control procedures.

The transmission right of way from El-Kureimat to Tebbin will be across desert terrain, and would have no adverse effect on the environment. No land acquisition issues are foreseen and no adverse aesthetic effects are contemplated.

The transmission right of way from El-Kureimat to the existing 500 KV and 220 KV transmission lines will require crossing of the Nile River and right of way across agricultural lands and desert, and would have no adverse effect on the environment. No land acquisition issues are foreseen. Potentially adverse aesthetic effects could be minimized by judicious planning.

D. AIR QUALITY:

The steam generators to be provided at El-Kureimat will be of pressurized design, burning natural gas and Mazout. All flue gases will be discharged to the atmosphere through a 152 meter high concrete stack provided for each unit.

In the case of clean burning natural gas, stack emissions of concern are primarily oxides of nitrogen. When Mazout is burned, primary emissions from the stack will be sulfur dioxide, oxides of nitrogen and particulates. Since the steam generators will burn a mix of natural gas and Mazout, the emissions will be less than expected for only Mazout burning. The proper design of the stack parameters, i.e. flue gas exit velocity and temperature, combined with stack height, will ensure that ground level concentrations of pollutants will not exceed applicable USEPA, World Bank or Egyptian standards. These standards are summarized in Table 1.

TABLE 1

AMBIENT AIR QUALITY STANDARDS

| POLLUTANT | TYPE AND PERIOD OF AVERAGING | AMBIENT QUALITY CRITERIA UG/m3 ** | | |
|---|---|---|---|---|
| | | IBRD | USEPA | Egyptian |
| Suspended Particulates | Max annual | 100 | 75 | --- |
| | Max 24-hour | 500 | 260 | 150 |
| Sulfur Dioxide | Max annual (arithmetic mean) | 100 | 80 | 60 |
| | Max 24-hour | 500 | 365 | 200* |
| Nitrogen Dioxide | Max annual (arithmetic mean) | 100 | 100 | 200 |

* Under review by Egyptian National Environment Committee.
** Microgram per Cubic Meter.

The stack will be designed and constructed to avoid excessive concentration of any emitted pollutant in the immediate vicinity of the stack as a result of aerodynamic down wash which may be created by the stack itself or by nearby plant structures.

The air quality impacts of each applicable pollutant produced from the operation of the two 600 MW generating units burning a mix of natural gas and Mazout has not been specifically analyzed by atmospheric dispersion modelling of the emissions.

Air quality impacts of each applicable pollutant produced from a similar operating 1,200 MW power station in Egypt have been measured from three air quality monitoring stations adjacent to the station and a meteorological station at the power station. The measurements were collected over a 12 month period. The air quality impacts of each pollutant are summarized in Table 2.

TABLE 2

MEASURED POLLUTANTS FROM OPERATING 1200 MW POWER STATION*

| POLLUTANT | TYPE AND PERIOD | CONTRIBUTION (percent natural gas/Mazout) ug/$m^3$ | | | |
|---|---|---|---|---|---|
| | | 90/10 | 80/20 | 25/75 | 0/100 |
| Suspended | Max annual | .1 | .2 | .4 | .6 |
| Particulates | Max 24-hour | 2 | 5 | 9 | 14 |
| Sulfur | Max annual | 1 | 2 | 5 | 9 |
| Dioxide | Max 24-hour | 21 | 62 | 128 | 195 |
| Nitrogen | Max annual | .6 | .7 | .6 | .8 |
| Dioxide | Max 24-hour | 14 | 21 | 14 | 18 |

* Shoubrah El Kheima Environmental Monitoring Program - Final Report prepared by Overseas Bechtel Inc.

Those measurements clearly indicate that a 1200 MW power station properly designed and burning a mix of fuels comparable to the mix of fuels to be burned at El-Kureimat will not have an adverse effect on the environment and is environmentally feasible if the El-Kureimat power station is properly designed and operated.

While the stack emissions of sulfur dioxide and particulates are directly related to the fuel being burned, the production of the oxides of nitrogen are a function of combustion and can be managed, within limits, by the design of the steam generator and its burners. The Grant Agreement Amendment will contain a Requirement Precedent to Disbursement of funds that EEA, in designing the plant and selecting equipment, will select boilers for the station incorporating burner designs and combustion controls that will minimize the production of oxides of nitrogen.

In the final design of the power station the engineer will give special attention to methods of reducing emissions to the atmosphere and make explicit the tradeoffs between enhanced air quality, and project cost so that EEA can make informed decisions.

An Environmental Monitoring System consisting of a minimum three air quality monitoring stations and one meteorological station will be installed on and near the El-Kureimat thermal power station and made operational not less than 12 months prior to commencement of on-site construction. The location of the monitoring sites will be based on an air quality modelling study to be performed by the project engineer with the proposed sites approved by USAID. The project engineer will train EEA personnel to operate and maintain the system and perform data analysis and air quality modelling. The system will measure the existing pollutant concentrations and diffusion conditions near the site. These measurements will be used in assessing the local air quality impacts which include the maximum projected contributions from the El-Kureimat thermal power station and measured background concentrations at the plant site and surrounding area. The monitoring will be conducted for at least one year to measure the month to month variability of meteorological conditions of the site and surrounding area and any seasonal variations of background pollution concentration levels. At the end of the first year data collection period, the project engineer will perform an air quality impact study to forecast the maximum impact resulting from the operation of the El-Kureimat thermal power station. The system will continue to monitor the site and surrounding area throughout the station construction and over the life of the operation of the generating units. At the end of each year, EEA will perform an assessment of air quality to determine the actual impact on air quality from the construction and operation of the thermal power station.

