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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C. 20523

PROJECT PAPER

PROJECT NO. 263-0160

JANUARY 1982

EGYPT: REHABILITATION AND MODERNIZATION OF THE ASWAN HIGH DAM HYDROELECTRIC POWER STATION

UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: — DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Arab Republic of Egypt

3. PROJECT NUMBER: 263-0160

4. BUREAU/OFFICE: NE — 03

5. PROJECT TITLE (maximum 40 characters): High Dam Rehabilitation/Modernization

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 07 DD 30 YY 90

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 82 B. Quarter 2 C. Final FY 82

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

A. FUNDING SOURCE	FIRST FY 82 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	85,000		85,000	100,000		100,000
(Grant)	(85,000)	( )	(85,000)	(100,000)	( )	(100,000)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
Host Country		20,417	20,417		24,017	24,017
Other Donor(s)						
TOTALS	85,000	20,417	105,417	100,000	24,017	124,017

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ESF	740B	825				85,000		100,000	
(2)									
(3)									
(4)									
TOTALS						85,000		100,000	

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 provide improved reliability and economy of operation of the High Dam Hydroelectric Power Station.

14. SCHEDULED EVALUATIONS
Interim MM 03 YY 83 MM 06 YY 85 Final MM 07 YY 90

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)

17. APPROVED BY
Signature
Title: Director, USAID/Cairo
Date Signed MM 11 DD 21 YY 82

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION
MM 11 DD 21 YY 82

AID 1330-4 (8-78)

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EGYPT: REHABILITATION AND MODERNIZATION OF THE ASWAN HIGH DAM HYDROELECTRIC POWER STATION

SUMMARY AND RECOMMENDATIONS

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

2. Implementing Agency: The Egyptian Electricity Authority (EEA), a separate entity within the Ministry of Electricity.

3. Grant Amount: U.S. $100 million. The Grant amount will be passed on to the EEA as a grant contribution to EEA's equity capital.

4. Project Purpose: To provide improved reliability and economy of operation of the High Dam Hydroelectric Power Station at Aswan.

5. Project Description: Design, manufacture, replace and test Francis turbine runners, 500KV and 132KV circuit breakers, differential relaying and control instrumentation associated with the twelve (12) hydro turbine generators and for necessary related technical assistance during manufacturing, along with supervision during installation, testing and startup in Egypt.

6. Total Project Cost: The total cost of the Project both foreign exchange and local currency is estimated at $124.0 million. The foreign exchange component is estimated at $100.0 million. The local currency requirement equivalent to $24.0 million, will be financed by the GOE.

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

8. Mission Views: USAID/Cairo recommends that the requested grant be authorized.

9. Source of U.S. Funds: Fiscal Years 1982-83 Economic Support Funds.

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

11. Recommendation: Authorize a Grant in the amount of $100 million in accordance with the terms and conditions set forth in the draft Grant Authorization which is appended hereto as Annex B.

12. Project Committees:

USAID/Cairo

Project Officer:	John P. Hunt
Loan Officer:	Mark I. Silverman
Project Engineer:	John P. Hunt
Legal Advisor	L. Michael Hager
Economist:	Jerry Lappitus

AID/Washington

Project Officer:	Alfred Hotvedt
Development Officer:	Thomas A. Sterner
Senior Economist:	Leonard G. Rosenberg
Project Engineer:	Alfred Hotvedt
Program Analyst:	Virgil Miedema
Program Analyst:	Carolyn Coleman
Des Officer:	Dennis H. Morrissey
Attorney:	Judd L. Kessler
Regional Coordinator:	Laurie Marshall

CURRENCY EQUIVALENTS

Currency Unit	= Egyptian Pound (LE)

Official Rate

LE 1 (or 1,000 milliemes)	= US $1.19
LE 1,000	= US $1,190
LE 1,000,000	= US $1.19 million

WEIGHTS AND MEASURES

1 Kilowatt (kW)	= 1,000 Watts
1 Megawatt (MW)	= 1,000 Kilowatts
1 Kilowatt hour (kWH)	= 1,000 Watt hours
1 Gigawatt hour (GWn)	= 1,000,000 kWh
1 Meter (m)	= 3.28 feet

PRESSURE

1 Hectobar (hbar)	= 1450 pounds per square inch

GLOSSARY OF ABBREVIATIONS

A-C	Allis-Chalmers
BUREC	Bureau of Reclamation
EEA	Egyptian Electricity Authority
EEC	European Economic Community
EIB	European Investment Bank
EdF	Electricite de France
GOE	Government of Egypt
HIDELCO	High Dam Company for Electrical and Mechanical Projects
IDA	International Development Association
MEE	Ministry of Elecricity and Energy
OPEC	Organization of Petroleum Exporting Countries
REA	Rural Electrification Authority
SWECO	Swedish State Power Board Consulting Services
USAID	United States Agency for International Development
USDOE	United States Department of Energy
USDOI	United States Department of Interior
UPS	Unified Power System

I. INTRODUCTION

1.01 The Government of the Arab Republic of Egypt (GOE) has requested assistance to finance the foreign exchange cost for the rehabiliation and modernization of the High Dam Hydroelectric Power Station at Aswan consisting primarily of replacement of twelve (12) Francis runners[1/], along with fourteen (14) 500KV circuit breakers, ten (10) 132KV circuit breakers, differential relays and control instrumentation.

1.02 The project will form part of the U.S. assistance for the strengthening of the electric power infrastructure in Egypt. The replacement of the twelve Francis turbine runners at the High Dam, will correct a design deficiency which has required repeated lengthy outages of the generating units for repairs to the runners and which, if uncorrected, will jeopardize the continued operation of the generating units. The replacement of the obsolete circuit breakers, relays, and control instrument will enhance the reliability of the Power Station and the Unified Power System.

1.03 A large portion of AID's program in Egypt is concentrated in the electric power sector. In FY 75, a $30 million Grant (No. 263-0001) was provided to finance power distribution equipment for the rehabilitation and reconstruction of the Suez Canal area. In FYs 76 and 77, a $141 million Grant (No. 263-0009) was provided for the construction of a 300-MW thermal plant at Ismailia (Abu Sultan) on the Great Bitter Lake in the Suez Canal area and a $69 million Loan (No 263-K-032) was provided for the construction of a 120-MW gas turbine generator plant at Helwan and a 180-MW gas turbine generator plant near the city of Talkha. In FYs 76 and 78, a $41 million Loan (No. 263-K-033) and in FY 80 a $2.5 million grant was provided for the construction and installation of a National Energy Control Center, an on-line computer system which will monitor and control the Egyptian Unified Power Systems. In FYs 77 and 78, a $46 million Loan (No. 263-K-043) and in FY 80 a $10 million Grant (No. 263-0033) were provided to finance engineering services and to procure distribution equipment for the rehabilitation and expansion of electric distribution systems in Cairo, Alexandria, Beni Suef and

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1/ The Francis runner is the rotating element which is driven by water directed under pressure against vanes or "buckets" to force rotation of the generator. The runner is coupled directly to the electrical generator thru a shaft.

Shibin El-Kom. In FYs 79 and 81, a $190 million Grant was provided for engineering and major equipment for the 900-MW Shoubrah El Kheima thermal power plant. Finally, in FY 81, AID provided a $14 million grant to assist in financing two (2) Kaplan turbine runners as part of the Aswan II project.

1.04 The World Bank and the IDA have been active in assisting the power sector and have made three power sector loans to Egypt. The first loan was made in 1977 for regional electrification and provided for the rehabilitation and extension of electric distribution networks serving some six (6) million people in thirteen (13) urban centers and nineteen (19) rural zones outside Cairo and Alexandria. The second loan was made in 1979 for cofinancing the first two (2) generating units at Shoubrah El Kheima Thermal Power Plant. The third loan was made in 1980 for the development of a hydro power plant (Aswan II) adjacent to the existing Aswan Hydroelectric Plant utilizing the Aswan irrigation dam, cofinancing of the third generating unit at Shoubrah El Kheima and further rehabilitation and extension of distribution systems in urban, sub-urban and rural areas outside Cairo and Alexandria. The World Bank has also acted as Executing Agency for the UNDP-financed Power Sector Survey carried out in 1976-1978, a study to improve the operation and maintenance of fossil fuel boilers and combustion turbines, a study of petroleum products pricing and finally the high, medium and low voltage electricity tariff studies currently under preparation.

1.05 In FY 78, the United States Department of Energy, in cooperation with the Government of Egypt, conducted a comprehensive assessment of Egypt's energy resources, needs, and uses, and developed several alternative energy strategies that utilize the available resources to meet their energy requirements.

1.06 The total foreign exchange cost of this project is estimated at $100.0 million. All local currency needs, currently estimated at $24.0 million will be provided by the GOE. The AID grant will be passed onto the EEA by the GOE as a contribution to EEA's equity capital since our expectation is that even after assets are properly valued, EEA's debt to equity position will be less than satisfactory.

II. THE POWER AND ENERGY SECTOR

A. Organization

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

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

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

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

2.05 The Higher Council for Electric Power approved the formation, effective January 1, 1979, of seven provincial electricity distribution companies. These companies were formed to take over distribution (at 11-KV and below) of electricity from the

Cairo and Alexandria zones and from the municipalities in the other zones. EEA continues to be responsible for generation and transmission through its five zones. Each company prepares its own budget for approval of EEA's Board of Directors, receives budget allocations from the Government, contracts loans and may retain any revenue surpluses.

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

Egyptian Electricity Authority

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

2.08 EEA is a Government-owned enterprise regulated by the Ministry of Electricity and Energy. It is managed by the Chairman of the Board of Directors assisted by the Deputy Chairman for System Operations, the Deputy Chairman for Technical Affairs, and the Deputy Chairman for Financial and Administrative Affairs. The Board of Directors includes the Heads of EEA's five regional offices; representatives of the Ministries of Electricity and Energy, Finance and Planning; and the Chairman of the Rural Electrification Authority (REA). Annex F shows EEA's present organization chart.

2.09 The EEA had about 23,950 employees at the end of 1980. Of the 23,950, about 34% are in the Upper Egypt zone, 14% in Lower Egypt, 31% in Cairo (including Head Office), and the remainder are in the Alexandria and Canal zones. About 64% are classified as technical staff and the rest are in administrative, financial and

services departments. The fundamental staffing problems identified earlier remain. There is still considerable overstaffing and a severe shortage of middle and top management level executives. Experienced and well qualified Egyptians continue to be attracted to neighboring oil-rich countries by higher salaries. EEA hopes to increase the productivity of its staff through training. Both the IBRD and AID have been involved in training and it is anticipated that a new activity, Power Sector Management, will be initiated by AID to focus on improving management of the authority at both middle and senior levels.

B. UNIFIED POWER SYSTEM OF EGYPT

2.10 The Unified Power System of Egypt (UPS) was conceived, designed, procured and put into operation in the rather short period of time between 1962 and 1970. The UPS interconnects all the main hydro and thermal generating stations in Egypt and supplies electric power to all the cities, villages and industrial and agricultural centers all over the country. The standardized voltages in Egypt are: 500 KV and 220 KV for bulk transmission and interconnection, 132 KV, 66 KV and 33 KV for subtransmission and 11 KV and 220/380V for medium and low voltage distribution.

2.11 The UPS is divided into five interconnected zones: Upper Egypt, Cairo, Alexandria, Lower Egypt and the Canal Zone. The major generating facilities consist of the two hydro plants at Aswan and a small thermal plant at Assuit, located in the Upper Egypt zone, and a group of thermal and gas turbine plants near Cairo and Alexandria and along the Suez Canal and in the Delta.

2.12 The development of the installed generating capacity, the maximum demand and installed reserves from 1954 through 1980 are summarized in Annex G.

2.13 The total installed generating capacity at the end of 1980 was 4,706 MW. The capacity of the hydro plants was 2,445 MW or 52 percent (of which the High Dam provides 2,100 MW or 45 percent), the thermal plants 1,674 MW or 36 percent and gas turbine generators 587 MW or 12 percent. The total nameplate rating, however, gives a highly exaggerated value; available capacity from the units is normally about 3,700 MW. The reasons are:

a) High and Aswan Dams - The hydroelectric power system consists of the Aswan Dam and the High Dam. The High Dam turbines discharge into the Aswan Dam reservoir that serves as a regulating basin. The available electric energy generation is constrained by the requirements that the

total discharge through the hydro system must be sufficient to keep the Nile navigable and meet irrigation requirements. The irrigation discharge is fixed by the Ministry of Irrigation; reaching a maximum in the summer and a minimum in the winter months during the dry season. The available usable output from the hydro plants presently varies from a minimum of 900 MW in the winter months to about 1,750 MW in summer months.

b) Thermal Plants - The existing thermal plants have an aggregate firm capacity of only about 71 percent of their nameplate capacity primarily due to their age and damage received during the intermittent wars. Also, there has been a lack of maintenance and spare parts during the past decade due to a shortage of funds.

Annex H lists the existing generating plants by zone, type and equipment and shows both nameplate capacity and available capacity.

2.14 Current load forecasts, summarized in Annex I, project a near doubling of load between 1981 and 1986. Consequently, the EEA has embarked on a number of power station construction programs to add 3,555 MW of new generating capacity to the UPS through 1985. The construction program is summarized in Annex I. It should be noted that AID is associated with various projects which will provide additional capacity of 1,620 MW or almost 46 percent of the planned increase.

2.15 The past trend in Peak Demand and Energy Output are summarized in Table 1.

TABLE 1

GROWTH RATES OF PEAK DEMAND AND ENERGY OUTPUT
PERCENT GROWTH PER YEAR

Period	Peak Demand	Energy Output
1980-1979	16.3%	11.9%
1980-1976	13.3%	11.1%
1980-1971	12.6%	11.5%
1980-1961	9.3%	9.1%

2.16 The policy of the Egyptian Electricity Authority is to utilize to a maximum the low cost hydroelectric energy available from the Aswan Cascade in supplying the UPS. This policy has resulted in great savings in fuel oil and thus puts great emphasis on the High Dam's capability of providing reliable power.

2.17 The hydro, combined thermal and gas turbine gross generation and total annual energy generation from 1976 to 1980 (the period during which Lake Nasser has been at the normal operating level) are summarized in Table 2.

TABLE 2

SOURCES OF ENERGY IN GIGAWATT-HOURS(1) AND PERCENT OF TOTAL

	HYDRO				THERMAL AND GAS TURBINE		TOTAL GENERATION
	High Dam		Aswan Dam				
YEAR	GWh	%	GWh	%	GWh	%	GWh
1976	6085	52	1918	17	3643	31	11,646
1977	7152	53	1886	14	4479	33	13,517
1978	8153	54	1782	12	5078	34	15,013
1979	7969	49	1639	10	6751	41	16,359
1980	8071	44	1729	9	8629	47	18,429

2.18 The 500 KV electric power transmission system is the main artery of the UPS, interconnecting the two large hydroelectric power stations at Aswan, namely the High Dam (2100 MW) and the Aswan Dam (345 MW) with the Northern Egypt 220 KV system. The Northern Egypt power stations, which are 15 in number, having 69 generating units and a total installed capacity of 1,694 MW, are interconnected by the 220 KV system.

2.19 The 500 KV system consists of two 788 kilometers long overhead transmission lines running from the High Dam to Cairo, and transformer substations at Nag Hammadi and Samallut. For voltage regulation of the 500 KV lines, 500 KV shunt reactors are installed at the High Dam, Nag Hammadi and Samallut and synchronous condensers in Cairo.

2.20 The Northern Egypt 220 KV system consists of 931 route kilometers of double circuit and 153 route kilometers of single circuit overhead transmission lines and supplies thirteen 220/66 KV transformer substations having a total transformer capacity of 3330 MVA. The 220 KV system is supplied from the Northern Egypt thermal power stations as well as from the High Dam through the Cairo 500 KV substation.

2.21 The Upper Egypt 132 KV system consists of 815 route kilometers of double circuit transmission lines and 468 route kilometers of single circuit transmission lines and supplies twelve 132/33 KV transformer substations having a total transformer

1/ One million KWh = One Gigawatt-Hours (GWh)

capacity of 1227 MVA. The 132 KV system is supplied from the Aswan Dam hydroelectric power station, the High Dam hydroelectric power station, the Assiut thermal power station and through transformers at Nag Hammadi and Samallut substations.

C. HIGH DAM HYDROELECTRIC POWER STATION

2.22 The Nile water discharge entering Egypt is irregular, not only during the same year, but also from year to year. During high flood years, the annual water discharge rises to 150 billion cubic meters, while during low flood years it drops to 45 billion cubic meters. The annual water discharge needed for irrigation is about 55.5 billion cubic meters. Any water discharge in excess of these requirements was wasted in the Mediterranean Sea, while any annual discharge less than the irrigation water requirements would subject Egypt to severe losses in cultivated crops.

2.23 To provide for long term storage of the Nile water, the High Dam was constructed across the Nile and a storage lake of sufficient capacity to hold the excess water discharge of the high flood years for use in low flood years, was formed extending south into Sudan.

2.24 The High Dam is situated seven kilometers to the south of the old Aswan Dam. Its construction was started in January 1960 and was completed in January 1971.