E. WATER QUALITY:

The primary use of water at El-Kureimat will be for condenser cooling. El-Kureimat is designed with a once through condenser system, wherein water is pumped from the Nile River through a condenser to condense the turbine exhaust steam. The circulating water is returned to the river by first going through a discharge tunnel at about 10°C (18°F) higher temperature to a seal pit structure where the condenser water will be discharged behind a weir into discharge pipes that then carry the water to the discharge structure.

The discharge structure will be so designed to maintain a maximum of 5°C (9°F) temperature outside the mixing zone in the river. Previous thermal plume studies have shown adequate dispersion of the thermal effects out from the shoreline and downstream. If the units discharge through diffusers, the plume should move further into the river and have a higher vertical mixing, thus reducing the overall thermal effect.

The wastewater treatment system will consist of: (1) lined equalization ponds (waste holding ponds) for receiving all non sanitary plant wastewater consisting of floor and equipment drainage, make up demineralizer regeneration wastewater, boiler blowdown, clarifier underflow, boiler washing wastes, and boiler chemical cleaning wastewater; (2) an oil/water separator for removal of floating oil from floor and equipment drainage prior to the equalization pond; (3) chemical feed systems including acid, caustic and polymer for conditioning the discharge of the equalization pond;

(4) a clarifier system for precipitation of the suspended solids and metal hydroxides from the equalization pond discharge; and (5) a sludge dewatering system for concentrating the underflow from the clarifier system. The treated clarifier effluent will be directed to the condenser cooling water seal pit and discharged into the river. All wastewater being returned to the river will meet existing USEPA and Egyptian Government standards.

The station's sanitary wastes will be piped to septic tanks and holding tanks.

The power station will have three systems which have a potential source for oil spills:

1. A turbine lubricating oil system is provided with each turbine and consists of an oil tank, pumps, strainers, coolers, instrumentation and piping. Oil spill protection on the tanks includes check valves on discharge lines to prevent flow reversal. Instrumentation will alert operators of excessive flows which could result in oil spills. Concrete dikes will retain any spillage and sumps with level actuated pumps will transfer oil to portable tanks for reclamation.

2. Each Mazout storage tank will be surrounded by an earthen containment dike to retain the total volume of oil in storage. Pumps will return spilled Mazout to the tanks.

3. Day tanks for Mazout storage will be surrounded by containment dikes to retain the total volumes in storage. Pumps will return spilled Mazout to the tank.

F. HEALTH, SAFETY:

Appropriate health and safety procedures will be implemented on the job site and the EEA will establish an on-site accident prevention staff working in conjunction with the project engineers staff. All contractors working on-site must document and enforce their safety program.

No Polychlorinated Biphenyls will be used in any project facilities.

G. ECOLOGICAL RESOURCES:

Considerations of the potential ecological impacts of the El-Kureimat power plant include: the removal of habitat by plant construction; air emissions effects; entrapment, impingement and entrainment of aquatic organisms in cooling systems; and effects of transportation systems. The significance of such impacts depends upon the specific plant design and the ecological systems affected. Because of these potential ecological impacts, certain design features will be evaluated:

1. Site location, design, construction techniques and technologies. The site was chosen because of the least cost alternative evaluation presented in the other sections of the feasibility study of the El-Kureimat plant. In addition, because of existing GOE statutes, the plant location decision also considered minimal disruption and removal of farm land, and water, air and ecological resources.

As mentioned in section C. LAND USE, the plant proper site is essentially devoid of native vegetation. Few if any plants or animals exist on the site. Any displaced flora and fauna can repopulate in similar nearby desert areas. Construction and operating activities will also force any animals living on the site to find similar habitats in the adjacent desert.

There are no wet lands within the site proper. Construction activities that may impact the Nile River and affect the fish population include dredging and filling along the river banks for barge loading and unloading structures, cooling system intake and discharge outfall.

The barge slip and the intake and discharge structures will, by necessity, require dredging the river bank, placing concrete and pilings for structural support, and construction of diffuser pipes into the Nile River. Dredged materials, mostly alluvial clay, will be spread along, and above similar, existing materials that characterized the Nile River banks, fronting the power plant site. At this location, the effective river width is close to three quarters of a kilometer. Any disruption to the fish population, caused by siltation due to dredging or construction activities, will be minimal, and the fish and other wildlife habitat will have ample opportunity to move elsewhere to adjacent similar habitat. The barge traffic normally takes the western bank route of the Nile, and no foreseeable disruption of barge traffic is anticipated during construction or operation of the plant.