2.25 The High Dam is a rock-fill dam, 3830 meters long of which 520 meters extend between the channel banks of the Nile and the rest extends toward the valley walls. The Dam rises 111 meters high above the river bed, its width at the bottom is 980 meters and at the top 40 meters. The Dam completely blocks the river channel and the water is conveyed from the upstream reservoir to the downstream lake through the power house at the toe of the dam on the eastern bank. Flood spills can be routed through a diversion canal to an overflow spillway.

2.26 The maximum water level above the High Dam is 183 m., the normal operational upstream level is 180 m., and the maximum allowable upstream level just before the flood season is 175 m. The maximum downstream level is 111 m. and the minimum is 105 m., while the normal average operational level is 108 m. Lake Nasser, the water reservoir above the High Dam, is 500 kilometers long, has an average width of 10 kilometers and surface area of 5,000 square kilometers. The total capacity of the reservoir is 165 billion cubic meters and consists of 30 billion cubic meters set aside for "dead storage" and to receive precipitated sediment; 90 billion cubic meters for live storage of usable flood water and up to 45 billion cubic meters for excess flood waters. In 19'5, the water level above the High Dam reached 175 m. and the water stored in the Nasser Lake exceeded 122 billion cubic meters.

2.27 Six concrete tunnels convey the Nile water from the upstream reservoir to the downstream lake through the power station. Each tunnel is 282 meters long and has a circular cross-section, with an internal diameter of 15 meters. Just before entering the power station, each tunnel is divided into two rectangular branches of 22 x 7.5 meters to supply water to a pair of hydraulic turbines or associated spillways. Each branch is again divided by a horizontal wall into two water passages, one, the penstock, for conveying the water through its hydroturbine, and the second, the spillway, for conveying the surplus water, not used for power generation, directly to the downstream canal. Revolving gates control the passage of the surplus water to the downstream canal.

2.28 The High Dam hydroelectric power station is built on the east bank of the Nile at the outlet of the tunnels. It houses twelve Francis type hydraulic generating units. Each unit can produce 175 MW at a maximum net dynamic head of 77 meters. The High Dam Hydraulic Turbine generators were placed in operation sequentially from mid-1967 through mid-1970. The dates of Initial Hydraulic and Electrical Operation are summarized in Table 3.

TABLE 3

HIGH DAM HYDRAULIC TURBINE - GENERATOR UNIT OPERATING DATES

UNIT	DATE OF INITIAL HYDRAULIC OPERATION	DATE OF INITIAL ELECTRICAL OPERATION
1	June 25, 1967	October 15, 1967
2	October 14, 1967	October 30, 1967
3	December 8, 1967	December 14, 1967
4	January 6, 1968	April 19, 1968
5	June 25, 1968	July 26, 1968
6	June 25, 1968	December 21, 1968
7	June 18, 1969	July 8, 1969
8	May 28, 1969	June 30, 1969
9	December 17, 1969	December 25, 1969
10	April 2, 1970	April 11, 1970
11	June 12, 1970	June 27, 1970
12	July 5, 1970	July 7, 1970

2.29 Twelve 15.75/500 KV 206 MVA step-up transformers raise the generated voltage to 500 KV. Each three generator-transformer units are connected on the 500 KV side by a bus-bar forming one generation block. The four blocks are connected to the 500 KV switchyard bus-bars by two 500 KV air-blast circuit breakers. Two outgoing 500 KV overhead transmission lines run northwards to Cairo. Two 500/132 KV 320 MVA stepdown transformers supply the 132 KV bus-bars. The 132 KV switchyard comprises eight outgoing 132 KV line bays. At present only one double circuit 132 KV overhead transmission line interconnects the High Dam and the Aswan Dam hydroelectric power stations.

2.30 The total available energy from the High Dam was 8.4 billion KWh in 1980. This available energy varies during the periods of year and follows the daily irrigation water discharge. It reaches a maximum value in the summer months of August through October, when the irrigation discharge is at its maximum value. During the winter months of December through February, when the irrigation discharge drops to its minimum value, the available energy from the High Dam also drops to a minimum value.

2.31 The annual water releases through the turbines, energy generation of the High Dam hydroelectric power station, spilled water and unutilized energy potential since the reservoir reached normal operating levels in 1975 are summarized in Table 4.

TABLE 4

ANNUAL WATER RELEASES THROUGH TURBINES AND SPILLWAYS AND ENERGY GENERATION AND UNUTILIZED ENERGY POTENTIAL

Year	Water Release Thru Turbines (Billion of Meter^3)	Energy Generated (Millions KWH)	Water Release Thru Spillway (Billions of Meter^3)	Estimated Unutilized Energy Potential (Millions KWH)
1976	44.661	6085.3	10.115	1350
1977	50.307	7152.2	7.490	1000
1978	53.159	8153.2	8.907	1400
1979	51.909	7969.3	6.077	780
1980	52.145	8071.3	4.635	720

2.32 The High Dam power station is operated as a peak load power station covering the fluctuations of the daily electric power demand. Normally, the water is discharged through the hydro turbines in accordance with the electric power demand but limited by the 500 KV

transmission line loading constraints. Any excess water required for irrigation is passed through the spillway tunnel and discharge gates. The fluctuating discharge through the High Dam hydro turbines and spillways is absorbed by the regulating lake between the two Dams. The allowable daily variation of the water level of the lake is $\pm$ 1.5 m. The total daily discharge through the High Dam is kept equal to the daily discharge through the Aswan Dam which in turn corresponds to the daily irrigation requirements.

2.33 Water for power generation flows from the tunnel (penstock) into a spiral case which completely surrounds the turbine runner. The spiral case is of decreasing cross section around the periphery of the turbine so as to maintain constant water velocity as the water is channelled inward around the circumference of the turbine. As the water is directed inward through the fixed vanes and governor controlled wicket gates, it is accelerated, due to the decreasing cross-sectional area of the passageways, and thrusts against the turbine runner where the kinetic energy of the water is converted into mechanical energy of rotation to drive the generator to produce electrical energy.

III. THE PROJECT

A. General

3.01 This project consists primarily of the replacement of twelve (12) Francis runner turbines; fourteen (14) 500KV circuit breakers; ten (10) 132KV circuit breakers; generator, generator/transformer, 500KV bus, 132 KV bus differential relays, and control instruments.

3.02 The proposed AID Grant assistance will finance:

a. The foreign exchange costs of the turnkey contract for providing and installing the replacement turbine runners and the project management and inspection services of EEA's technical advisor.

b. The foreign exchange costs of the procurement of circuit breakers, relays and metering instruments, technical direction during installation and the engineering and possible procurement services of EEA's technical advisor.

B. Purpose

3.03 The purpose of the project is to improve reliability and economy of operation of the High Dam Hydroelectric Power Station.

3.04 The Francis Runners design will be based upon proven state of the art hydraulic and metallurgic techniques which will provide an additional 5MW of generating capacity per unit and a 3 percent improvement in efficiency. Runner replacement will eliminate the need for frequent unit outages and associated high maintenance costs to maintain the present Francis runners.

3.05 The circuit breakers, relays and control instruments will be state-of-the art design which will permit fault detection and interruption substantially faster than provided by the present apparatus and controls and provide the station staff with accurate and timely operating data upon which to base operating decisions.

C. Cost Estimate

3.06 A cost estimate for the replacement of the turbine runners has been prepared by Allis Chalmers and reasonableness of the cost has been verified by both AID and the BUREC. The cost estimate was based on a Turnkey Contract which provides for the design,

engineering, model-testing, manufacturing, transporting to the High Dam, runner replacement and testing and related supervision during installation. The Preliminary Cash Flow is presented in Annex K.

3.07 The contract cost includes fixed prices based upon December 1981 price levels with escalation adjustments based upon indices published monthly by the Bureau of Labor Statistics. The labor force is presumed to consist primarily of local Egyptian labor.

3.08 The cost estimate for the replacement of circuit breakers, relays and control instruments is based upon a preliminary cost estimate prepared by BUREC. Circuit breaker cost estimates compare favorably with tendered costs for similar circuit breakers recently obtained by EEA in an international tender. Installation of this equipment will be done by Egyptian contractors or EEA personnel.

3.09 The preliminary cost estimate for BUREC engineering services include their engineering services during the manufacture and installation of the runners and engineering services in the preparation of bid documents, bid evaluation and possible procurement agent role for the circuit breaker, relay and control instrument replacement.

3.10 The project cost estimates are summarized in Table 5. A more detailed analysis of the runner replacement costs and BUREC estimate to replace the circuit breakers, relays and control instruments are presented in Annex S.

TABLE 5

SUMMARY OF COST ESTIMATES
(U.S. $ THOUSANDS)

	FOREIGN	LOCAL	TOTAL
a. Runner Replacement			
Fixed Price	56,639	12,214	68,853
Escalation	25,381*	8,203*	33,584
Sub-Total	82,020	20,417	102,437
b. Circuit Breaker, Relay, Control Instrument Replacement			
Engineering	166	-	166
Equipment	13,000	-	13,000
Installation	250	2,900	3,150
Contingency	1,000		1,000
Sub-Total	14,416	2,900	17,316
c. Technical Services			
Price	3,564	700	4,264
Sub-Total	3,564	700	4,264
Total Estimated Project Cost	100,000	24,017	124,017

* Escalation calculated on basis of December 1981 prices adjusted for future increases in cost at an assumed rate of 12 percent per year.

D. Section 611(a) Requirements

3.11 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. The project is based upon sound engineering and analysis originally performed by the Swedish Consulting Group (SWECO) and the Hydraulic Generator Department of Electricite de France (EDF) and confirmed by the Bureau of Reclamation (BUREC). BUREC has also prepared a reasonably firm cost estimate of the project. The Mission has reviewed the plans and cost estimate and finds them reasonable and accurate.

IV. TECHNICAL ANALYSIS

A. General

4.01 The operational integrity of the Aswan High Dam Power Station has been flawed by progressively deteriorating turbine runners in each of the twelve 175 MW power generator units and obsolescence of the 500KV and 132KV circuit breakers, protective relaying and control instrumentation. Despite limitations on operating parameters and constant repair activity, the deterioration of the turbine runners has progressed to the point that knowledgeable experts have concluded that structural failure is likely to occur within a time frame (impossible to predict with precision -- from one month to five years, has been mentioned) that demands replacement as soon as possible. The obsolete circuit breakers, relaying and control instrumentation and inability to obtain necessary spare parts from the Russian manufacturers adversely affect the reliability of the station and the Unified Power System.

B. Description of Turbine Runner

4.02 Stripped to the barest essentials, the rotating parts of the vertical-mount hydraulic turbine-generator unit (as at the High Dam) may be visualized as three components rigidly connected and turning together: the turbine runner at the lower end of the assembly, the generator rotor at the upper end, the two connected by a large vertical shaft.

4.03 The concern here is primarily with the turbine runner. It is a "Francis" type (inward flow reaction turbine) which comes from the name of an American, James Francis, who devised the basic configuration in 1849. The Francis Runner is the type generally utilized for medium head installations as at the High Dam where the head (depth of water over the turbine runner) has ranged between 64 and 69 meters (210-225 feet) since 1975.

4.04 The turbine runner at Aswan is a stainless steel welded casting some 7.2 meters (24 feet) in diameter, 3.7 meters (12 feet) high and weighing 140 tons. It consists essentially of an upper ring or Crown at the top joined to a bottom ring or Band some 2.2 meters (7.2 feet) below by 14 vanes or buckets. The Crown is 0.34 meters (1.1 feet) high and 4.55 meters (15 feet) in diameter. The Band is 1.1 meters (3.6 feet) high with an outside diameter of 7.2 meters (23.6 feet). The leading (outside) edge of each vane is 2.75 meters (9 feet) in length and 100 mm (4 inches) thick; the discharge

(inside) edge is 4.3 meters (14.1 feet) in length and 12 mm (0.5 inch) thick. The thrust of water under pressure from the dam reservoir flowing through water passages against the vanes rotates the turbine runner (at 100 revolutions per minute at the High Dam) and, through the connecting shaft, the generator rotor. The water drops downward from the turbine runner through the draft tube and out to free-flowing condition in the tail race below the power station.

4.05 The service life generally expected of a hydroturbine runner is at least 35-50 years. After initial run-in and completion of acceptance tests the turbine pit is routinely dewatered and the runner inspected at about four-year intervals. Repair if any at such time is normally no more than filling cavitation pitting -- an occurrence associated with formation and collapse of vapor filled bubbles due to changes in hydrodynamic pressure of the water on the runner surfaces.

C. The Turbine Runner Problem

4.06 During routine inspection of Units 1 and 2 in 1969, cracks were observed at the trailing edges of the buckets at the runner band as well as at the runner crown. The cracks were of various sizes, from a few millimeters up to about 1,500 mm. It was observed that the buckets contained many cavities, corrosion bleedings and that the blade surfaces were irregular. A few cavitation shadows were found on the suction sides of the buckets.

4.07 Upon the discovery of the first cracks, specialists from the turbine supplier, Leningrad Machine Works (LMZ) inspected the units and proposed welding procedures to repair the cracks and to increase the thickness of the bucket trailing edges at their connections to the crown and band. These recommended repairs and modifications were made to the Francis runners during the normal maintenance inspections through 1974. Subsequent inspections revealed that, while the repairs had greatly reduced the cracking of the blades at the runner bands, additional cracks were occurring either adjacent to or within the runner crown. EEA has through the years utilized the services of numerous consultants and welding specialists to correct the blade cracking. All recommended procedures have been unsuccessful in correcting or limiting the occurrence of blade cracking. A history of Inspection Data for Cracks in the Francis Turbine Runners is summarized in Annex L.

4.08 In 1977, LMZ performed additional tests and inspections and recommended operation limits for the heads and tail water levels encountered which severely limited the operating range of the units

and the units' ability to share loads under the variable loading conditions required for the full range of plant operation.

4.09 In 1979, the Swedish Consulting Group (SWECO) undertook a study of the runner design and turbine performance at various loads. As a part of this study a series of operating tests were performed on one unit. These tests revealed severe cavitation noises and vibrations under various loading conditions. The SWECO study concluded that "the frequent cracking of the runner buckets is due to dynamic forces caused by hydraulic instability created by wrong design of the crown as well as a wrong shape of the trailing edges of the buckets." SWECO also reported that a review of the history of the cracks showed "there is a clear tendency of increased lengths of the cracks. From being only about 100 mm. in the beginning, they are now more than 1,000 mm. This means that the margin towards a serious failure is decreasing." In sum, rectification appears to lie not with repair (welding, heat treatment, etc.) but with major design modification, most likely redesign and replacement of existing turbine runners.

4.10 During 1980 representatives of the Hydraulic Generator Department of Electricite de France (EDF) conducted a series of tests on several Francis runners to determine the extent of cracking, the metallurgy of the runners, and the magnitude of residual and operational stresses within the runner buckets. The dye penetration and radiography tests confirmed extensive cracking in the fillets where the buckets and crown are joined. The cracks were found to elongate either in the fillet tending to detach the blade from the Crown; or to penetrate into the Crown and disappear under the runner cone where their continued development could not be seen. There is no non-destructive test method for measuring the depths of the cracks. Many defects where found in the metallurgy of the runners including occlusions, gaps, cracks and pipes in the cast metal.

4.11 The measurement of the residual and in-service stresses revealed in-service stresses nearly double stresses on runners of standard design in the area of the bucket adjacent to the attachment to the Crown indicating improper design. The stress level should not however have caused the fatigue cracking if the casting was of good quality. The previous efforts to correct the cracking problem were of poor quality and was confirmed by very high internal stresses. The combined action of high in-service and residual stresses on a poor quality cast metal welded structure have caused the serious cracking at the tops of the blades, where they join the Crown, on the water discharge side. EDF concluded that the fatigue cracks will continue to develop and reappear in the same location on

the runner blades. EDF recommended an improved welding procedure which they believed would withstand further cracking. EDF recently completed repairs to Runners 3 and 4 and will repair additional runners in subsequent years. It is hoped that the new welding procedures will prolong the service life of the repair work on the runners sufficiently to maintain operation until the runner replacement program is complete.

4.12 During the most recent maintenance outages to repair the cracked runner buckets, progressive cracking within the Crown of the runners was observed. The Crown, containing many openings for air passages and shaft bolting, cannot be welded nor can the full extent of the fracturing be identified. Complete fracture of the Crown would probably result in the runner freezing to the wearing rings and removal of the runner could only be accomplished by cutting the runner into pieces. The Government of Egypt has recognized the gravity of the situation and is determined to replace the existing turbine runners with runners of proper design and metallurgy.

4.13 In order for AID to develop a program to assist the Government of Egypt in overcoming the defective Francis turbine runner problem, in August 1981, a team of highly qualified engineers from the United States Department of Interior, Bureau of Reclamation (BUREC), inspected two (2) runners, reviewed operating data and previous studies prepared for EEA. The BUREC team concluded that:

1. Turbine runners are improperly designed.
2. Runner castings are very poor quality.
3. Welding repairs have compounded the problem.