2. Cooling system intake and discharge location and type. As part of the project consultant's duties, the design, location and timing of the construction of the intake and discharge structures will take into consideration the latest technologies offered for the protection and the least negative impact to the fish and wild life habitat, including the periods of fish spawning or wild life migration. Such considerations will include trash screens and travelling screens at cooling water intake, as well as water intake

velocity; condenser cooling system as it affects the temperature and velocity of water discharge, including plume size, plume permanency, and maximum of 5°C (9°F) temperature outside the mixing zone in the river. In addition, the project consultant will consider using multiport diffusers to reduce in-river impacts and alternatives to reduce the quantity of cooling water for the plant optimum operating needs.

The Nile River annual average flow is 53 billion cubic meters past this site, and thus provides ample water supply for the plants, without any disruption to the needs of others.

3. Thermal and chemical discharges. As mentioned previously in Section E. WATER QUALITY, and above, the thermal discharges need to adhere to existing Egyptian standards water quality criteria. The condensers will be so designed to maintain a maximum of 5°C (9°F) temperature outside the mixing zone of the river. Sludge from the chemical discharges as well as any petroleum based wastes will be disposed of in an approved land fill, designed by the project consultant.

## H. MITIGATION PLAN:

The project consultant will prepare a Mitigation Plan to show mitigation measures taken in design as well as those to monitor those environmental impact mitigative measures to be taken during construction and thereafter; a short summary for the need or impact; the mitigation activity; and the responsible implementation organization. This Mitigation Plan will also be used as a monitoring tool similar to one for construction activities as is required under USAID Environmental Procedures 22 CFR 216.3 (8). Included in this list of activities will be the transmission lines for both the Mazout fuel and the natural gas supply right-of-way, as well as any highway modifications necessary to build the plant. The Mitigation Plan will be reviewed and approved by USAID.

## I. INSTITUTIONAL DEVELOPMENT:

Operation of all environmental control systems and monitoring programs at El-Kureimat will be the responsibility of EEA. In the past, EEA's environmental unit was within the Studies and Research Group and was involved only with air quality. Water quality was the responsibility of the Egyptian General Inspectorate for Control Laboratories. Under the World Bank Fourth Power Project, EEA agreed to establish an Environmental Coordinating Committee to review all aspects of any environmental issues and advise the EEA management.

EEA has formed an Environmental Coordinating Committee to strengthen its environmental capability. The Committee, which reports to the reports to the Deputy Chairman for Studies and Research, includes representative from the previous environmental unit (air pollution), the Central Laboratory (water pollution), and from each of the operating zones. The Committee ensures that all the EEA related environmental activities are properly addressed, designed and executed.

## II. NATIONAL ENERGY CONTROL CENTER:

### J. BACKGROUND:

The National Energy control Center is located in the system dispatching building, adjacent to the Cairo West thermal power station, 18 Km. north of Cairo along the west bank of the Nile River. The control center was financed by AID in 1976 under Project 263-0023. The initial environmental examination indicated that the project would not have a significant effect on the human environment and that neither an Environmental Assessment nor an Environmental Impact Statement was required. The control center was constructed in the early 1980's and consists of main frame computers with man-machine interfaces, communications systems and necessary support facilities, including redundant climate control systems. The Center collects operating data from power generating stations and major transmission stations, analyzes performance, identifies optimum operating strategies and presents and records appropriate data for subsequent analysis.

This component of the Project will finance the procurement and installation of microprocessors and a reconfiguration of the data collection and computation processes thereby relieving the mainframe computers of lower order processing so that they can fully handle the higher order economic dispatch, reliability and security analysis routines.

There will be no physical construction at the site, nor expansion of water or sewage facilities or access roads which are presently adequate for the operation of the center. There will be no increase in staffing. The equipment to be installed will not contribute to the sound pressure level within the computer room, which is below 35 dB.

### K. CONCLUSIONS:

The construction and operation of the 2-600 MW steam turbine generating units will not adversely impact the air or water quality surrounding the thermal power station and will meet with existing U.S. EPA and Egyptian standards and mitigative measures developed during assessment and design of the project. An Environmental

Monitoring System will be installed on and around the site to establish background air quality levels and verify the impact of the plant operation on the environment.

The upgrading of the National Energy Control Center will not adversely affect the human environment.

ACTION AID3 INFO DCM ECON CNT5

VZCZCCRO007
RR RUEHEG
DE RUEHC #2132 1491848 30-MAY-90 TOR: 06:36
ZNR UUUUU ZZH CHRG: AID
R 291849Z MAY 90 DIST: AIDA
FM SECSTATE WASHDC
TO AMEMBASSY CAIRO 8595
BT
UNCLAS STATE 172132

ACTION TO DR PDS
ACTION TAKEN DATE 6/6
NAME INITIALS

AIDAC FOR JOHN HUNT, DR/UAD AND KEN LUEPHANG, DR/ENG

E.O. 12356: N/A
TAGS:
SUBJECT: APPROVAL OF ENVIRONMENTAL ASSESSMENT (EA) FOR THERMAL POWER PLANT AT EL KUREIMAT (PROJECT NO. 263-0215).