A summary of the situation is put more cogently in the words of the BUREC Team:

> "The present condition of runners 3 and 4 makes their structural integrity questionable and these two runners according to EEA records are supposed to be the best. There are no turbine runners on Bureau of Reclamation projects with the severe cracking and casting problems of the Aswan High Dam Power Plant runners. <u>If they were, they would be replaced</u> (emphasis added). The gravity of the vane cracking problem cannot be over emphasized nor a runner replacement program implemented too quickly."

The BUREC report is included in Annex M.

D. Solution to the Turbine Runner Problem

4.14 With severe operating limitations on the units and the structural integrity of the turbine runners seriously in question, it is clear that action must be taken to restore the operational integrity of the power plant and the structural integrity of the turbine runners. In a defective runner situation, one would normally examine three options:

- in situ repair
- removal and repair or design modification of the existing runner either on site or at the original (or comparable) factory
- replacement of the existing runner with a carefully designed and tested runner.

4.15 In situ Repair: This is normally utilized when problems are minor and limited such as a localized materials defect.

4.16 Removal and Repair or Design Modification of Existing Runner: Extraction and repair might be indicated if an otherwise satisfactory runner had sustained damage in an accident or a replaceable part such as a wearing band needed attention. Extraction and design modification might be attempted if the design flaw had been pinpointed, if it could be corrected by removal, addition to or reshaping of parts of the basic casting; any of which should be verified previously by model testing. Either repair or modification is a major undertaking: the unit must be dismantled and the runner lifted from the turbine pit and transported to the manufacturer, or else layed out in the powerhouse erection bay where necessary shop facilities, equipment and skilled staff have been assembled to accomplish the work.

4.17 Replacement of Existing Runner: In the event a runner is damaged beyond repair, or has an inherent defect -- design or material -- that is intolerable with respect to either operating or structural integrity, then it must be replaced. This exercise is essentially a repeat of the steps involved in supplying the intial runner with at least three major additions:

1. the existing unit must be dismantled and the defective runner removed;

2. the replacement runner must be redesigned (and confirmed by model tests) to eliminate previous defects; and

3. the redesigned runner must be compatible to both physical and operating characteristics with existing facilities, i.e. generator, shaft, governors, scroll case, wicket gates, draft tube, etc.

4.18 In the High Dam case it has become clear that the root of the problem is the design of the runner both in geometry and proportioning of intersecting stressed elements. This was definitively stated by SWECO and EDF consulting groups after tests in 1979 and 1980 and confirmed by observations of the Bureau of Reclamation team in August 1981.

To quote from the SWECO "Report on Turbine Study for SEA (Aswan Plant)" performed during September and December 1979:

> "The observations of cavitation damages at the upper labyrinth ring together with the observations made during the test run of unit No. 4 clearly indicate that the runner crown has an incorrect design, meaning that an underpressure is created at the top of the runner. This underpressure gives rise to an unsteady flow through the turbines, meaning that pulsations and water hammer effects will occur. The dynamic forces created by the unsteady flow give rise to high stresses especially in the buckets. In fact, the problems seem to exist within the main part of the operating range 0-175 MW.
>
> It is also rather clear that the runner buckets are vibrating during operation. Based on our experiences from some turbine units in Sweden - Francis as well as Kaplan type - we know that such vibrations alone may cause cracks in the buckets and blades.
>
> Based on the above we are confident that the frequent cracking of the runner buckets is due to dynamic forces caused by hydraulic instability created by wrong design of the crown as well as a wrong shape of the trailing edges of the buckets. Consequently it is not possible to overcome the problems of the cracks just by using other types of electrodes and by making heat treatments in connections with the repairs. In our opinion the problem can only be overcome by tackling the sources of the problem."

4.19 In March 1980, the SWECO group suggested two approaches to solution of the problem: (a) purchase completely new runners of "appropriate design", or (b) setting up extensive welding facilities, heat treating furnace, and turning machine in the

powerhouse, dismantle the unit, remove the runner to powerhouse erection deck, and modify the existing runner by (1) chamfering the trailing edges of the vanes on the pressure side (expected to reduce blade vibration) and (2) changing the design of the runner crown by inserting a conical plate (expected to stabilize the flow through the runner). It was recognized that the latter approach might not give a satisfactory result; that a pilot modification should be made first on the spare runner (LMZ originally provided thirteen runners in all -- one a spare) and then tested under operation for output and vibration. The EEA did not pursue the on-site modification attempt -- probably just as well in view of the complexity of the undertaking with no assurance a satisfactory solution would be attained.

4.20 To quote from the EDF "Final Report, Aswan High Dam Hydro Electric Power Station" performed during the period May thru November 1980:

> "The runners at the Aswan High Dam Hydro-Electric Power Station are 13% chrome steel machine welded structures. The in-service stress measurements have shown that, despite the thicker section where the blades are joined on, there were high stresses where they meet the hub; the maximum recorded stress was 25 hbar, as against not more than 14 hbar on runners of standard design. This means there is a design fault in this zone.
>
> However, this stress level should not cause fatigue cracking if the metal were of good quality, especially as the vibratory stresses are low. In particular it can be stated that there is no abnormal excitation by Karmann vortices as intimated by some reports.
>
> The gamma radiography has on the contrary shown that the metal deposited to increase the blade thickness or to repair the cracks was of very poor quality on the whole. The residual stress meaurements also showed that there are very high (50 hbar tension) internal stresses in this metal owing to the repair method used.
>
> Even the original manufacturing welds by the constructor, LMZ, have notable defects.
>
> It is therefore not surprising that the combined action of high in-service and residual stresses on a poor quality metal should have caused serious fatigue cracking systematically on all the runners.

> These cracks are located chiefly at the tops of the blades, where they join the hub, on the water discharge side. It can be confidently said that, in these zones, so long as repairs are made as at present, fatigue cracks will develop and reappear in the same place or a few centimeters away."

EDF proposed a welding process which they anticipated would extend the life of the repair work on the runners. EEA executed a contract for this demonstration repair process and Runners 3 and 4 were turned over to EDF technicians in August 1981.

4.21 The findings of the BUREC Study Team of August 1981 were unequivocal: that the runner design was faulty and the castings of poor quality; the structural integrity of the runner in its present state is questionable and catastrophic failure possible; that complete runner replacement proceed as quickly as possible.

4.22 AID concluded at this juncture the only sound option is to proceed without delay with procurement and installation of new runners of improved design; such design to represent state of the art and proven by model testing prior to fabrication.

4.23 As indicated earlier, the replacement process is technically complex and demanding. It requires careful redesign of the turbine runner, model testing, fabrication with proven materials and techniques, and installation; all to be physically and operationally compatible with the existing turbine-generator unit. It is considered critical that this entire process be under the direct control and responsibiltiy of a single entity. The special nature of the project compels extraordinary measures to assure the integrity of the design/model testing/fabrication/installation process. This is particularly no place for any element essential to the success of the undertaking to "fall between the cracks". There is only one firm with the capability of designing, model testing, and fabricating turbine runners of this size in the United States -- Allis-Chambers.

4.24 The replacement process of all units from the date of contract award through design, model testing, fabrication, transportation, and installation is estimated to require eight to nine years, three and a half years for the first pair of units. The arrangement of the water passages in the High Dam Power Station (each intake from the reservoir serving a pair of units) dictates that the replacement runners be installed in pairs to maintain the maximum on-line capability of the plant over the replacement period.

4.25 Given the long lead time for replacement of the runners, the repair continues to be of prime importance. If the runner(s) fails on any unit(s) it would mean the loss of millions of kilowatt-hours of energy to the Egyptian economy or else replacement generation with high cost thermal energy if capacity is available.

E. Description of Electrical Protection and Instrumentation

4.26 Electrical protection of the generators, transformers, 500KV and 132KV busses is provided by relays which compare electrical currents entering and leaving the equipment being protected and respond to any difference to actuate circuit breakers to interrupt the flow of electric current and isolate the generators, transformers or busses from the adjacent electrical systems.

4.27 Electrical short circuits are characterized by extremely large current flows and the release of large quantities of energy in the form of heat that damages areas adjacent to the short circuit. To minimize equipment damage from the short circuit and disruption to the power network, rapid isolation of the malfunctioning equipment is required. Isolation times include the times for the relay to detect the short circuit, actuate the circuit breaker mechanism, and for the circuit breaker mechanism to open the current carrying contacts to isolate the malfunctioning generator, transformer or bus.

4.28 The control of the station is dependent upon accurate and timely data on generator, transformer, bus and transmission line loading upon which the station staff is able to determine equipment status and operating performance with the specified ratings. During and following abnormal operation, a record of station performance is invaluable. Where instrumentation is sluggish, nonresponsive or inoperable, the station's performance is impaired and at critical times insufficient or reliable information is unavailable upon which to assure reliable station operation.

F. The Protection and Instrumentation Problem

4.29 The circuit breakers, relays and control instrumentation which were installed at the High Dam in the late 1960's were approaching obsolence when installed. Shortly after being placed in service, spare parts were no longer available. Spare parts inventories are being exhausted and a portion of the plant instrumentation is no longer functioning.

4.30 The 500KV circuit breakers are rated 525KV, 1800 amperes continuous current with an interrupting rating of 17,500 amperes. The circuit breakers are of Air Blast design and are slow operating with an interrupting time of 4 to 5 cycles (0.08 to 0.1 seconds based upon a system frequency of 50 cycles per second). Spare parts are nearly exhausted and are no longer available for purchase.

4.31 The 132KV circuit breakers are rated 132KV, 1500 amperes continuous current with an interrupting rating of 21,800 amperes. The circuit breakers are of Air Blast design and are slow operating with an interrupting time of 4 to 5 cycles (0.08 to 0.1 seconds based upon a system frequency of 50 cycles per second). Spare parts are nearly exhausted and are no longer available for purchase.

4.32 The differential relays are electromechanical devices with an inherently slow response time. The present relays have an operating time of 2 to 3 cycles (.04 to .06 seconds)whereas current state of the art relays offer operating times of less than 2 cycles (.04 seconds). Spare parts are no longer available for purchase and the supply of spare parts is nearly exhausted.

4.33 The control instruments for the monitoring and control of the hydro turbine generators, substation and transmission facilities are obsolete, sluggish, often nonresponsive and some twenty (20) percent of the instruments are no longer operating.

4.34 In sum, the present state of affairs suggest that plant performance is being impaired through poor equipment performance, and at certain times, insufficient information is provided to station operators to effectively manage the output of the station.

G. Solution to the Protection and Instrumentation Problem

4.35 The obsolescence of the circuit breakers, relaying and control instrumentation and unavailable spare parts severely limits any efforts to modernize or upgrade the existing equipment and devices. While spare parts could be custom made to meet immediate requirements of the station, long term support would require a major design effort on the part of a supplier for a relatively low volume of parts compared to other product lines being manufactured. The cost for the spare parts would reflect the special nature of the limited production.

4.36 The critical role of the High Dam in the overall reliability of the Unified Power System favors the replacement of the obsolete equipment and devices with state-of-the art circuit breakers and relays with their inherent high operating speeds and

consequent improvements in system reliability and fault clearing. The circuit breakers would utilize Sulphur Hexa-floride gas (SF_6) as the dielectric media and would provide interrupting speeds of 2 cycles (.04 seconds) or less. Equipment which presently does not function will be replaced by state of the art instrumentation. The replacement of the relays and instruments for the supervision and control of the hydro turbine generators and associated substation would be achieved through replacement of the respective relay and control panels rather than attempt to modify the existing panels by enlarging or covering over existing instrument opens.

H. Training Program

4.37 Training programs will be conducted as a part of the project; foreign exchange costs will be from project funds, and local costs, including overseas air transportation, will be provided by the EEA. The contractors will be responsible for conducting the formal training program at the contractor's and/or subcontractor's Works.

4.38 It is presently anticipated that a maximum of 36 High Dam staff will receive formal training.

a. Training of 10 High Dam engineers and technicians for a period of one month at the Works of the governor manufacturer will include both theoretical and on-the-job training in the design, testing, maintenance and operation of the governor equipment.

b. Training of 10 High Dam engineers and technicians for a period of one month at the Works of the Runner manufacturer will include both theoretical and on-the-job training in runner design, model testing, manufacturing processes, operating and maintenance procedures for the runners and hydroturbine generators.

c. Training of 8 High Dam engineers and technicians for a period of one week at the Works of the Circuit Breaker manufacturer will include training in the design, testing, maintenance and operation of the circuit breakers.

d. Training of 8 High Dam engineers and technicians for a period of two weeks at the Works of Relay and Control Instrument manufacturer will include training in the design, operation, testing and calibration of the relays and control instruments.

4.39 The training programs should result in an operating and maintenance staff at the High Dam possessing enhanced capabilities to operate and maintain the hydroturbine generators, circuit breakers, relays and control instrumentation.

V. FINANCIAL ANALYSIS

A. General

5.01 EEA is an operational organization within the Ministry of Electricity and Energy. Although EEA planned to establish its own chart of accounts when it was formed, it still follows and is bound by the principles described in the Government's "Standardized Accounting System". Deficiencies in the accounting system were pointed out in the 1976 UNDP Power Sector Survey Report by Sanderson & Porter, Inc.

5.02 While some progress was made in removing certain deficiencies in the EEA accounting system during the implementation phase of a study conducted by Sanderson & Porter that ended in August 1979, much remains to be done to establish an appropriate accounting system in EEA and the distribution companies. This work, with special reference to the distribution companies, has now been contracted to NRECA International, the consultant financed by the World Bank.

5.03 Sanderson & Porter could not complete development of the Management Information System (MIS) concept by the time their study contract ended in 1979. NRECA is handling the work of modifying the existing accounting system and establishing an MIS for EEA and REA. This work will help to implement improvements in the accounting systems and the flow of information within the respective organizations.

5.04 The Financial Statements of EEA were prepared in 1979. EEA is preparing Financial Statements and Forecasts based upon audited records of 1979 and 1980 and preliminary data for fiscal year 1980/1981 and will review these statements with USAID and the World Bank. This Financial Analysis is based upon statements issued in 1979. Preliminary information would indicate that the financial position has not improved from 1977-1978 and may, in fact, have deteriorated.

5.05 The income statements and balance sheets of EEA for the years 1977-1986 are given in Annexes N and O. In 1977, EEA's second year of operation as an independent electricity authority, it earned a modest profit of LE 11.9 million. The results produced a rate of return of 10% on unrevalued assets. In 1978, EEA is estimated to have earned a return of 5.8% on the revalued assets. EEA's internal cash generation, which is a better measure of performance considering the valuation of its assets, was nil in 1977 and 7% of expansion requirements in 1978.

5.06 While these rates of return achieved appear to be reasonable, they have been obtained in a period when EEA has reaped the benefits of cheap Aswan hydro power, and subsidized fuel oil at LE 7.50 a ton (US $11)/ton) compared to the recent world market price of fuel oil of about $180 a ton (July 1980). In addition, salaries and wages were very low averaging about LE 350 per annum per employee (US $550 equivalent), although this advantage is offset by considerable overstaffing.

5.07 With the growth in demand for electric energy to be met in the next five to six years from fossil fueled plants, the possibility of the GOE reducing fuel subsidies to EEA and government wide wage increases put into effect, the future outlook is for higher electricity rates.

5.08 EEA's debt/equity ratio improved from 2.84/1 at 1976-end to 2.57/1 at 1977-end based on its historical balance sheet figures. With the revaluation of assets as of December 31, 1977, resulting in the creation of a revaluation reserve, the debt/equity ratio improved to 1.70/1 at the end of 1978. It should be noted, however, that long-term debt has not been valued to reflect current rates each year on the basis of current exchange rates. EEA has recently agreed with the World Bank though to revalue its debt each year on the basis of current exchange rates. The bulk (90%) of EEA's existing long-term debt is owed to the GOE and is repayable over 12 years at an annual interest rate of 5%. The remainder comprises USSR loans for the High Dam project and short-term suppliers' credits.

5.09 EEA's debt service coverage (times annual debt service is covered by internal cash generation) in 1977 was only about 0.7 due mainly to the abnormally high repayments made on its loans to the GOE. It improved to 1.1 in 1978 and further improved to a satisfactory 1.3 in 1979. The current ratio which was 1.3 at 1977-end fell to 1.0 at 1978-end, reflecting a tight liquidity position, but improved significantly to 1.9 at the close of 1979. Preliminary data received from EEA indicates that the debt service coverage declined to 1.04 reflecting a continuing tight liquidity position.

B. Sources and Application of Funds

5.10 The forecast of sources and applications of funds of EEA for the period 1979-87 is given in Annex P. A condensed version for the period 1981-86 is given below in Table 6.

TABLE 6

Source and Application of Funds, 1981-1986

	Amount (Thousands		% of Capital
	LE	US $	Expenditures
Capital Expenditures (Including Interest during Construction)			
The Project	104,174	124,017	2%
Other Construction	4,745,701	5,649,644	98%
Total Expenditures	4,849,875	5,773,661	100%
Sources of Funds			
Net Internal Cash Generation	197,802	235,479	5%
Grants	1,332,208	1,585,962	27%
Loans	3,319,865	3,952,220	68%
Total Sources	4,849,875	5,773,661	100%

5.11 As Table 6 indicates, EEA's investment program for 1981-86 will require about LE 4,850 million (US $5,774 million) which is expected to be financed from net internal cash generation, from donor grants, and from borrowings. After allowing for debt service but before providing for working capital increases, the internal cash generation would be about 20%, which is adequate. Although the size of the borrowings of LE 3,319 million (US $3,952 million) calls into question the realism of the investment program given the resources available, the program itself is not unrealistic. It represents 20% of the GOE's total investment program, which is an acceptable share for power sector investments in a developing country.

5.12 EEA will be required to provide evidence that the local currency required for the project will be budgeted by the Egyptian Government in accordance with Egyptian law and that EEA assures USAID that all funds needed to cover local cost requirements of the project will be available when needed.

C. Operation and Maintenance

5.13 The rehabilitation of the High Dam Power Station under this project requires no additional staff for the operation of the station. It is expected that personnel needed to operate and maintain the station will follow practice already established and institutionalized within EEA. Thus, there is no additional budgetary requirement for these activities.

5.14 Given the fact that plant is hydroelectric, there are no recurrent fuel costs to be incurred by the EEA. The recurrent costs generated by this project are nil.

5.15 The program of welding the runners to prolong their service life at an annual cost of $1.5 million will be terminated by the end of 1984 as the runner replacement program is implemented and runners scheduled for this welding are replaced.

5.16 We recommend that the AID grant be passed on to EEA by the GOE as a contribution to EEA's equity capital since we believe that EEA's debt to equity position will still be less than satisfactory even after proper evaluation of its assets. We believe provision of the AID funds as a grant will be the best method of assisting the EEA.

VI. ECONOMIC ANALYSIS

6.01 The primary economic benefit of this project is the greater reliability and reduced cost of system operation resulting from the increased capacity and efficiency of the High Dam.

6.02 The replacement of the turbine runners, circuit breakers, relays and control instruments will enhance the reliability of the High Dam power Station. The structural integrity of the turbine runners has been seriously jeopardized and technical authorities have concluded that failure is likely. The present circuit breakers, and control instruments are obsolete and spare parts have been unavailable for more than five years. Any equipment failure could result in substantially longer outages than would be expected with modern equipment and adequate spare parts inventory or access to replacement parts. The outage of a pair of generating units, due to the failure of a runner or circuit breakers or malfunction of the associated relay and control instruments will require replacement energy from oil fired generation consuming up to 1,500 tons of fuel oil per day at a loss in opportunity cost savings of $322,000 per day (based on $215 per ton present border price).

6.03 The Francis turbine runners being provided by this Grant will incorporate design features which will provide an additional 5MW of generating capacity per unit and improve efficiency by a minimum of three percent. Overall, the High Dam Power Station capacity will be increased by 60MW. This additional capacity could permit EEA to avoid Capital Expenditures of $20 million for the installation of comparable peaking capacity. The three percent improvement will annually produce more than 240 million KWH for the same volume of water passing through the turbines. This increase in energy generation will displace energy generation from thermal or gas turbine units with annual fuel savings of exceeding 80,000 tons of Mazout (No. 6 Fuel Oil) at an opportunity cost savings exceeding $17,200,000 per year based upon an estimated world market price of fuel oil of $215 per ton.

6.04 With the replacement of the turbine runners, the current welding program to extend the operating life of the deteriorated runners at an estimated cost of $1.5 million a year, will no longer be required.

6.05 Annually some 4 billion cubic meters of water with an energy equivalent of 700 million KWH are spilled due to wicket gate leakage and unit unavailability during the lengthy runner welding program outages. With the increased capability and availability of

the hydro turbine generators, an estimated 350 million KWH could be generated rather than spilled. This increase in hydro energy generation would displace energy generation from thermal or gas turbine units with annual fuel savings of 117,000 tons of Mazout (No. 6 Fuel Oil) at an opportunity cost savings of $25,100,000 per year based upon estimated world market price of fuel oil of $215 per ton.

6.06 Based upon a total project cost of $124.0 million and the above projected benefits, the resulting economic rate of return of this project is about 35 percent based upon Mazout fuel cost savings. The details of the calculation and the technical and economic assumptions are given in Annex Q.

6.07 If only the benefits from the three percent efficiency improvement are considered, the economic internal rate of return of this project is 17 percent based upon Mazout fuel cost savings.

6.08 A sensitivity analysis of the Rate of Return to variations in capital costs and fuel cost assumptions is included in Annex Q.

VII. SOCIAL ANALYSIS

7.01 In looking at an activity such as the rehabilitation and modernization of the High Dam Power Station, we must assess the social consequences of not rehabilitating and upgrading the major equipment given our knowledge of the questionable structural integrity of the turbine runners along with the obsolesence of the plant major control systems.

7.02 The Aswan High Dam Power Station is responsible for generating nearly 50% of Egypt's current electric power capacity which is used to fuel industrial and other economic activities. At present, the Egyptian Unified Power System experiences high generating unit unavailability due to deteriorated equipment, minimal plant maintenance and limited spare parts. Thus, the remaining limited steam generating capacity is subject to frequent interruptions and questionable reliability making the High Dam a significant national asset.

7.03 Should a major failure occur at the High Dam, a pair of generating units (350MW or almost 8% of total system) would be out of service for a period of three to four years while a replacement was manufactured and shipped to the station. All of the consultants hired to review the situation at the power station have concurred with the need for immediate replacement of the runners given the potential of catastrophic failure at any time. Since all of the units share the same technical design and have developed similar failure signs, the potential for successive failures of runners with complete shutdown of the plant is real.

7.04 Undoubtedly, the most significant social impact of this project will result from the longer term effects that the provision of adequate low cost reliable power availability from the High Dam plant will have on the Egyptian economy. Failure to rapidly implement such a program might very well contribute to increased power shortages in Egypt based upon lost plant output and could seriously constrain Egypt's economic development plans. Interruptions of service would seriously disrupt the economy and place the EEA in a position to install high cost inefficient combustion turbine equipment in the system to make up for the lost generating capacity. The Egyptian Government would be required to utilize its scarce investment resources to finance this high cost capacity. Inevitably, funds required for this interim addition would probably come from the existing social and physical infrastructure budget and result in the deferral of certain projects slated for implementation. Planned beneficiaries would be negatively affected by project deferrals.

7.05 The project will attempt to maximize the use of an Egyptian labor force in both skilled and non-skilled areas. Installation of all major equipment will be performed by EEA personnel or contractors from within Egypt under the supervision of the turbine runner turnkey contractor and various suppliers for control and instrumentation equipment. The net result should be a more capable Egyptian implementation force which can have spread effects over time as future projects are implemented in a more expeditious manner. Intensive on-the-job training will undoubtedly have a positive employment effect. Government capacity to carry out similar work without a great deal of supervision will be enhanced.

7.06 In summary, this rehabilitation and modernization project will assist the Egyptian Government to continue utilizing the Aswan High Dam Power Station as a dependable source of low cost bulk electricity needed for Egypt's economic development. This project is critical to the maintenance of political and economic stability in Egypt; failure to take remedial action in the near future may create serious negative social benefits.

VIII. ENVIRONMENTAL ANALYSIS

8.01 This Project will implement a program to replace the existing turbine runners with runners of correct design and improved efficiency and to replace obsolete circuit breakers, relays and control instruments. Being a physical replacement of hydraulic equipment and electrical apparatus and instruments, there will be no impact on Land Use, Water Quality, Noise/Air Quality, Natural Resources, Culture, or Socio-economic conditions.

8.02 The Bureau Environmental Coordinator has reviewed project documentation and concurs with the Mission that the project be given a "Negative Determination" in compliance with the requirements of 22 CFR 216, "A.I.D. Environmental Procedures".

IX. PROJECT PROCUREMENT AND IMPLEMENTATION

A. Implementing Agency

9.01 EEA will have prime responsibility for the oeverall management of the project and for providing direction to the contractor and engineering consultant.

B. Procurement

9.02 Allis-Chalmers (A-C) is the only firm with the capability of designing, testing, and fabricating large turbine runners in the United States as a single entity (judged essential for the present undertaking). A-C is recognized as a world leader in the supply of hydraulic turbine machinery with some 61,000 MW of capacity of installed in 36 countries. Recent experience with large Francis turbines includes 800 MW units at Grand Coulee and 300 MW units at Alicura in Argentina. As such, a single source determination was approved in principle by the AID Administrator October 18, 1981 and is included as Annex P.

C. Contracting Procedure

Runners

9.03 Allis Chalmers submitted a technical proposal to EEA on July 19, 1981 for the supply of twelve replacement turbine runners, associated parts and supervisory services at the High Dam Power Station. The A-C proposal was based on a review of operating characteristics of the existing High Dam hydraulic turbines, data collected during several inspections of the Power Station and extensive engineering and computer analysis of both the mechanical and hydraulic conditions at the High Dam. This proposal formed the basis for the contract negotiations.

9.04 EEA chose to negotiate a Turnkey (Single Responsibility) Contract since the Power Station staff did not have previous experience in the disassembly and reassembly to the hydraulic turbine generators nor the capability to handle the logistics of a project of this magnitude in which scheduling of equipment deliveries integrated with disassembly and reassembly become critical. As mentioned earlier, the special nature of the project compels measures to assure integrity of designing, model testing, etc. Since the turbine runner phase of the project is a rehabilitation of an operating plant, requiring the reconditioning of substantial portions of the associated hydraulic works which have

never been inspected, this further justified the "single responsibility" contract.

9.05 EEA assisted by BUREC has negotiated a Turnkey Contract with Allis Chalmers for the design, fabrication and delivery to the High Dam of twelve (12) 209 MW Francis turbines and accessories; provision of construction equipment not currently available at the station; labor and supervision to disassemble, rehabilitate, reassemble and test the twelve (12) hydraulic turbine generators. The contract is based upon a fixed price as of December 1981 with US dollar escalation adjustments to be made from indices published monthly by the Bureau of Labor Statistics of the U.S. Department of Labor. Local currency requirements are also based on a fixed price with adjustments to be made based upon an agreed upon index published in Egypt. Payments under the contract will consist of an initial payment of ten precent (10%) of the base contract price with price adjustments for mobilization; eighty five percent (85%) of the base contract price, with price ajustment paid in monthly progress payments supported by work progress certification, and the remaining five percent (5%) of the base contract price paid, with adjustment, upon satisfactory completion of the Warranty Period and issuance of Final Certification for each unit. Foreign exchange costs will be for goods and services of US origin only.

9.06 Under the contract, Allis Chalmers will guarantee runner peak prototype efficiency of equal or exceed 94.5% under the rated net head of 67 meters and will pay to EEA liquidated damages of $10,000 per each one hundredth of one pecent (0,01%) per unit for failure to achieve the guaranteed peak efficiency.

9.07 Allis Chalmers will also guarantee runner capacity to equal or exceed 180,000 KW under the minimum normal net head of 62 meters and will pay to EEA, liquidated damages of $1,000 per KW per unit for failure to achieve the guaranteed capacity.

9.08 While Allis Chalmers has turnkey responsibility, it is anticipated it will subcontract with an Egyptian contractor for the actual installation of the turbine runners. Hidelco, the High Dam company or a company of similar qualifications will carry out the work under the direct supervision of Allis Chalmers.

Circuit Breakers, Relay, Instrumentation

9.09 All contracting for materials will be in accordance with applicable procedures set forth in AID Handbook 11, Country Contracting, Chapter 3, Procurement of Equipment and Materials. All equipment, materials and services financed by AID will be of U.S. source and origin.

D. Engineering Services

9.10 EEA will obtain the services of the Bureau of Reclamation (BUREC) to assist them as Engineering Advisor. The BUREC is uniquely qualified to serve as the engineering advisor to EEA based upon their extensive experience in hydraulic machinery design, rehabilitation and modernization of hydro electric power stations, presence of experienced inspectors near the manufacturing sites to monitor the manufacturing; familiarity with industry, natural and international standards, practices and procedures for the design manufacture and test of hydro electric power stations equipment, and capability to act as contract administrator during implementation of the project. BUREC has also played a vital role identifying problem areas at the High Dam and has developed a good working relationship with EEA personnel. BUREC will review the turbine runner detailed design, observe and review the results of model tests, and establish and administer an "in-shop" inspection program in the U.S. during fabrication of the runners. BUREC will perform engineering, prepare specifications and tender documents for the replacement of the 500KV and 132KV circuit breakers, relays and control instruments, and assist EEA in the evaluation of the resulting bids. It is anticipated that BUREC will be contracted under a Participating Agency Services Agreement or Host Country Contract arrangement. BUREC may act as the procurement agent for EEA to place orders for the required circuit breakers, relays and control instrumentation, expedite the deliveries and arrange transportation and insurance.

9.11 Upon commencement of the rehabilitation and modernizzation work at the High Dam, BUREC will serve as the EEA's project manager to supervise the rehabilitation of the water spiral case and replacement of the runners, circuit breakers, relays and control instruments until commissioning tests are completed and EEA has issued the final certificates for all facilities.

E. Schedule

Runners

9.12 Upon receipt of a Letter of Intent from EEA confirming EEA's Board approval of the proposed contract, Allis Chalmers will begin detailed engineering and construction of a model hydraulic turbine having the same relative physical dimensions and duplicating the water passages of the spiral case and draft tube and will include the proposed replacement turbine runner and modifications to the draft tube. The model hydraulic turbine will be tested to verify the hydraulic design and operating characteristics. Upon EEA's approval of the turbine runner design and draft tube

modifications, based upon hydraulic performance of the model throughout the anticipated operating range, Allis Chalmers will proceed with the manufacturing of the turbine runners and draft tube liners.

9.13 Concurrently with the model testing program, Allis Chalmers will subcontract for the turbine governor modernization. Governor engineering will be completed within 13 months from receipt of a Letter of Intent from EEA confirming EEA's Board approval and replacement governor components will be manufactured and delivered to the station within 21 months of EEA's Board approval with individual unit governor modernization coordinated with the EEA runner or water passage maintenance programs or at the time of runner replacement.

9.14 The replacement runners will be of cast-fabricated construction using cast stainless steel components. Each runner crown will be cast in one piece; each of the 13 runner buckets will be cast in one piece; and each runner band will be cast in halves. Procurement of materials for the first runner will begin within 6 months of EEA's Board approval with manufacturing of the runner completed within 31 months of receipt of a Letter of Intent from EEA confirming EEA's Board approval.

9.15 The runners will be shipped upon completion to Alexandria and then transported by barge to the station with arrival at the High Dam coordinated with the unit disassembly schedule. The schedule of Runner Manufacturing and Readiness to Ship and Delivery to the Port of Alexandria is summarized in Table 7.

TABLE 7

SCHEDULE OF RUNNER MANUFACTURING AND READINESS FOR SHIPPING AND DELIVERY TO PORT OF ALEXANDRIA (MONTHS FROM EEA'S BOARD APPROVAL)

Runner Number	Completion of Manufacturing and Readiness to Ship	Delivery to Port of Alexandria
1	31	33
2	32	34
3	43	45
4	44	46
5	55	57
6	57	59
7	66	68
8	68	70
9	78	80
10	80	82
11	87	89
12	89	91

9.16 Allis Chalmers and their subcontractor, Hidelco, will verify the serviceability of lifting devices and barges, as part of their contract with EEA. BUREC, as the Owner's Engineering Advisor, will coordinate and work closely with all concerned parties to ensure that both contractor's and Owner's supplied equipment are available for project needs. The barges utilized to transport the original turbine runners up to the Nile from Alexandria to the High Dam will be reconditioned and utilized to move the replacement runners to the station and transport the original runners to Cairo for disposal. Customs clearances and barge transportation of each runner from Alexandria to the High Dam is estimated to require 2 months.

9.17 Since the High Dam is an operating plant, outages on pairs of units for the runner replacement must be coordinated with the continuing need for preventive maintenance on station auxiliary systems and possible welding repairs by the French, on runners scheduled for future replacement. EEA, therefore, has set aside a 90-day period between replacement outages for this preventive maintenance. During these preventive maintenance periods, the water passageways including the spiral cases, stay rings and wicket gates, for units being serviced, will be cleaned by sand blasting and sealed as part of the rehabilitation of the hydraulic turbines. Scaffolding and epoxy sealant for the rehabilitation of the waterways will be provided under the terms of the contract.

9.18 Following receipt by the contractor of the Permit for Disassembly from EEA, both units will be disassembled to the degree

possible simultaneously. Two units cannot be completely disassembled at the same time due to lack of floor space.

9.19 During disassembly of the turbine generator under the technical direction of Allis Chalmers, precise measurements of component alignment will be taken for reference during the reassembly. Portions of the turbine generator not previously observed due to their inaccessability will be cleaned, inspected, and where necessary, rehabilitated.

9.20 The new draft tube cone insert will be supplied in sections to be assembled in place and welded to the existing draft tube liner. The void area between the old and new liner will be filled with a non-shrink grout.

9.21 New stationary wearing rings for turbine runner will be installed.

9.22 The connection between the shaft and new turbine runner will be reamed or bored in the field to match the existing shaft coupling, flange holes.