REF: (A) STATE 145404; (B) FAX DATED MAY 16, 1990 FROM PAUL THORN TO JIM GALLUP; (C) FAX DATED MAY 17, 1990 FROM JOHN HUNT TO JIM GALLUP; (D) FAX DATED MAY 22, 1990 FROM JOHN HUNT TO JIM GALLUP.

1. ANE/PD/ENV PROVIDED COMMENTS ON THE DECEMBER 1985 DRAFT ENVIRONMENTAL ASSESSMENT (EA) FOR THE NEW POWER PLANT AT EL KUREIMAT, EGYPT IN (A) ABOVE. USAID/CAIRO RESPONDED TO OUR COMMENTS AND QUESTIONS IN (B) AND IN ADDITIONAL COMMUNICATIONS ON MAY 17 (C) AND MAY 22 (D). THE ANE BUREAU ENVIRONMENTAL COORDINATOR APPROVED THE EA FOR THIS PROJECT ON MAY 23, 1990 BASED ON THE DRAFT EA AND THE THREE SUPPLEMENTS ((B), (C) AND (D)).

2. OUR INITIAL COMMENTS AND QUESTIONS IN (A) REQUESTED CLARIFICATION OF INFORMATION ABOUT THE SITE AND FUEL FOR THE NEW POWER PLANT AND INCLUDED RECOMMENDATIONS ON MONITORING, MITIGATIONS AND COOLING WATER ALTERNATIVES.

WE ALSO RAISED QUESTIONS ABOUT THE QUALITY OF MAZOUT, FINAL AIR EMISSION STANDARDS AND HANDLING OF WASTES GENERATED ONSITE. ANNEX L (B) ADDRESSED MOST OF OUR CONCERNS AND QUESTIONS COVERING LAND USE, AIR AND WATER QUALITY, HEALTH AND SAFETY, ECOLOGICAL RESOURCES, INSTITUTIONAL DEVELOPMENT AND THE MITIGATION PLAN. BECAUSE ONLY THE ELEMENTS OF THE MITIGATION PLAN ARE CURRENTLY AVAILABLE, USAID/CAIRO AGREED IN (C) TO PROVIDE ANE/PD/ENV WITH THE DEFINITIVE MITIGATION PLAN PREPARED BY THE CONSULTANT IN THE FINAL ENGINEERING DESIGN. USAID/CAIRO ADDRESSED OUR REMAINING CONCERNS IN (D), ESPECIALLY OUR CONCERN ABOUT THE AIR POLLUTION DISPERSION MODELING. BECAUSE OF THE RURAL LOCATION AND FUEL USED AT THIS POWER PLANT, ANE/PD/ENV ACCEPTS THE AGREEMENT TO CONSIDER THE CONSULTANT'S EXPERIENCE IN MODELING AS WELL AS POWER PLANT DESIGN IN THE SELECTION OF THE CONSULTANT. USAID/CAIRO MAY CONTACT ANE/PD/ENV IF THEY DESIRE SPECIFIC EXPERTISE TO HELP REVIEW THE CONSULTANT'S QUALIFICATIONS. ANE/PD/ENV ALSO

APPRECIATES THE INFORMATION PROVIDED BY USAID/CAIRO ON MAZOUT FUEL SPECIFICATIONS, NATURAL GAS ANALYSIS, STACK EMISSION CHARACTERISTICS AND CHLORINE LEVELS IN COOLING WATER.

3. ANE/PD/ENV ACKNOWLEDGES THE INFORMATION PROVIDED IN (B) REGARDING THE NATIONAL ENERGY CONTROL CENTER AND CONCURS WITH THE UPGRADING OF THE CENTER AND ENVIRONMENTAL MONITORING ON AND AROUND THE SITE.

4. THE INITIAL ENVIRONMENTAL EXAMINATION, PAGE 11 OF ANNEX L (B) WAS SIGNED BY THE BUREAU ENVIRONMENTAL COORDINATOR ON MAY 23, 1990 AND SENT TO KEN LUEPHANG THE MISSION ENVIRONMENTAL COORDINATOR. A COPY OF THE IEE AND THIS CABLE WAS FAXED TO PAUL THORN ON MAY 23, 1990. BAKER
BT
#2132

NNNN

# INITIAL ENVIRONMENTAL EXAMINATION

| | |
|---|---|
| PROJECT LOCATION | : Egypt |
| PROJECT TITLE AND NUMBER | : Power Sector Support 263-0215, Amendment 1 |
| FUNDING | : AID $215 million grant, GOE LE 130 million |
| LIFE OF PROJECT | : Nine Years. |
| IEE PREPARED BY | : John P. Hunt<br>USAID Project Officer<br><br>: Signature [signature]<br>Date May 16, 1990 |
| ENVIRONMENTAL ACTION | : No other environmental concerns arising from this project. Therefore, no further action required. |
| MISSION ENVIRONMENTAL OFFICER'S CONCURRENCE | : Signature [signature]<br>Ken Lue Phang<br>DR/ENG<br><br>Date May 16 1990 |
| ASSOCIATE MISSION DIRECTOR'S CONCURRENCE | : Signature [signature]<br>Paul Thorn<br>AD/DR<br><br>Date May 16, 1990 |
| DECISION OF ENVIRONMENTAL COORDINATOR, BUREAU FOR ASIA AND NEAR EAST | : Approved M. Vax<br>Disapproved ____<br>Date 5-25-90 |