9.23 In addition to installing new replacement runners and two sets of new wicket gates, the old wicket gates of the remaining 10 units will be reconditioned for use in the succeeding units. An engine lathe will be installed to remachine the 10 sets of wicket gates.

9.24 New governors will be installed by the contractor. Any control wiring external to the new governor control cubicle will be performed by EEA. All piping and cleaning of oil pressure system and sumps will be performed by the contractor.

9.25 Upon completion of the reassembly, EEA will issue a Certificate of Completion of Reassembly and will, upon completion of Preliminary Tests by the Contractor, initiate prescribed pre-startup procedures that include generator dryout and pre-operational tests. Upon completion of EEA pre-startup procedures, Allis Chalmers will complete the operational tests and will advise EEA of the units readiness for commercial operation. EEA will issue a Take Over and Acceptance Certificate indicating provisional acceptance of the turbine replacement. The 60-month Warranty period will commence upon receipt of the Take Over and Acceptance Certificate. Upon termination of the Warranty period, EEA will issue a Final Certificate notifying Allis Chalmers that their obligation under the contract has been completed.

9.26 A qualified commissioning engineer will be provided for startup of the first two modified units. Following startup, this engineer will coordinate index testing of one of the first two modified units to verify the capacity and performance characteristics.

9.27 The overall modernization program for each pair of units is estimated to require nine months working shift work as required, six days per week, eight hours per shift.

9.28 The schedule of runner replacement is summarized in Table 8.

TABLE 8

SCHEDULE OF TURBINE RUNNER REPLACEMENT
(MONTHS FROM EEA'S BOARD APPROVAL)

Pairs of Units	Release to Dismantle	Completion of Reassembly	Completion of Testing
First	32	40	41.5
Second	44	52	53.5
Third	50	64	65.5
Fourth	68	76	77.5
Fifth	80	88	89.5
Sixth	89	97	98.5

- Circuit Breakers, Relays and Control Instruments

9.29 It is anticipated the BUREC will prepare and issue IFBs for the replacement circuit breakers by mid-1982 with bid opening 2 months later. Evaluation of bids would require 2 months with contract awards made during the first quarter of FY 83. Delivery of the circuit breakers would begin in mid-1984 with installation not necessarily coordinated with unit outages for runner replacement or unit preventive maintenance. Installation would be performed by EEA personnel or EEA contractor under the supervision of the manufacturer's Installation Engineer. Final tests and commissioning would be the responsibility of the manufacturer.

9.30 The engineering design and preparation and issue of IFBs for the panels containing relays, meters and instruments would be completed by BUREC by mid-October 1982 with bid opening 3 months later. Evaluation of bids would require 3 months with contract awards made during the second quarter of FY 83. Delivery of the panels would begin in mid-1984 with installation coordinated with outages for runner replacement or preventive maintenance.

Installation would be performed by EEA personnel or EEA contractor under the supervision of the supplier's Installation Engineer. Final tests and commissioning would be the responsibility of the supplier.

F. AID Financing Procedures

9.31 All procurements of materials and services financed by this Grant will be financed by Letters of Commitment (L/Comms). Upon receipt of a request from EEA, AID will issue one or more L/Comm with a U.S. bank(s) of the supplier choice. Each L/Comm will specify the materials or services eligible for Grant-financing and appropriate Letters of Credit will be issued by the EEA.

G. Terminal Dates

9.32 Conditions Precedent. The terminal date for meeting Conditions Precedent to Disbursement will be 120 days from the date of Grant signing, the date by which funds will be needed to finance the runners, and engineering service contract.

9.33 Project Assistance Completion Date. The project assistance completion date will be ninety-seven (97) months after receipt of a Letter of Intent by Allis Chalmers, the date when testing is completed on the last pair of turbine units.

9.34 Terminal Disbursement Date. The terminal disbursement date will be nine (9) months after the last pair of units are completed. The contractor will provide warranty guarantees per unit in the form of a surety bond valid throughout the 5-year Warranty Period on a unit-by-unit basis.

H. Control and Monitoring Measures

9.35 Upon signing of the Grant Agreement, USAID will issue an Implementation Letter which, among other things, will contain the necessary guidance and details on the types of reports and reporting formats to be followed. At the commencement of his work, EEA's Engineering Advisor will review and, where necessary, revise the implementation schedule (Annex T), and prepare a CPM/PERT network which will become the basis for project execution. EEA's Project Advisor and the Contractor will be required to submit monthly and quarterly progress reports to AID, through EEA, stating progress in conformance with the implementation schedule. USAID/Cairo staff, including both a USAID Electrical Engineer and Loan Officer and EEA will monitor progress based upon review of Contractor reports, progress review meetings, and regular site visits. In addition, AID's internal financial reports will be monitored to ensure that

disbursements are occurring in accordance with the implementation schedule. Regular quarterly reviews of progress will be conducted by the USAID Mission's top management staff. Such reviews, when required, will be followed by substantive meetings with EEA senior management staff.

I. Evaluation

9.36 USAID will conduct annual evaluations of the project beginning twelve months after the effective date of the turbine replacement contract which will coincide with the completion of the model-testing phase of the project or approximately March 1983. The initial evaluation will be concerned with the results of the model test and performance of the model.

9.37 Upon completion of the replacement of the first pair of turbine runners and the index test of one of these units, a more comprehensive evaluation will be performed to confirm actual runner performance in relation to the technical criteria, and to evaluate the installation schedule and expenditures. This evaluation will occur in approximately June 1985.

9.38 Upon completion of the first replacements of the circuit breakers, relays and control instruments, an evaluation will be performed to confirm the installation procedures and adequacy of the installation schedule and budget. This evaluation may be either incorporated in the runner replacement evaluation or conducted as an independent evaluation.

9.39 Successive evaluations will be made after completion of each pair of runner replacements and subsequent runner inspection after sustained periods of operation to confirm runner performance. These evaluations will be in addition to monthly and quarterly reviews of the project which will include a review of disbursement records and regular site visits.

9.40 A final evaluation will be performed in July 1990 following completion of the runner replacement and replacement of the circuit breakers, relays and control instruments to assess the effectiveness of the project in rehabilitating and modernizing the High Dam Power Station and correcting the runner bucket fracturing problem. This evaluation will determine:

a. whether design, supply, installation and testing were completed on schedule, in accordance with technical specifications, and within the cost estimates;

b. whether the runner design efficiencies and guarantees actually occurred;

c. whether EEA has complied with the financial covenants contained in the Grant Agreement.

X. RECOMMENDATIONS, CONDITIONS AND COVENANTS

A. Recommendation

10.01 The Aswan High Dam and Hydroelectric Power Station, designed and constructed by the Soviet Union in the 1960's, constitutes a bloc project as defined in Chapter 9 of AID Handbook 1, Supplement B. It should be noted, however, that modifications to the power station from other western sources either have been or are being made to improve the reliability of the electrical generators.

10.02 AID assistance in the rehabilitation and modernization of the Aswan High Dam Power Station can be construed as commingling in that this assistance will promote the efficiency and reliability of the Aswan Dam's power generation, a project which has already been identified as bloc in nature. Section 620(h) of the FAA states that use of foreign assistance dollars in a manner which, contrary to the best interests of the United States, promotes or assists activities of Communist bloc countries, is prohibited.

10.03 In our opinion, there is no absolute prohibition against commingling if it serves AID's program interests and would not be contrary to the best interests of the United States. Thus it is the considered judgment of the AID Mission and the American Embassy in Egypt that promotion of this important project will not be contrary to the best interests of the United States and, in fact, will be supportive of our economic and political relationship, political stability within Egypt and will significantly enhance Egypt's ability to promote its critical long-range economic development. Failure to support this activity will be contrary to the best interests of the United States.

10.04 We recommend that a specific affirmative determination be made by the Administrator in this regard.

10.05 Subject to the Conditions and Covenants listed below, we recommend that AID authorize a grant to the Government of Egypt (GOE) in the amount of $100 million for the replacement of the Francis Turbines Runners, Circuit Breakers, Relays and Control Instruments at the High Dam Hydroelectric Power Station at Aswan. We further recommend that the grant be passed on by the GOE to the Egyptian Electricity Authority (EEA) as a grant contribution to EEA's equity capital.

B. Conditions Precedent to Disbursement

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

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

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

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

4. An acceptable contract with Allis Chalmers for the turnkey provision of 12 Francis runners.

5. Evidence that local currency financing for the Project has been budgeted by the Grantee and will be available for expenditure by EEA on the Project pursuant to a cost estimate made by the Engineering Advisor and approved by EEA.

C. Covenants

10.07 The GOE will be required to covenant as follows:

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

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

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

4. Grantee shall ensure that the proceeds made available under the Grant will be made available to the EEA as a grant contribution to its equity capital.

5. The high and medium/low voltage tariff studies presently underway will form the basis for implementing major changes in electricity tariffs. AID will be provided copies of the studies and will consult with the GOE as to the adequacy of recommendations before implementation begins.

6. Any interim changes in fuel prices will be broadly distributed and not exclude EEA.

7. Until the Parties agree that a comprehensive tariff structure can be implemented, the Grantee shall ensure that a minimum yearly rate of return for EEA will be established in consultation with AID. For the year 1982, the Grantee agrees to allow EEA to take the necessary action to achieve such a rate of return on net revalued assets as is acceptable to the World Bank under its existing assistance agreements.

8. The results of the current seismic investigation of the Aswan area will be promptly brought to the attention of all concerned entities so that any impact on the design of the Francis Runners can be addressed as early as possible to minimize costs and risks.

GRANT APPLICATION

ANNEX A

MINISTRY OF ECOMONY
AND ECONOMIC COOPERATION

Mr. Donald S. Brown
Director
Agency for International Development
5, Latin America Street
Garden City - Cairo

Dear Mr. Brown:

The Government of Egypt is planning to rehabilitate and modernize the Aswan High Dam Hydroelectric Power Station by replacement of the turbine runners with runners of appropriate design, composition and manufacture and to replace obsolete Circuit Breakers, Relays and Control Instruments. This will enhance the reliability of this important power station. The Egyptian Electricity Authority intends to contract for the services of United States firms to carry out the project.

The Engineering Advisor of the project, the U.S. Bureau of Reclamation, has prepared a reasonably firm estimate of the cost of this project. Total project costs are estimated to be $124.0 million, of which $100 million are foreign exchange costs. We, therefore, request the Agency for International Development to provide a $100 million grant to finance foreign exchange costs of this important project, of which $85 million to be obligated within the FY 1982 U.S. Assistance Program.

Given the unique capability of the BUREC to perform engineering services and the time which would be saved by immediate negotiation of such a contract, GOE requests retention of BUREC for project implementation.

It is understood that the Government of Egypt will provide all local currency costs of the project.

Kindly keep us informed of various steps undertaken towards proceeding with the execution of the contract.

Best regards.

Sincerely yours,

/ s /

Fouad Iskandar
Senior Undersecretary of State
for Economic Cooperation with U.S.A.

CAIRO, March 18, 1982

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

ANNEX B

PROJECT AUTHORIZATION

Name of Country: Arab Republic of Egypt

Name of Project: Rehabilitation and Modernization of the Aswan High Dam Hydroelectric Power Station

Number of Project: 263-0160

1. Pursuant to Part II, Chapter 4, Section 532 of the Foreign Assistance Act of 1961, as amended (The Act), I hereby authorize the Rehabilitation and Modernization of the Aswan High Dam Hydroelectric Power Station Project for the Arab Republic of Egypt (the cooperating country) involving planned obligations of an amount not to exceed $100 million in grant funds over a three-year period from date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing the foreign exchange costs for the Project.

2. The Project consists of the supply and replacement of Francis turbine runners, 500KV and 132KV circuit breakers, differential relaying and control instrumentation associated with the twelve (12) Aswan High Dam hydro turbine generators and the necessary related technical assistance during manufacturing along with supervision during installation, and testing and startup in Egypt.

3. The Project Agreement which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority shall be subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

4. a. Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the project shall have their source and origin in the United States, except as A.I.D. may otherwise agree in writing.

Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

b. Conditions Precedent to Disbursement

Prior to the first disbursement under the Grant or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the GOE shall furnish to A.I.D. in form and substance satisfactory to A.I.D.:

1. An opinion of the Minister of Justice or of other counsel acceptable to A.I.D. that this Grant Agreement has been duly authorized and/or ratified by, and executed on behalf of the Grantee in accordance with all its terms.

2. A statement of the names of the persons authorized to represent the Grantee and the Egyptian Electricity Authority (E.E.A.) and a specimen signature of each person.

3. An acceptable contract for engineering services for the Project with an organization acceptable to A.I.D.

4. An acceptable contract, with Allis Chalmers, for the turnkey provision of 12 Francis runners.

5. Evidence that local currency financing for the Project has been budgeted by the Grantee and will be available for expenditure by EEA on the Project pursuant to a cost estimate made by the engineering advisor and approved by EEA.

c. Covenants

The GOE will be required to covenant as follows:

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

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

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

4. The high and medium/low voltage tariff studies presently underway will form the basis for implementing major changes in electricity tariffs. A.I.D. will be provided copies of the studies and will consult with the GOE as to the adequacy of recommendations before implementation begins.

5. Any interim changes in fuel prices will be broadly distributed and not exclude EEA.

6. Until the Parties agree that a comprehensive tariff structure can be implemented, the Grantee shall ensure that a minimum yearly rate of return for EEA will be established in consultation with A.I.D. For the year 1982, the Grantee agrees to allow EEA to take the necessary action to achieve such a rate of return on net revalued assets as is acceptable to the World Bank under its existing assistance agreements.

7. The Grantee shall ensure that the proceeds made available under the Grant will be made available to the EEA as a grant contribution to its equity capital.

Administrator

29 MAR 1982
Date

Clearance:
AA/NE: W. Antoinette Ford Date 24 MAR 1982
A-GC: Kelly C. Kammerer Date 3/26/82
AA/PPC: John R. Bolton Date 3/26/82

ANNEX C

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

I, Donald S. Brown, the Director 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, do hereby certify that, in my judgment, Egypt has both the financial capability and human resources capability effectively to maintain and utlize the capital assistance to be provided for the rehabilitation and modernization of the Aswan High Dam Hydroelectric Power Station at Aswan, Egypt.

Donald S. Brown
Director

January 21, 1982
Date

5C(2) PROJECT CHECKLIST

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

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

A. GENERAL CRITERIA FOR PROJECT

1. Continuing Resolution Unnumbered; FAA Sec. 634A; Sec. 653(b).

   (a) Describe how authorizing and appropriations Committees of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that amount)?

   a) Congressional notification will be submitted.

   b) The intended obligation is within the level of funds appropriated for Egypt for FY 82.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

   a) Yes, firm financial plans have been developed as part of the Project Paper.

   b) Yes.

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

   None required.

A.	4.	FAA Sec. 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973?	The project is for the rehabilitation and modernization of the hydro turbines and the replacement of obsolete circuit breakers, relays and control instruments. The project does not include water or related land resource construction. The project is purely electrical, and Sec. 611(b) is not applicable.
	5.	FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	Yes.
	6.	FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	No.
	7.	FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	The project is intended to enhance the reliability of Egypt's electricity generating capacity, enabling sale of adequate power to any and all industrial, commercial and domestic consumers. It will therefore directly affect (e) and indirectly affect (a) and (b).
	8.	FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S.	All goods and services to be procured under the Grant will be US source and origin.

A.8. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

9. FAA Sec. 612(b), 636(h); Continuing Resolution Sec. 508. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.

The Grant Agreement will require certification that all local currency funds required will be provided by GOE.

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

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

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

Yes.

12. Continuing Resolution Sec. 522. 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.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

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

N/A.

B.1.a. intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

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

(1) [103] for agriculture, rural development or nutrition; if so (a) extent to which activity is specifically designed to increase productivity and income of rural poor; 103A if for agricultural research, full account shall be taken of the needs of small farmers, and extensive use of field testing to adapt basic research to local conditions shall be made; (b) extent to which assistance is used in coordination with programs carried out under Sec. 104 to help improve nutrition of the people of developing countries **N/A.**

B.1.b.(1)	through encouragement of increased production of crops with greater nutritional value, improvement of planning, research, and education with respect to nutrition, particularly with reference to improvement and expanded use of indigenously produced foodstuffs; and the undertaking of pilot or demonstration of programs explicitly addressing the problem of malnutrition of poor and vulnerable people; and (c) extent to which activity increases national food security by improving food policies and management and by strengthening national food reserves, with particular concern for the needs of the poor, through measures encouraging domestic production, building national food reserves, expanding available storage facilities, reducing post harvest food losses, and improving food distribution.	
	(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, (i) extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research.	N/A.
	(4) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development;	N/A.