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## MAZOUT FUEL SPECIFICATIONS

(A medium to low sulfur fuel oil equivalent to a No. 6 Oil)

| DESCRIPTION | INDICES OF FUEL QUALITY |
|---|---|
| Specific weight at 15°C (59°F) | 0.945 to 0.990<br>7.9 to 8.3 Lb/gal |
| Deg API | 18.2 to 11.4 |
| Viscosity at 38°C (100°F)<br>at 50°C (122°F) | 37°Engler (1311 SUS)<br>22.6°Engler (780 SUS) |
| Freezing temperature | 13°C max. (55°F) |
| Ignition temperature | 70°C min. (158°F) |
| Moisture content | 0.5 to 1.0% |
| Ash content | 0.1 to 0.3% |
| Sulfur content | 2.3% to 5.0% |
| Carbon content | 85% |
| Hydrogen content | 10.7% |
| Oxygen content | not present |
| Nitrogen content | not present |
| Sodium content | 0.0006 to 0.00239% |
| Potassium content | 0.00015 to 0.00042% |
| Iron content | 0.00106 to 0.005664% |
| Nickel content | 0.00152 to 0.0200% |
| Calcium content | 0.00066% |
| Vanadium content | 0.001 - 0.005% |
| Lower Heating Value | 9500 Kcal/kg |
| Higher Heating Value | 10,000 to 10,060 Kcal/Kg |

Source: EGPC, EEA and EPS Fuel Study.

# FUEL ANALYSIS OF NATURAL GASES

| | Average Vol., % | Average Wt., % |
|---|---|---|
| Nitrogen | 0.385 - 0.75 | 0.62 - 1.03 |
| Carbon Dioxide | 0.69 - 4.00 | 1.72 - 9.48 |
| Methane | 83.37 - 92.77 | 69.61 - 84.49 |
| Ethane | 4.117 - 8.13 | 7.03 - 13.13 |
| Propane | 0.75 - 3.02 | 1.77 - 6.95 |
| I - Butane | 0.06 - 0.04 | 0.18 - 0.12 |
| N - Butane | 0.03 - 0.02 | 0.09 - 0.06 |
| Molecular weight | 17.57 - 19.16 | |

| | |
|---|---|
| Density g/L at N.T.P. | 0.78 - 0.855 |
| Density g/L at 60°F & 14.696 psia | 0.742 - 0.809 |
| Specific gravity (air=1) at 60°F | 0.607 - 0.662 |
| Dew point at delivery conditions | Below 0°C |
| Gross calorific value -BTU/lb. | 21,427 - 23,056 |
| BTU/cu.ft. @ 60°F & 14.696 psia | 1,071 - 1,073 |
| @ N.T.P. | 1,113 - 1,132 |
| Kcal/$m^3$ @ 60°F & 14.696 psia | 9,530 - 9,545 |
| @ N.T.P. | 10,078 - 10,090 |
| 1 Ton Fuel Oil | 0.781 - 0.840 Ton gas |
| 1 Ton Gas | 1.191 - 1.282 Ton gas |
| 1 Ton Gas | 1,256 - 1,348 $m^3$ gas @ 60°F and 14.696 psia |
| 1 Ton Fuel Oil | 1,053 - 1,055 $m^3$ gas @ 60°F and 14.696 psia |
| 1 Ton Gas | 1,187 $m^3$ gas @ N.T.P. |
| 1 Ton Fuel Oil | 997 $m^3$ gas @ N.T.P. |
| Cu. ft./therm @ 60°F | 93.2 - 93.3 |
| Cu. ft./therm @ N.T.P. | 88.2 - 88.3 |

Source: EGPC and EEA

## STACK EMISSIONS PARAMETERS PER 600 MW UNIT

Stack Height - 152.4 m (500 ft)

Volumetric Flow Rate - 986 $m^3$/sec (2.1 X $10^6$ cfm)

Exit Temperature - 149°C (300°F)

Exit Velocity - 27.4 m/sec (90 ft/sec)

Exit Diameter - 6.8 m (22.2 ft)

Source: 1200 MW Gas/Oil Thermal Power Plant Engineering/Economic Feasibility Study for El-Kureimat, Final Report, July 1989 and December 1985

## COST ESTIMATE

A. El-Kureimat:

The El-Kureimat cost estimate was developed by the feasibility study consultant. The schedule is based on a reference thermal power plant schedule developed to support the basic scope assumption, including quantities, lead times and manpower requirements for a project of this size. The duration of the Project Implementation Schedule is 78 months through construction completion of Unit 2. The first 18 months are designed for various implementation functions to be performed by the EEA including the procurement of the project engineer and the obtaining of foreign exchange commitments.

The key to the completion of the project on schedule, and within the cost estimate, lies in placing the order for the boiler no later than 39 months before the scheduled completion of Unit 1, i.e. March 1993, because the boiler manufacturer's vendor data and drawings constrain the development of supporting structures and major piping systems on both units.

Prices for major components of the plant were obtained from vendors. The following assumptions were included in the project cost estimate:

* The project was totally subcontracted.
* Labor productivity and wage rates are based on Egyptian and Korean labor.
* Import taxes/duties are excluded.
* All payroll taxes and sales and use taxes are excluded.
* Escalation was excluded.
* Facilities outside the site were included.

The capital cost estimate for the two unit thermal power station, power transmission interconnection and the community facilities is summarized in Table M-1. The project is broken down into 21 procurement packages in accordance with the EEA procurement procedures which are summarized in Table M-2. The cost of each package has been estimated either by price estimates by major equipment suppliers; the consultants recent price experience on similar projects or previous industry experience. Each of the 21 procurements has been broken down into material and labor components and further divided into Egyptian and foreign supply components. The costs of each procurement package include an appropriate assignment of the total distributable costs, allowances for indeterminants and miscellaneous costs.

The total estimated cost, at the time of estimating in January 1989, was equivalent to $861.8 million, $693.7 million in foreign exchange and LE 454 million ($1= 2.7LE). These costs were escalated to 1991 to reflect the assumption that contracts for the majority of procurement packages would be executed in that year. The adjusted total equivalent foreign exchange requirement is $932.1 million, allocated 80 percent foreign exchange and 20 percent local currency results in foreign exchange equivalent to $745.7 million and local currency of LE 503.3. Further adjustment of the project cost components to reflect an additional 1 year delay in the procurement process resulted in an estimated total project cost of $780 million in foreign exchange and LE 604 million.

TABLE M-1

## SUMMARY OF KUREIMAT PROJECT CAPITAL COSTS (1)

| | Power Plant(2) | Community Facilities | NUPS Interconnection | Total |
|---|---|---|---|---|
| 1. Direct Costs | | | | |
| • Materials: Egyptian | 41.8 | 5.8 | 6.2 | 57.1 |
| Foreign | 340.7 | 0.8 | 25.3 | 363.0 |
| • Labor: Egyptian, unskilled | 10.7 | 1.8 | 20.5 | 34.1 |
| Egyptian, Skilled | 32.7 | 1.7 | 22.5 | 57.6 |
| Foreign, Skilled | 40.8 | - | 4.2 | 45.0 |
| • Total Direct Cost | 466.7 | 10.1 | 78.7 | 556.8 |
| 2. Indirect and Distributable Costs | 133.4 | 0(1) | 7.0 | 139.1 |
| 3. Allowance for Indeterminate and Miscellaneous Cost | 150.6 | 2.6 | 12.7 | 165.9 |
| 4. Total Present Day (1/1/89) Installed Cost | 750.7 | 12.7 | 98.4 | 861.8 |

**NOTE:**

1. All costs are expressed in millions of 1/1/89 dollars. The exchange rate used to convert cost developed in Egyptian pounds is U.S. $1 = L.E. 2.3.

2. Includes natural gas pipeline costs $6.7 million.

TABLE M-2

PROCUREMENT PACKAGE BREAKDOWN
TOTAL PROJECT COSTS

| Procurement Package | Description | Material $ | Labor $ | Total $ | Egyptian % Factor | Egyptian Component | Foreign Supply |
|---|---|---|---|---|---|---|---|
| 1. | Structural Piling | 4,013 | 937 | 4,950 | 60 | 2,970 | 1,980 |
| 2. | Civil Work | 33,751 | 16,485 | 50,236 | 58 | 29,342 | 20,874 |
| 3. | Structural Steel | 45,308 | 5,194 | 50,502 | 15 | 7,575 | 42,927 |
| 4. | Pumps and Drives | 18,180 | 0 | 18,180 | 0 | 0 | 18,180 |
| 5. | Feedwater Heaters, Deaerator, & Condenser | 17,502 | 0 | 17,502 | 0 | 0 | 17,502 |
| 6. | Water and Waste Treatment Systems | 16,698 | 0 | 16,698 | 0 | 0 | 16,698 |
| 7. | Turbine Generator, Erected | 140,045 | 9,613 | 149,658 | 1 | 1,442 | 148,216 |
| 8. | Boiler, Erected | 122,113 | 37,966 | 160,079 | 4 | 5,695 | 154,384 |
| 9. | Piping, Valves, & Miscellaneous Equipment | 38,027 | 0 | 38,027 | 5 | 1,850 | 36,177 |
| 10. | Instruments & Controls | 26,014 | 0 | 26,014 | 0 | 0 | 26,014 |
| 11. | Electrical Distribution Equipment | 29,219 | 0 | 29,219 | 5 | 1,461 | 27,758 |
| 12. | Switchyard | 21,210 | 0 | 21,210 | 5 | 1,061 | 20,149 |
| 13. | Yard Tanks | 6,637 | 1,224 | 7,861 | 85 | 6,682 | 1,179 |
| 14. | Mechanical/Pipe Erection | 11,972 | 25,183 | 37,155 | 25 | 9,289 | 27,866 |
| 15. | Electrical/Instrument Erection | 20,910 | 29,329 | 50,239 | 17 | 8,725 | 41,514 |
| 16. | Architect/Engineer Services | 0 | 59,661 | 59,661 | 16 | 9,460 | 50,201 |
| 17. | Colony | 8,300 | 4,400 | 12,700 | 92 | 11,694 | 1,006 |
| 18. | NUPS Interconnection | 39,356 | 59,034 | 98,390 | 63 | 61,986 | 36,404 |
| 19. | Wrapup Insurance | 3,561 | 0 | 3,561 | 100 | 3,561 | 0 |
| 20. | Simulator Training | 0 | 3,264 | 3,264 | 20 | 653 | 2,611 |
| 21. | Gas Transportation (Pipeline) | 2,680 | 4,020 | 6,700 | 70 | 4,690 | 2,010 |
| | GRAND TOTAL (U.S. $) | 605,496 | 256,310 | 861,806 | | 168,136 | 693,670 |