8.1.b.(4)	and (ii) extent to which assistance provides advanced education and training of people in developing countries in such disciplines as are required for planning and implementation of public and private development activities.	
	(5) [106; ISDCA of 1980, Sec. 304] for energy, private voluntary organizations, and selected development activities; if so, extent to which activity is: (i) (a) concerned with data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot projects to test new methods of energy production; (b) facilitative of geological and geophysical survey work to locate potential oil, natural gas, and coal reserves and to encourage exploration for potential oil, natural gas, and coal reserves; and (c) a cooperative program in energy production and conservation through research and development and use of small scale, decentralized, renewable energy sources for rural areas;	N/A.
	(ii) technical cooperation and development, especially with U.S. private and voluntary or regional and international development, organizations;	N/A.
	(iii) research into, and evaluation of, economic development process and techniques;	N/A.
	(iv) reconstruction after natural or manmade disaster;	N/A.
	(v) for special development problems, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;	N/A.
	(vi) for programs of urban development, especially small laborintensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.	N/A.

B.1.	c. [107] is appropriate effort placed on use of appropriate technology? (relatively smaller, cost-saving, labor using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor.)	N/A.
	d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least developed" country)?	N/A.
	e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?	N/A.
	f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.	N/A.
	g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?	N/A.
2.	Development Assistance Project Criteria (Loans Only)	
	a. FAA Sec. 122(b). Information and conclusion on capacity of the country to	N/A.

8.2.a. repay the loan, at a reasonable rate of interest.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

N/A.

3. Project Criteria Solely for Economic Support Fund

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

a) Will enhance ability of GOE to sustain economic growth and recovery which will have positive political results. To the extent rural areas will be served, policy direction of Section 102 will be reflected.

b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?

b) No.

5C(3) - STANDARD ITEM CHECKLIST

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

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

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	Sole source waiver approved by AID Administrator for turbine runner procurement. Procurement of circuit breakers, relays, control instruments will be pursuant to established AID procedures which include opportunities for small business.
2. FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes.
3. FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will commodities be insured in the United States against marine risk with a company or companies authorized to do a marine insurance business in the U.S.?	Yes.
4. FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably procured in U.S.)	There will be no such procurement.
5. FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities	No.

A.5. (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates?

6. FAA Sec. 621. If technical assistance is financed, to the fullest extent practicable will such assistance, goods and professional and other services be furnished from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

Project Paper provides full justification for utilization of the Bureau of Reclamation (BUREC).

7. International Air Transport, Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will provision be made that U.S. carriers will be utilized to the extent such service is available?

Yes.

8. Continuing Resolution Sec. 505. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States?

Yes.

B. Construction

1. FAA Sec. 601(d). If capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interests?

Yes.

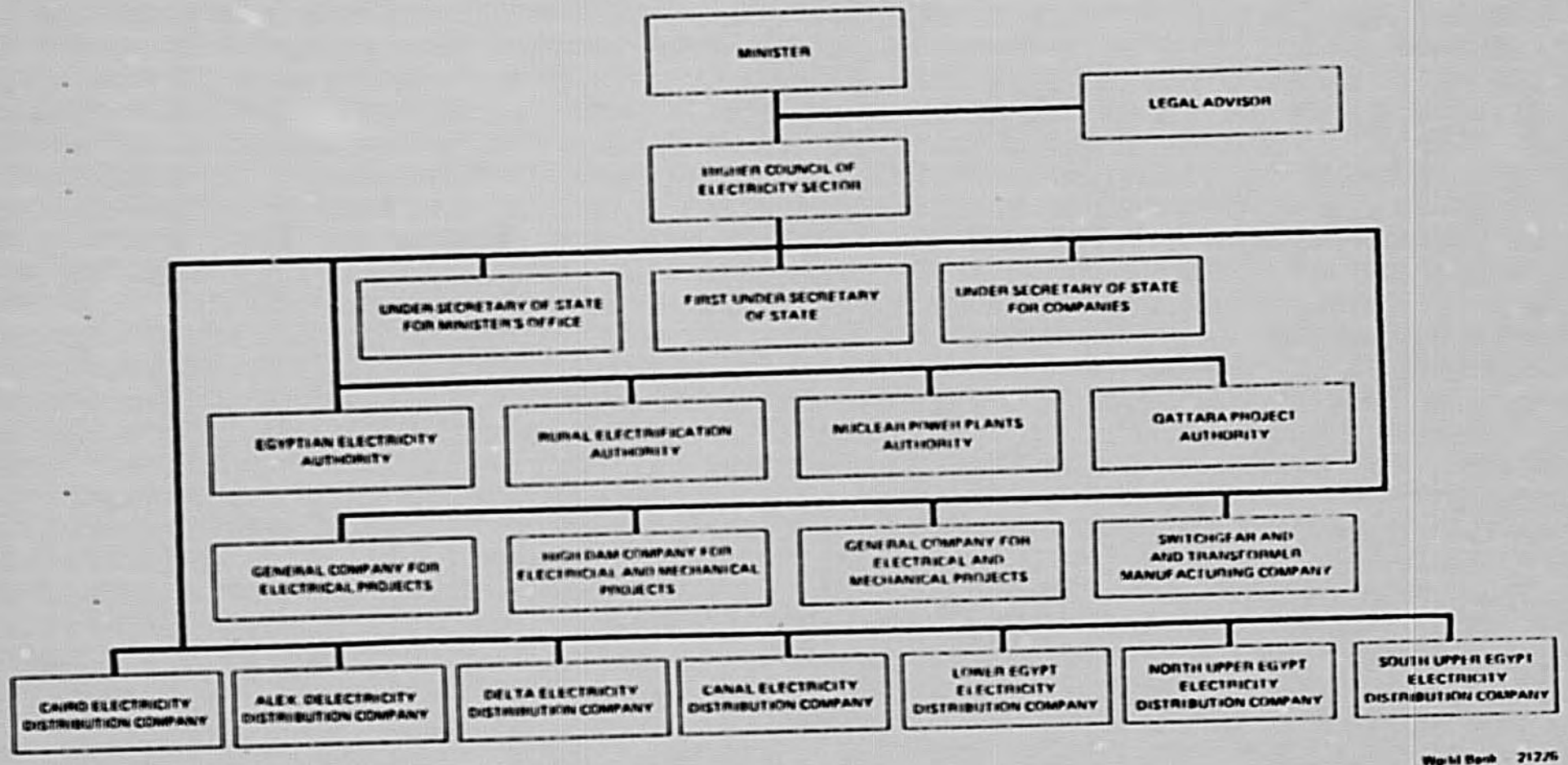
B. 2.	FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable?	Yes. Sole source waiver approved by AID Administrator for turbine runner turnkey contract which includes runner replacement. Contracts for circuit breakers, relays and control instruments will be left on a competitive basis to maximum extent practicable.
3.	FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million?	N/A.
C.	Other Restrictions	
1.	FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter?	N/A.
2.	FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights?	N/A.
3.	FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries?	Commingling determination, based upon Mission and American Embassy recommendations that this activity is in the best interests of the United States will be made by the AID Administrator.
4.	Continuing Resolution Sec. 514 If participants will be trained in the United States with funds obligated in FY 1981, has it been determined either (a) that such participants will be selected otherwise than by their home governments, or (b) that at least 20% of the FY 1981 fiscal year's funds appropriated for participant training will be for participants selected otherwise than by their home governments?	N/A.

C. 5. Will arrangements preclude use of financing:

a. FAA Sec. 104(f). To pay for performance of abortions as a method of family planning or to, motivate or coerce persons to practice abortions; to pay for performance of involuntary sterilization as a method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization?	Yes.
b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property?	Yes.
c. FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs?	Yes.
d. FAA Sec. 662. For CIA activities?	Yes.
e. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained.	Yes.
f. Continuing Resolution Sec. 504. To pay pensions, annuities retirement pay, or adjusted service compensation for military personnel?	Yes.
g. Continuing Resolution Sec. 506. To pay U.N. assessments, arrearages or dues.	Yes.
h. Continuing Resolution Sec. 507. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending.)	Yes.
i. Continuing Resolution Sec. 509. To finance the export of nuclear equipment fuel, or technology or to train foreign nationals in nuclear fields?	Yes.

C.5.	j. Continuing Resolution Sec. 510. Will assistance be provided for the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?	Assistance will preclude use of financing for this purpose.
	k. Continuing Resolution Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes.

EGYPT
MINISTRY OF ELECTRICTY
ORGANIZATION CHART



World Bank 21276

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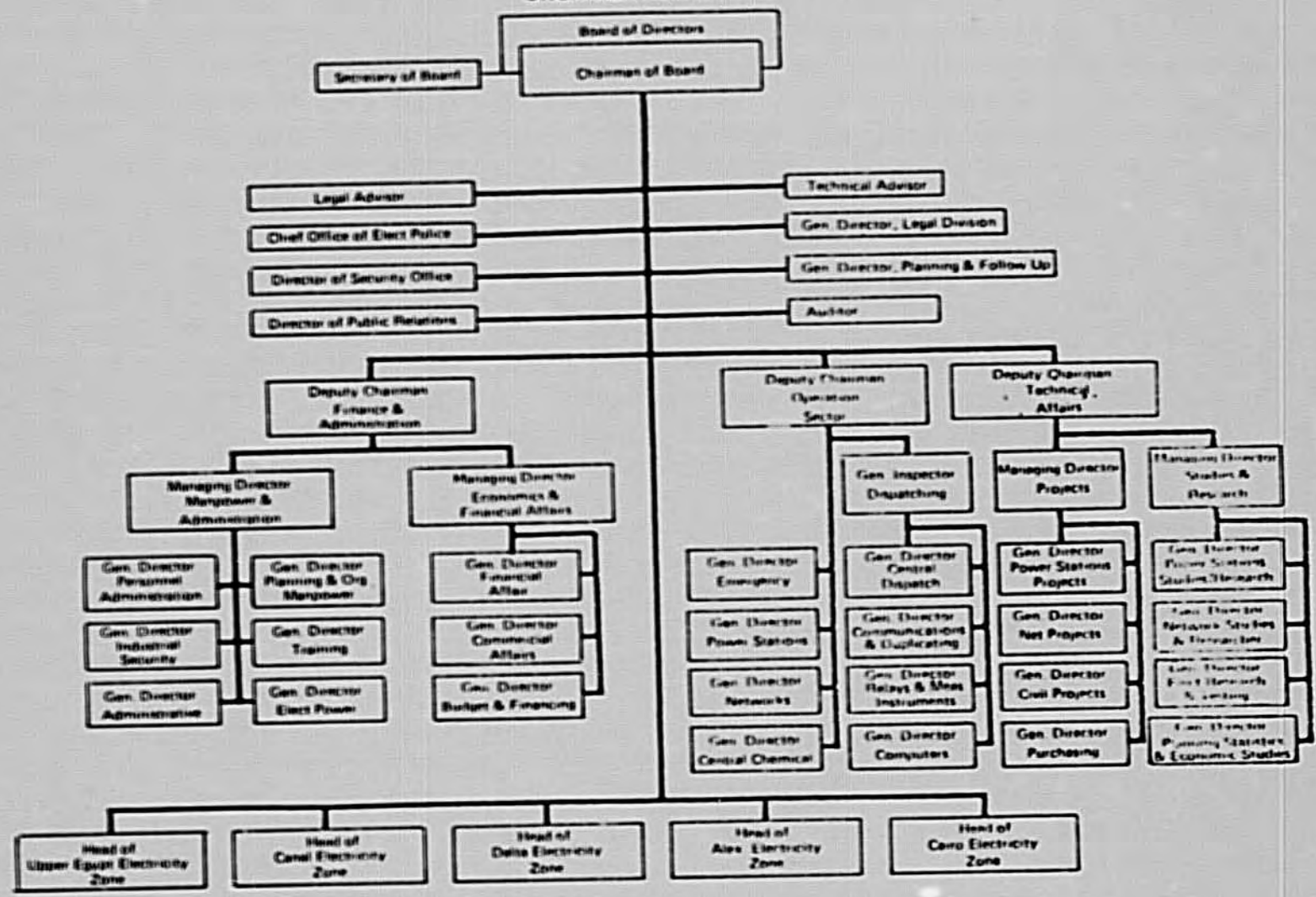
EGYPT
EGYPTIAN ELECTRICITY AUTHORITY
ORGANIZATION CHART



ANNEX G

EGYPTIAN ELECTRICITY AUTHORITY

SUMMARY OF INSTALLED GENERATING CAPACITY - MW, PEAK LOAD - MW AND RESERVE CAPACITY - MW AND PERCENT

Year	Thermal	Gas Turbine	Hydro	Total	Peak Load-MW	Installed Reserves MW	Installed Reserves %
1952	154	-	-	154	125	29	23
1953	205	-	-	205	137	68	50
1954	251	-	-	251	160	91	57
1955	321	-	-	321	173	148	86
1956	331	-	-	331	186	145	78
1957	466	-	-	466	210	256	122
1958	511	-	-	511	250	261	104
1959	511	-	-	511	282	229	81
1960	541	-	256	797	372	425	114
1961	593	-	345	938	522	416	80
1962	593	-	345	938	548	390	71
1963	593	-	345	938	590	348	59
1964	593	-	345	938	659	279	42
1965	672	-	345	1017	750	267	36
1966	1034	28	381	1443	824	619	75
1967	1179	28	1221	2428	872	1556	178
1968	1322	28	1730	3080	930	2150	231
1969	1382	28	2333	3743	987	2756	279
1970	1302	28	2445	3775	1100	2675	243
1971	1302	28	2445	3775	1160	2615	225
1972	1302	28	2445	3775	1176	2599	221
1973	1302	28	2445	3775	1248	2527	202
1974	1302	28	2445	3775	1433	2342	163
1975	1302	28	2445	3775	1733	2042	118
1976	1299	45	2445	3789	1909	1880	98
1977	1278	137	2445	3860	2284	1576	69
1978	1323	137	2445	3905	2564	1341	52
1979	1409	375	2445	4229	2829	1400	49
1980	1674	587	2445	4706	3329	1377	41

Source - EEA Annual Reports.

EXISTING GENERATING STATIONS
(December 31, 1980)

Plant	Type	Units No.	Units MW	Capacity (MW) Design	Capacity (MW) Available
Upper Egypt Zone					
High Dam	Hydro	12	175	2100	1750(1)
Aswan Dam	Hydro	7	46		
	Hydro	2	11.5	345	225(2)
Assiut	Thermal	3	30	90	55
				2535	2030
Cairo Zone					
Cairo North	Thermal	2	10		
	Thermal	1	20		
	Thermal	2	30	100	45
Cairo North	Gas Turbine	1	23	23	20
Cairo South	Thermal	4	60	240	180
Cairo East	Gas Turbine	2	24	48	45
Cairo West	Thermal	4	87.5	350	245
El Tebbin	Thermal	3	15	45	35
El Tebbin	Gas Turbine	2	24	48	46
Helwan	Gas Turbine	5	24	120	110
Heliopolis	Gas Turbine	3	12.5	37	35
				1012	761
Delta Zone					
Talkha	Thermal	3	12.5		
	Thermal	3	30	127	110
Talkha	Gas Turbine	8	24	192	192
Damanhour	Thermal	2	15		
	Thermal	3	65	225	190
Kafr El Dawar	Thermal	2	110	220	180
				764	672
Alexandria Zone					
Siouf	Thermal	2	26.5		
	Thermal	2	30	113	55
Siouf	Gas Turbine	1	25	25	25
El Max	Gas Turbine	2	14	28	24
Karmouz	Thermal	4	16	64	25
	Gas Turbine	2	12.5	25	20
				255	149
Canal Zone					
Suez	Thermal	4	25	100	75
Suez	Gas Turbine	1	17	17	15
Ismailia	Gas Turbine	1	23	23	15
				140	105
SUMMARY		Hydro		2445	1975
		Thermal		1674	1195
		Gas Turbine		587	547
				4706	3717

(1) Based on ten (10) units available for operation with two units normally scheduled out of service for maintenance.
(2) Capacity limited by available net head.

EGYPTIAN ELECTRICITY AUTHORITY
LOAD FORECAST 1981-1990

YEAR	PEAK LOAD (MW)
1981	3650
1982	4250
1983	5020
1984	5790
1985	6665
1986	7330
1987	8065
1988	8870
1989	9758
1990	10735

ANNEX J

EGYPTIAN ELECTRICITY AUTHORITY

CAPACITY ADDITION SCHEDULE

Plant	Type	Units No.	Units MW	Capacity	Year
Siouf	Gas Turbine	2	50	100	1981
El Mahmodya	Gas Turbine	4	50	200	1981
Abu Qir	Thermal	1	150	150	1981
Abu Qir	Gas Turbine	1	25	25	1981
El Mahmodya	Gas Turbine	2	50	100	1982
Sites to be specified	Gas Turbine	-	-	200	1982
Kafr El Dawar	Thermal	1	110	110	1982
Ismailia	Thermal	1	150	150	1982
Suez	Thermal	1	150	150	1982
Abu Qir	Thermal	2	150	300	1982
Ismailia	Thermal	2	150	300	1983-84
Suez	Thermal	1	150	150	1983
Abu Qir	Thermal	1	150	150	1983
Aswan II	Hydro	4	67.5	270	1984
Suez	Thermal	1	300	300	1984
Shoubra El Kheima	Thermal	2	300	600	1984-85
Shoubra El Kheima	Thermal	1	300	300	1985-86
				3555	

SUMMARY	Hydro	270
	Thermal	2660
	Gas Turbine	625
		3555

PRELIMINARY CASH FLOW - ASWAN HIGH DAM

REHABILITATION AND MODERNIZATION OF HYDRO-TURBINES

YEAR	QUARTER	ESCALLATED ESTIMATED US$ IN 1000's		ESCALLATED ESTIMATED LE IN 1000's	
		QUARTERLY	CUMLATIVE	QUARTEPLY	CUMLATIVE
1982	1	0	0	0	0
	2	0	0	0	0
	3	5,034	5,034	973	973
	4	605	5,639	131	1,104
1983	1	2,541	8,180	266	1,370
	2	2,365	10,454	69	1,439
	3	446	10,991	274	1,713
	4	3,222	14,213	80	1,793
1984	1	5,725	19,938	501	2,294
	2	2,060	21,998	52	2,346
	3	2,373	24,371	508	2,854
	4	4,881	29,252	448	3,302
1985	1	3,979	33,231	584	3,886
	2	1,357	34,588	396	4,282
	3	1,717	36,305	483	4,765
	4	3,840	40,145	380	5,145
1986	1	3,898	44,043	630	5,775
	2	1,532	45,575	444	6,219
	3	1,934	47,509	525	6,744
	4	4,325	51,834	412	7,156
1987	1	4,408	56,242	681	7,837
	2	1,726	57,968	497	8,334
	3	5,435	63,403	573	8,907
	4	4,859	68,262	461	9,368
1988	1	1,892	70,154	840	10,208
	2	1,555	71,709	556	10,764
	3	2,454	74,163	628	11,392
	4	1,298	75,461	516	11,908
1989	1	1,270	76,731	705	12,613
	2	870	77,601	524	13,137
	3	1,405	79,006	687	13,824
	4	521	79,527	579	14,403
1990	1	470	79,997	778	15,181
	2	1,541	81,538	599	15,780
	3	207	81,745	668	16,448
	4	275	82,020	702	17,150

ALLIS-CHALMERS
SEB 12-15-81

ALLIS-CHALMERS TURNKEY CONTRACT
PRELIMINARY ANNUAL CASH FLOW REQUIREMENTS
AND BASIS OF ESCALATION ADJUSTMENTS

YEAR	CASH FLOW (US DOLLAR-MILLIONS)
1982	5.6
1983	8.6
1984	15.1
1985	10.8
1986	11.7
1987	16.5
1988	7.2
1989	4.0
1990	2.5
Total	82.0

Cash flow is based upon firm base price levels of December 1981 with escalation, forecast to increase at an annual rate of 12 percent, applied to firm base price level cash flow projections.

Actual escalation adjustments for wages and price level changes will be based upon the following selected indices independently prepared by the United States Department of Commerce:

(A) The labor index (wage index) will be the average hourly earnings for the standard industrial classification code for major industry Group 35, "Machinery, except Electrical".

(B) The materials index will be composed of the "Iron and Steel Index, Code Number 10.1," and the "Hydroturbine Industry Index of Prices for Selected Materials".

(C) The energy index will be composed of the "Electrical Power Index, Code Number 05.4, the "Natural Gas Index, Code Number 05.31 and the "Middle Distillate Index, Code Number 05.73".

The base level for these indices will be established by averaging each indice for the months of January, February and March 1982.

Inspection data for cracks in turbin runners

ANNEX L

Unit №	Date of Inspection	Exploitation hrs after the last inspection	Total hours of exploitation	№ & length of cracks on the lower end			№ & length of cracks on the upper end		
				№	From to mm		№	From to mm	
1	19-2-69	1st inspection	8063	2	20 : 70		1	80	
	2-8-71	15379	23424	2	25 : 120		—	—	
	23-3-72	3441	26883	6	30 : 200		1	125	
	15-2-76	24388	51272	—	—		2	50 : 70	
2	2-5-69	1st inspection	8244	—	—		5	10 : 70	
	9-9-71	15231	23475	3	15 : 60		1	150	
	23-3-72	2147	25622	6	10 : 100		1	300	
	15-2-76	18728	44350	—			1	50	
3	30-8-70	1st inspection	15467	—	—		—	—	
	13-11-72	9400	24868	4	40 : 80		1	120	
	8-6-74	8694	33562	—	—		1	250	
	19-2-77	14315	47876	2	100 : 350		4	100 : 350	
4	30-8-70	1st inspection	15206	—	—		—	—	
	13-11-74	9317	24522	10	30 : 100		2	10 : 120	
	8-6-74	9819	34342	—	—		—	—	
	19-2-77	15976	50318	—	—		8	80 : 400	
5	19-9-70	1st inspection	8972	1	25		2	50	
	6-2-73	15552	24546	12	15 : 150		3	100 : 240	
	12-1-75	10486	35010	—	—		—	—	
	25-1-79	22231	57241	—	—		10	15 : 600	
6	13-9-70	1st inspection	6927	—	—		—	—	
	6-2-73	14023	20950	10	30 : 160		6	150 : 400	
	12-1-75	8960	29910	—	—		—	—	
	25-1-79	21016	50926	—	—		14	200 : 1100	
7	15-2-71	1st inspection	6362	—	—		—	—	
	14-1-74	19047	25409	12	45 : 130		4	115 : 250	
	30-7-78	23225	48634	—	—		9	21 : 700	
	—	—	—	—	—		—	—	
8	18-5-71	1st inspection	11103	12	40 : 140		—	—	
	14-1-74	10040	21143	14	50 : 170		—	—	
	30-7-78	24149	45292	1	200		11	100 : 600	
	—	—	—	—	—		—	—	
9	16-10-71	1st inspection	11070	12	50 : 130		—	—	
	14-5-73	8023	19093	13	65 : 150		2	235 : 340	
	15-9-77	25155	44248	—	—		9	50 : 300	
	1-8-79	8863	53111	—	—		11	50 : 600	
10	16-10-71	1st inspection	8016	12	20 : 115		—	—	
	14-5-73	10614	18630	13	45 : 125		6	130 : 360	
	15-9-77	27254	45884	—	—		13	71 : 450	
	1-8-79	7535	53419	—	—		13	80 : 400	
							2	in the crown	
11	8-12-71	1st inspection	9245	10	25 : 120		6	50 : 120	
	4-8-73	5873	15118	—	—		1	10	
	19-9-75	9932	25050	—	—		—	—	
	7-11-79	21400	49450	1	400		8	250 : 450	
12	8-12-71	1st inspection	8680	12	20 : 130		6	100 : 200	
	4-8-73	7936	16616	—	—		2	90 : 250	
	14-9-75	10792	27408	—	—		2	150 : 300	
	7-11-79	23498	50906	2	50 : 300		11	100 : 1000	

United States Department of the Interior
BUREAU OF RECLAMATION
WASHINGTON, D.C. 20240

IN REPLY REFER TO: 2000
167.-EGYPT

AUG 26 1981

Mr. Selig A. Taubenblatt
Director
Office of Project Development
Bureau for Near East
Agency for International Development
International Development Cooperation
Agency
Washington, DC 20523

Dear Mr. Taubenblatt:

Enclosed is the Bureau of Reclamation's report of the review of the condition of the Francis Turbine Runners at Aswan High Dam.

We have concluded as you will read in the report that the runners are in extremely bad condition and we recommend replacement as soon as possible.

As the report indicates 10 generators must be operating at all times to meet their power demand, consequently, only two machines may be out of service at a time. The time period required should be approximately 600 days from award of contract for design and fabrication for delivery of the first unit. The remaining 11 units should probably follow at 6-month intervals. It will probably take 6 to 9 months to install each unit.

If the Agency for International Development (AID) decides to ask for competitive bids restricted to U.S. companies or U.S. controlled joint ventures, you can expect three or four bids. Almost all U.S. companies will obtain designs and casting of parts from foreign companies. The fabrication and testing would be done in the U.S. by the bidding U.S. companies. If AID decides to go sole source, you can save about 4 months in time to award.

Even though you normally hire consultants for specification preparation, factory inspection and installation inspection we have the capability to do these tasks for you if you wish. It would take about 4 months to prepare the specifications. Time from specification preparation to award would be within your control. We can furnish a review of model tests and inspection of casting and fabrication. If we were requested to inspect installation work at Aswan, we would send 3 or 4 inspectors.

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If you have any questions concerning the report, please call:

R. Vissia, 234-2041
D. Temple, 234-2029
A. Rickett, 234-3162

Sincerely yours,

Acting Commissioner

Enclosure

REPORT ON ASSESSMENT OF FRANCIS TURBINE RUNNERS - ASWAN HIGH DAM

Purpose

To inspect for the Agency for International Development (AID), the physical condition of the Francis Turbine Runners at Aswan High Dam and determine:

1. The damage to the turbine vanes.
2. The criticality of replacement of the turbine runners as it affects the integrity of the power station and its capability to meet load demand.
3. A judgement as to the remaining life of the turbine runners.

Team Members

Rodney J. Vissia - Assistant Commissioner - Engineering and Research

Albert Rickett - Head, Hydraulic Machinery Section, Division of Design

Darrell Temple - Mechanical Engineer, Power O&M Branch, Division of O&M Technical Services

(U.S. Bureau of Reclamation, Engineering and Research Center, Denver, Colorado)

Background and Activities

Background information about the turbine runner problem is contained in attachment 1 titled "Scope of Service - Aswan High Dam Power Plant - Assessment of Defective Hydraulic Turbine Runners and Rectification Program."

Upon arrival, meetings were held with AID personnel Don Brown, his Deputy, Owen Cylke and John Hunt, Project Officer, to discuss the turbine runner problems and the mission. The following day meetings were held with EEA/ Chairman, Hussein Sirry and Upper Egypt Zone President Refaat Bashandy to discuss their assessment of the problem. At Aswan a meeting to discuss the turbine runner issue was held with Mr. Bashandy and the following members of his staff.

Mohamed El Nefeihy - Inspector General, Hydraulic Power Station and Acting Superintendent - High Dam Power Station

Ibrahim Awad - Manager Electrical Maintenance - High Dam Power Station

William Georgy - Manager Mechanical Maintenance - High Dam Power Station

Samir Zazouh - Manager, Planning and Follow-up - Upper Egypt Zone

A general tour of the Dam and Power Station and a full day's inspection of the spare runner and the runners for units 3 and 4 were made (see attachment 2). A detailed inspection of unit 3 as depicted on attachment 2 was made. Unit 4 was inspected in less detail. Attachment 2 includes in addition to the detailed inspection forms, two tables recording the crack measurements for units 3 and 4 made by the personnel at Aswan Dam. Information and documents obtained and studied are listed on attachment 3 titled "List of Information Concerning Francis Turbine Runner Damage - Aswan High Dam Hydraulic Power Station."

Overview

According to Mr. Sirry and Mr. Bashandy, the electrical power load for Egypt severely taxes the existing power system which consists of hydro, thermal and gas turbine plants. Furthermore, the demand for power is growing faster than the amount of capacity being added to the system. Aswan Dam power station must provide 50 to 60 percent of the power. Consequently, ten of the twelve units are operated during peak load every day and only two units are down at any time for repairs. It takes 6 to 7 months to repair the cracks in the two runners that are down, and in many cases only the most severe cracks are welded and the units are returned to service. Because of the amount of time the two units are out of service, the maintenance of other equipment in the power plant is suffering. Scheduled preventive maintenance is not met and equipment is being operated longer than it should be without maintenance. Runner repairs are made in place without the benefit of blowers or fans. Most of the work is overhead welding which is difficult and tiring. As a result of working in this hostile environment, the welds are poor quality and it is difficult to keep welders on the job and willing to work.

EEA management has contracted with the French (Electricite de France) for demonstrating a different welding process using different welding electrodes on two units. The French will perform the repairs on units 3 and 4 starting in early September 1981. EEA management is also awaiting a proposal from the U.S.S.R. on another welding repair program.

The Egyptians are convinced that the units must be replaced, but because they must operate 10 units at all times, the replacement program will take 6 or 7 years. Consequently, they will need to continue a repair program during the replacement program. Originally, they had decided to replace six runners and if the French method of repair looked successful after a 1-year operation period, they were going to repair the remaining four runners. However, they now plan to replace all 12 runners.

Conclusions

An extensive review of the material (attachment 3) applicable to historical data of the turbine runner vane cracking problem was made. Both the number of cracks and the length of the cracks are generally increasing, on all runners. The time needed for repair is also increasing and only the most severe cracks are being welded within the allotted repair period.

The maintenance personnel at the power station are falling behind in their turbine repair program. Furthermore, it appears that the welding procedures which have been used are compounding the vane cracking problem.

The consultants who have investigated the vane cracking problems have suggested a number of possible causes for the problem. We believe that all of these are factors. It appears that:

1. Turbine runners are improperly designed.

2. Runner castings are very poor quality.

3. Welding repairs have compounded the problem.

Replacement of the turbine runners with new runners of proper design, with sound castings is by far the most desireable solution. It may, in fact, be the only solution. This could involve more than replacement of the runners, i.e., the head covers may require modification or replacement.

The present condition of runners 3 and 4 makes their structural integrity questionable and these two runners according to Egyptian records are supposed to be the best. The original casting was of very poor quality and the design was poor. Their are no turbine runners on Bureau of Reclamation projects with the severe cracking and casting problems of the Aswan High Dam Powerplant runners. If there were, they would be replaced.

Catastrophic failure is possible. If a catastrophic failure of the turbine runner occurs the runner would probably freeze to the wearing rings. The removal of the runner would be extremely difficult requiring the runner to be cut into pieces for removal. Failure would, of course, also result in loss of critically needed power to the system. Based upon a rough estimate at today's prices, the cost of replacement runners should be approximately $2 million per unit delivered. Installation costs are not included in the two million dollar estimate.

The gravity of the vane cracking problem can not be over emphasized nor a runner replacement program implemented too quickly.

<u>Recommendations</u>

The process of complete runner replacement proceed as quickly as possible.

BOTSWANA ELECTRICITY AUTHORITY

Income Statements for the Years Ended December 31, 1977-1987
(Thousands of LP)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Sales of Electricity - GWh	11,488	12,607	13,146	16,117	18,205	20,732	23,856	27,003/8	29,755/9	32,479/10	35,954/11
Average Revenue per kWh sold (eLLiliwane)	8.34	8.19	9.57	9.89/2	13.51/4	17.72/6	22.34/7	25.17	28.94	32.63	35.71
Operating Revenues	94,664	103,268	125,396	158,441	245,950	367,371	532,943	679,666	861,110	1,057,506	1,262,491
Sales of Electricity	448	365	425	467	527	600	691	787	862	939	1,094
Connection & Reconnection Charges	9,282	10,550	12,090	20,479	22,638	24,277	26,117	28,281	31,105	33,925	36,934
Other Operating Revenues	104,394	114,183	137,911	179,387	269,115	392,248	559,751	708,734	893,077	1,092,370	1,301,519
Total Operating Revenues											
Operating Expenses											
Fuel	34,000	17,063	26,075	37,533	80,342/5	143,945/5	234,489/5	283,356	313,731	357,183	404,652
Salaries and Wages	18,324	25,252	27,974	38,903	44,738	51,649	59,167	68,042	78,248	89,985	103,483
Purchase of Materials & Services	15,962	13,651	10,155	17,153	25,490	36,247	47,447	56,225	68,651	84,098	104,974
Other Operating Expenses	6,438	8,216	8,741	11,735	16,230	17,848	20,017	21,729	23,902	26,292	28,971
Depreciation	17,408	20,883	26,869	31,372/3	43,303	57,597	81,181	104,042	124,916	152,931	180,369
Total Operating Expenses	92,132	85,065	99,774	138,163	210,103	307,038	442,301	533,376	609,448	710,489	822,359
Operating Income	12,919	29,118	37,917	41,224	58,812	85,160	117,450	175,335	283,629	381,880	478,110
Non-Operating Income (Net)	(3,001)	467	444	101	500	500	500	500	500	500	500
Gross Income	9,918	29,585	38,361	41,325	59,312	85,660	117,950	175,835	284,129	382,380	478,610
Interest	17,064	20,437	24,621	38,367	42,129	49,615	80,048	116,344	145,368	186,710	294,477
Gross Interest	-	(13,920)	(12,477)	(12,658)	(18,351)	(26,961)	(36,496)	(67,876)	(93,089)	(98,048)	(119,207)
Less: Interest Charged to Construction	17,064	6,517	12,144	25,709	23,778	22,654	43,552	48,468	52,279	88,722	175,270
Net Interest Expense											
Net Income	11,857	23,068	26,217	15,616	35,534	63,006	74,398	127,367	231,850	293,718	303,340
	------	------	------	------	------	------	------	------	------	------	------
Average Net Plant Assets in Service/1	336,490	492,328	603,143	839,436	1,176,241	1,703,199	2,348,997	2,927,249	3,545,358	4,243,109	5,117,344
Operating Income as % Opened - %	10.0	5.8	6.3	5.0	5.0	5.0	5.0	6.0	8.0	9.0	9.0
Net Internal Cash Generation (Excluding working capital changes) as % of Construction Requirements - %	811	6.8	13.2	811	3.9	8.1	10.7	17.5	31.4	36.2	31.4

/1 Assets revalued as of the beginning of 1978 and thereafter as of the end of each year beginning with 1978 using the inflation factors given in Annex 4.1.
/2 Reflects a Tariff Increase for domestic consumers from January 1, 1980 resulting in a total revenue increase of LP 8.0 million in 1980.
/3 Depreciation and Asset Base adjusted for only partial utilization of rural electrification assets in generation of revenues (assets valued at about LP 45 million earmarked for the purpose).
/4 Assume an average Tariff Increase of about 33% effective January 1, 1981.
/5 Assume a 250% Increase in fuel prices during 1981-1983 to be reached in three equal installments effective January 1 of each of these years.
/6 Assume an average Tariff Increase of about 32% effective January 1, 1982.
/7 " " " " " " " 26% " January 1, 1983.
/8 " " " " " " " 13% " January 1, 1984.
/9 " " " " " " " 11% " January 1, 1985.
/10 " " " " " " " 13% " January 1, 1986.
/11 " " " " " " " 9% " January 1, 1987.