TABLE M-3



DATE:4-10-89

EGYPTIAN ELECTRICITY AUTHORITY
CALCULATION OF I.D.C.
KUREIMAT GAS/OIL FUELED POWER PLANT    I.D.C.RATE    8.50%

KUREIMAT - GAS/OIL UNIT 1    LE X 1000

| FISCAL YEAR | U.S. DOLLARS | EGYPTIAN POUNDS | ESTIMATED GRANT | FISC.YR. EXPEND. | BASIS FOR IDC | INTEREST DUR.CONST. | TOTAL CONSTR. | END OF YR. C.W.I.P | PLANT IN SERVICE |
|---|---|---|---|---|---|---|---|---|---|
| 89/90 | $10,671 | 24,540 | | 24,540 | 12,270 | 1,043 | 25,583 | 25,583 | |
| 90/91 | $80,029 | 184,070 | | 184,070 | 116,575 | 9,909 | 193,979 | 219,562 | |
| 91/92 | $203,983 | 469,160 | 99.514 | 469.160 | 393.433 | 33.442 | 502,602 | 722.164 | |
| 92/93 | $205,154 | 471.850 | 99,514 | 471.850 | 764,424 | 64.976 | 536.826 | 1.258.990 | |
| 93/94 | $41,004 | 94,310 | | 94.310 | 498.874 | 42,404 | 136,714 | 1.395.704 | |
| 94/95 | | | | | | | | | 1.395.704 |
| | $540,841 | 1,243,930 | 199,028 | 1,243,930 | | 151,774 | 1,395,704 | | 1.395.704 |

KUREIMAT - GAS/OIL UNIT 2    LE X 1000

| FISCAL YEAR | U.S. DOLLARS | EGYPTIAN POUNDS | ESTIMATED GRANT | FISC.YR. EXPEND. | BASIS FOR IDC | INTEREST DUR.CONST. | TOTAL CONSTR. | END OF YR. C.W.I.P | PLANT IN SERVICE |
|---|---|---|---|---|---|---|---|---|---|
| 89/90 | | | | | | | | | |
| 90/91 | $23,038 | 52,990 | | 52,990 | 26.495 | 2,252 | 55,242 | 55,242 | |
| 91/92 | $26,878 | 61.820 | | 61.820 | 83,900 | 7,132 | 68,952 | 124.194 | |
| 92/93 | $116,435 | 267.800 | 71,998 | 267.800 | 212,711 | 18,080 | 285,880 | 410,074 | |
| 93/94 | $179,042 | 411,800 | 71.998 | 411,800 | 480,513 | 40,844 | 452.644 | 862.718 | |
| 94/95 | $45,894 | 105,560 | | 105,560 | 351,597 | 29,886 | 135,446 | 998,164 | |
| | | 0 | | | | | | | 998,164 |
| | $391,287 | 899,970 | 143,996 | 899,970 | | 98,194 | 998.164 | | 998.164 |

KUREIMAT - GAS/OIL UNITS 1 & 2    LE X 1000

| FISCAL YEAR | U.S. DOLLARS | EGYPTIAN POUNDS | ESTIMATED GRANT | FISC.YR. EXPEND. | BASIS FOR IDC | INTEREST DUR.CONST. | TOTAL CONSTR. | END OF YR. C.W.I.P | PLANT IN SERVICE |
|---|---|---|---|---|---|---|---|---|---|
| 89/90 | $10,671 | 24,540 | 0 | 24,540 | 12,270 | 1,043 | 25,583 | 25,583 | |
| 90/91 | $103,067 | 237,060 | 0 | 237,060 | 143,070 | 12,161 | 249,221 | 274,804 | |
| 91/92 | $230,861 | 530,980 | 99.514 | 530.980 | 477,333 | 40,574 | 571.554 | 846.358 | |
| 92/93 | $321.589 | 739,650 | 171,512 | 739,650 | 977.133 | 83,056 | 822.706 | 1.669,064 | |
| 93/94 | $220.046 | 506.110 | 71,998 | 506,110 | 979,387 | 83,248 | 589,358 | 2.258,422 | |
| 94/95 | $45.894 | 105.560 | 0 | 105,560 | 351,597 | 29,886 | 135.446 | 998.164 | 1,395,704 |
| | | | | | | | | | 998,164 |
| | $932,128 | 2,143,900 | 343,024 | 2,143,900 | | 249,968 | 2,393.868 | | 2,393,868 |

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B. The National Energy Control Center:

The NECC Upgrade cost estimate is based on an unsolicited proposal from the original equipment supplier adjusted for EEA requirements.

TABLE M-3
NECC UPGRADE COST ESTIMATE

| | | |
|---|---|---|
| Computer System | | |
| Computer/Peripheral Hardware | | $ 2,600,000 |
| Digital Input Units and Hardware | | $ 400,000 |
| Graphic Consoles w/Software | | $ 500,000 |
| Software - Basic | | $ 2,000,000 |
| - Engineering, Planning, Hydro | | $ 285,000 |
| Communication | | $ 1,994,000 |
| Support | | |
| Computer Installation | | $ 800,000 |
| Software and RTU | | $ 270,000 |
| Spare Parts | | $ 925,000 |
| Training | | $ 270,000 |
| | Sub-total | $10,044,000 |
| Remote Terminal Units | | |
| Replacement of 37 units @ $30,000 ea | | $ 1,200,000 |
| Modification of 20 units @ $10,000 ea | | $ 200,000 |
| | Sub-total | $ 1,400,000 |
| Consultant Services | | |
| 6 staff years @ $250,000/year | | $ 1,500,000 |
| Travel 12 RT @ $2500/RT | | $ 30,000 |
| Fee 12% | | $ 184,000 |
| | Sub-total | $ 1,714,000 |
| | TOTAL | $13,158,000 |
| Contingency - 14 percent of total estimate | | $ 1,842,000 |
| | GRAND TOTAL | $15,000,000 |

PROJECT IMPLEMENTATION PLAN
Project 263-0215
Amendment

| ACTIVITY | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | | 1990 | | 1991 | | | | 1992 | | | | 1993 | | | | 1994 | | | |
| | | Q4 FY 90 | Q1 FY 91 | Q2 FY 91 | Q3 FY 91 | Q4 FY91 | Q1 FY92 | Q2 FY 92 | Q3 FY 92 | Q4 FY92 | Q1 FY93 | Q2 FY 93 | Q3 FY 93 | Q4 FY93 | Q1 FY94 | Q2 FY 94 | Q3 FY 94 | Q4 FY94 | Q1 FY95 |
| Month | 6 | 7 8 9 | 10 11 12 | 1 2 3 | 4 5 6 | 7 8 9 | 10 11 12 | 1 2 3 | 4 5 6 | 7 8 9 | 10 11 12 | 1 2 3 | 4 5 6 | 7 8 9 | 10 11 12 | 1 2 3 | 4 5 6 | 7 8 9 | 10 11 12 |
| Months to go | | 72 71 70 | 69 68 67 | 66 65 64 | 63 62 61 | 60 59 58 | 69 68 67 | 66 65 64 | 63 62 61 | 60 59 58 | 57 56 55 | 54 53 52 | 51 50 49 | 48 47 46 | 45 44 43 | 42 41 40 | 39 38 37 | 36 35 34 | 33 32 31 |
| Months Completed | | 1 | 2 3 4 | 5 6 7 | 8 9 10 | 11 12 13 | 14 15 16 | 17 18 19 | 20 21 22 | 23 24 25 | 26 27 28 | 29 30 31 | 32 33 34 | 35 36 37 | 38 39 40 | 41 42 43 | 44 45 46 | 47 48 49 | 50 51 52 |
| Project Authorized | XXXXX | | | | | | | | | | | | | | | | | | |
| Project Grant Agreement Signed | | XXXXX | | | | | | | | | | | | | | | | | |
| RP's Satisfied | | XXX | XXXXXXXXX | | | | | | | | | | | | | | | | |
| El-Kureimat | | | | | | | | | | | | | | | | | | | |
| ------------ | | | | | | | | | | | | | | | | | | | |
| Consultant Selected | | XX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXX | | | | | | | | | | | | | |
| Prepare Final Design and Specifications | | | | | | XX | XXXXXXXXX | XXXXXXXXX | | | | | | | | | | | |
| Equipment Material, Construct. Services Procurements | | | | | | | | X | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | | | | |
| Construction - Unit 1 | | | | | | | | | | | | X | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXX6/96XX |
| Construction - Unit 2 | | | | | | | | | | | | | | X | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XX12/96XX |
| Warranty Period | | | | | | | | | | | | | | | | | | | XX12/96 to 12/99XX |
| NECC | | | | | | | | | | | | | | | | | | | |
| ----- | | | | | | | | | | | | | | | | | | | |
| Consultant Selected | | XX | XXXXXXXXX | XXXXXXXXX | XXXXXX | | | | | | | | | | | | | | |
| Prepare Specification and RFP | | | | | XX | XXXXXXXXX | | | | | | | | | | | | | |
| Turnkey Contract Procurement | | | | | | | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXX | | | | | | | | | |
| Computer Supply & Installation | | | | | | | | | | XX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXX | | | | | |
| Warranty Period | | | | | | | | | | | | | | XX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XXXXXXXXX | XX08/95XX |
| Project Completed | | | | | | | | | | | | | | | | | | | *12/99* |

ANNEX N
Page 1 of 1

215