April 1980

ANNEX N

MOROCCAN ELECTRICITY AUTHORITY

Balance Sheets as of December 31, 1977-1987
(Thousands of DH)

	Actual 1977	Estimated 1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
ASSETS											
Fixed Assets in Service	491,115	791,186	1,051,615	1,324,262	1,777,743	2,529,004	3,250,321	3,909,738	4,795,567	5,660,684	7,368,846
Less: Accumulated Depreciation	(182,822)	(251,361)	(311,410)	(378,626)	(456,005)	550,084	669,771	818,688	996,819	1,212,550	1,468,077
Net Fixed Assets in Service	308,293	539,825	740,205	945,636	1,321,738	1,978,920	2,580,550	3,091,050	3,798,748	4,448,134	5,900,769
Work in Progress	346,894	267,967	273,484	338,763	483,317	534,436	813,045	1,293,626	1,553,269	1,966,521	1,777,808
Investments	4,126	4,126	-	-	-	-	-	-	-	-	-
Long-Term Receivables	407	407	-	-	-	-	-	-	-	-	-
Current Assets											
Cash	7,358	5,098	7,589	9,140	2,200	10,344	11,477	7,118	13,513	13,500	10,000
Accounts Receivable	124,392	130,000	43,760	39,390	55,550	84,090	115,120	137,460	163,110	198,420	240,570
Inventories	86,024	323,231	245,268	232,081	241,276	242,300	329,330	468,480	639,330	1,044,484	967,304
Total Current Assets	217,775	458,329	297,117	280,621	299,026	336,734	455,127	613,058	815,953	1,256,404	1,217,874
TOTAL ASSETS	607,443	1,067,674	1,260,906	1,561,020	2,104,081	2,850,090	3,849,722	4,997,784	6,167,970	7,671,059	8,896,471
LIABILITIES											
Capital and Reserves											
Capital	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990	76,990
Reserves	42,690	62,390	71,805	81,162	140,186	447,090	715,170	908,373	1,047,281	1,050,580	1,050,580
Legal Reserves	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932	9,932
Revaluation Reserve	-	137,387	208,643	285,624	370,732	476,471	614,995	787,892	988,810	1,228,131	1,503,915
Retained Earnings	4,433/1	22,525	35,742	69,868	105,408	168,408	242,806	320,173	608,023	895,741	1,199,081
	135,045	311,234	403,112	523,576	713,248	1,178,091	1,659,893	2,243,360	2,735,036	3,261,374	3,840,598
Long-Term Debt											
Total Long-Term Debt	398,773	530,117	728,985	828,638	1,127,657	1,445,393	1,843,851	2,330,748	3,014,571	3,972,689	4,602,188
Less: Debt due within the year	(29,637)	37,637	50,990	60,037	67,453	67,498	69,674	76,461	93,307	116,801	135,000
Net Long-Term Debt	369,136	567,755	677,995	768,601	1,060,204	1,377,895	1,774,177	2,254,287	2,921,264	3,855,888	4,467,188
Current Liabilities											
Long-Term Debt due within the year	29,637	37,637	50,990	60,037	67,453	67,498	69,674	76,461	93,307	116,801	135,000
Accounts Payable & Current Liabilities	176,833	213,851	190,100	199,287	242,429	213,561	331,887	407,707	410,789	417,894	437,903
Consumers Deposits	6,018	7,486	8,799	9,319	10,753	12,245	14,091	15,969	17,574	19,142	20,082
Total Current Liabilities	212,488	258,970	258,889	268,643	320,635	293,304	415,652	500,117	521,670	553,797	588,785
TOTAL LIABILITIES	607,443	1,067,674	1,260,906	1,561,020	2,104,081	2,850,090	3,849,722	4,997,784	6,167,970	7,671,059	8,896,471
Ratios											
Debt/Equity Ratio	72/28	63/37	63/37	61/39	61/39	55/45	53/47	51/49	53/47	55/45	55/45
Current Ratio	1.3	1.0	1.9	1.0	0.9	1.1	1.1	1.2	1.6	2.3	2.1

/1 After amount transfer of DH 5.000 million to the Ministry of Finance.

EGYPTIAN ELECTRICITY AUTHORITY

Sources and Applications of Funds for 1979-1986
(Thousands of LE)

	1979	1980	1981	1982	1983	1984	1985	1986
Sources of Funds								
Internal Cash Generation								
Gross Income	38,361	41,325	59,312	85,660	117,950	175,835	284,129	382,380
Depreciation	26,869	33,339	43,303	57,599	81,181	104,042	124,916	152,931
Total Internal Cash Generation	65,230	74,664	102,615	143,259	199,131	279,877	409,045	535,311
Grants								
USAID - For Project	-	-	20,104	45,085	35,340	20,555	10,860	-
- Other	5,158	8,040	3,200	2,314	-	-	-	-
Canada/Japan/Netherlands	-	267	4,670	7,677	4,934	11,847	2,028	3,299
CGE	4,257	1,050	61,050	251,828	247,806	263,321	36,000	-
Total Grants	9,415	9,357	89,024	306,904	288,080	295,723	48,888	3,299
Borrowings								
Foreign Loans -								
For Project IBRD/IDA	-	-	15,972	48,334	49,556	13,572	-	-
Others	-	-	-	22,597	2,958	44,882	12,313	20,028
For Other Construction	183,548	150,643	258,054	291,735	394,442	462,806	477,727	516,902
Local Loans	52,957	-	75,030	2,523	-	22,856	270,244	514,495
Total Borrowing	236,505	150,643	349,056	365,189	445,956	544,071	760,284	1,051,425
Liquidation of Investments & Long-Term Receivables	4,533	-	-	-	-	-	-	-
Total Sources	315,683	234,664	540,695	815,352	933,167	1,119,671	1,218,217	1,590,035
Application of Funds								
Construction Requirements (Incl. Interest During Construction)								
- Project	-	-	54,207	101,619	113,458	123,160	41,014	45,639
- Other Construction	116,610	274,458	428,644	558,042	707,938	796,616	847,150	927,714
Total Construction Requirements	116,610	274,458	482,851	659,661	821,396	919,776	888,164	973,353

	1979	1980	1981	1982	1983	1984	1985	1986
Debt Service								
Amortization	37,637	50,990	60,037	67,453	67,498	69,674	71,253	58,099
Interest Expense	12,144	25,709	23,778	22,654	43,552	48,468	52,279	88,662
Total Debt Service	49,781	76,669	83,815	90,107	111,050	118,142	123,532	176,761
Net Change in Working Capital (Excl. Long-Term Debt Due Within One year)	149,292	(116,493)	(25,971)	65,584	721	81,753	206,521	439,921
Total Applications	315,683	234,664	540,695	815,352	933,167	1,119,671	1,218,217	1,590,035
Times Annual Debt Service Covered by Internal Cash Generation	1.3	1.0	1.2	1.6	1.8	2.4	3.3	3.0

EGYPT
EGYPTIAN ELECTRICITY AUTHORITY
COSTS, BENEFITS AND RATE OF RETURN

YEAR	COSTS: CAPITAL EXPENDITURE	BENEFITS: MAINTENANCE COSTS	FUEL COSTS	NET BENEFITS	DISCOUNTED AT 34.6%	CUMMULATIVE DISCOUNTED AT 34.6%
1982	7.0			- 7.0	-5.2	- 5.2
1983	8.4			- 8.4	-4.6	- 9.8
1984	18.0			-18.0	-7.4	-17.2
1985	15.9	1.5	5.6	- 8.8	-2.7	-19.9
1986	14.8	1.5	14.0	+ .7	+ .2	-19.7
1987	13.0	1.5	22.5	+11.0	+1.9	- 7.8
1988	6.2	1.5	29.7	+25.0	+3.1	- 4.7
1989	4.1	1.5	38.1	+35.5	+3.3	- 1.4
1990	3.0	1.5	42.3	+40.8	+2.8	- 8.6
1991		1.5	42.3	+43.8	+2.2	- 6.4
1992		1.5	42.3	+43.8	+1.7	- 4.7
1993		1.5	42.3	+43.8	+1.2	- 3.5
1994		1.5	42.3	+43.8	+ .9	- 2.6
1995		1.5	42.3	+43.8	+ .7	- 1.8
1996		1.5	42.3	+43.8	+ .5	- 1.4
1997		1.5	42.3	+43.8	+ .4	- 1.0
1998		1.5	42.3	+43.8	+ .3	- .7
1999		1.5	42.3	+43.8	+ .2	- .5
2000		1.5	42.3	+43.8	+ .2	- .3
2001		1.5	42.3	+43.8	+ .1	- .2
2002		1.5	42.3	+43.8	+ .1	- .1
2003		1.5	42.3	+43.8	+ .1	0
	90.4	28.5	702.1	640.2		0

1. Capital costs are the unescalated current estimates with disbursements based upon the following:

PROJECT DISBURSEMENTS BY YEAR
(MILLIONS OF DOLLARS)

YEAR	RUNNER REPLACEMENT	CIRCUIT BREAKER RELAY, METER REPLACEMENT	TECHNICAL SERVICES	TOTAL
1	6.6	.1	.3	7.0
2	7.9	.1	.4	8.4
3	12.9	4.5	.6	18.0
4	9.3	6.0	.6	15.9
5	9.0	5.3	.5	14.8
6	11.2	1.3	.5	13.0
7	5.7		.5	6.2
8	3.6		.5	4.1
9	2.6		.4	3.0
	68.8	17.3	4.3	90.4

2. Local currency requirements have been converted to equivalent U.S. dollars at the official exchange rate of LE .84 equals US $1.00.

3. Unit replacement and startup based upon SUMMARY SCHEDULE FOR FIELD REHABILITATION AND MODERNIZATION OF HYDRO TURBINE.

4. Runner repair program will continue through 1984 at an annual expenditure of US $1.5 million equivalent.

5. Border price of mazout fuel is $215/ton.

6. Increased capability and availability of the hydro turbines will reduce generation from mazout fueled generation but will not consequently reduce maintenance expenditures on these generating units as present level of maintenance is not adequate.

RATE OF RETURN SENSITIVITY ANALYSIS

	RATE OF RETURN (%)
Base Case	35
Fuel Cost 5% Higher	36
Fuel Cost 10% Higher	37
Fuel Cost 20% Higher	39
Fuel Cost 5% Lower	33
Fuel Cost 10% Lower	32
Fuel Cost 20% Lower	29
Capital Cost 5% Higher	33
Capital Cost 10% Higher	32
Capital Cost 20% Higher	30
One year delay in circuit breaker, relay and instrument phase	36
Two years delay in circuit breaker, relay and instrument phase	37
Three years delay in circuit breaker, relay and instrument phase	38

ACTION MEMORANDUM FOR THE ADMINISTRATOR

THRU: ES W. Antoinette Ford

FROM: AA/NE, W. Antoinette Ford

SUBJECT: Egypt: Francis Runners/Aswan High Dam: Approval in Principle for Single Source Procurement

Problem: Following a request from the Egyptian Government that AID assist in financing replacement of the twelve Francis-type turbine runners (Francis Runners) at the Aswan High Dam, AID asked a Bureau of Reclamation team to confirm the extent of damage and need for early replacement of the runners. The BuRec team, in its report dated August 26, 1981, concluded that the existing runners should be replaced with new ones of improved design as soon as possible. The next step is to determine the appropriate method for selection of a U.S. contractor to supply the runners.

Background: Improved design and replacement of the Francis Runners involves four basic components: design, model testing, fabrication and supervision of installation. Design and testing together represent only about 10 percent of the total dollar value of the transaction but are at least as critical to the success of the replacement process as fabrication and installation. From a technical point of view, there is thus a clear preference for a procurement solution which puts the entire transaction under the control of a single entity. This preference for a fixed responsibility "turnkey" arrangement, which has been confirmed by the technical experts with whom we have consulted, is, in our judgement, made all the more compelling by the special nature of this project and the need to assure maximum protection of the Egyptian "owner" against risk of failure in the integrity of the design/fabrication/replacement process. (Additional details on the unique technical requirements of this project are provided in the attached memorandum.)

Discussion: Only one U.S. firm, Allis-Chalmers, has the capacity to design, test, fabricate and install Francis Runners. From time to time U.S. companies with fabrication capacity only, have formed joint ventures with foreign firms having the requisite capacity for design and testing of large turbines. Where such relationships exist, the principle of having a single control point, i.e., a turnkey contract, would be generally satisfied. As a practical matter, however, the only joint venture now in effect involving a U.S. fabricator and foreign designer (Combustion Engineering of the U.S. and Nyerpic of France) was only recently formed (June 1981) to compete in the U.S. market and has not produced any large turbines for either the U.S. market or for the overseas market.

Other factors which need to be considered in determining the most appropriate procurement method are:

(1) Timing - while the entire replacement process will take an estimated six years from design to installation of the last runner, the need to begin replacement as quickly as possible has been confirmed by Burec, which finds that cracks in the runners are growing larger and that welding is becoming more time consuming and less technically adequate. Single source procurement from Allis-Chalmers, which has already submitted a proposal to the Egyptian Government, would save approximately 8-10 months by eliminating the need for development of specifications, preparation and issuance of an IFB, bidding, evaluation and award of contract. This time saving alone is not considered critical but is an important element to be weighed with other factors;

(2) Foreign design - the joint venture arrangement described above would require a Code 935 waiver (in the amount of about $5 million) to permit AID financing of foreign design and testing services. In short, to achieve competition, non-U.S. nationality firms would have to be brought into the competition. This foreign participation would be required because no U.S. firm other than Allis-Chalmers has the design and testing capability for this equipment. Further, because of the relative importance of the design component, any turbine produced under such a joint venture arrangement would as a practical matter be considered the product of the foreign design firm rather than the U.S. fabricator;

(3) Price - procurement from Allis-Chalmers would require a determination by AID and the GOE of price reasonableness before AID could approve final award. In this respect, Allis-Chalmers has already represented that approximately sixty percent of the value of the total transaction would be competitively procured from U.S. subcontractors (primarily the forgings and castings). To the extent that this representation is accurate, the task of assuring price reasonableness is obviously made that much easier. Although BuRec in its preliminary review has indicated that the $53.0 million price of the Allis-Chalmers proposal is higher than prices BuRec has experienced, it is clear BuRec has not made an in-depth review of price.

(4) Commingling: in accordance with Section 620(h) of the Foreign Assistance Act, any AID financing which promotes or assists a Communist-bloc project calls for a special determination by the AID Administrator that this commingling of assistance is in the best interests of the United States. Financing replacement of the turbine runners at the Russian-built Aswan High Dam constitutes such a commingling and will therefore require a special determination on U.S. interests to be served.

Conclusion: AID Handbook 11 Chapter 3, Section 2.2.5 states that where, due to special design or operational requirements, necessary equipment or materials are available from only one source, competition in the procurement of this equipment may be waived and negotiation with a single source authorized by the

Administrator if the value of the procurement exceeds $500,000. Accordingly, the absence of any U.S. competition which would satisfy the technical requirements for a fixed responsibility, turnkey type contract, warrants single source procurement from Allis-Chalmers, the only U.S. firm capable of performing all elements of the design/fabrication/replacement process. Other factors which lend weight to this conclusion are the time savings associated with single source procurement and the negative implications of a competitive mode involving foreign design and testing. Further review of the Allis-Chalmers price proposal is necessary, however. Upon approval in principle of a waiver to negotiate with a single source, the next step would be to have the BuRec review price factors with Allis-Chalmers so that a threshold decision on price reasonableness could be made. Following that, preparation of the project paper by the Cairo Mission would commence. During this time, AID's approval in principle of single source procurement would permit the Egyptian Electricity Authority and Allis-Chalmers to proceed with contract negotiations. Execution of the contract would occur following authorization and signing of the A.D project agreement. With respect to commingling, a full justification for the required determination will be prepared in conjunction with the project paper and presented for your approval along with the project authorization.

Recommendation: Based upon the above rationale and the standards set forth in AID Handbook 11, Chapter 3, for single source procurement of equipment, it is recommended that you approve in principle a single source determination by the Government of Egypt to permit procurement from Allis-Chalmers, subject to confirmation by BuRec that the Allis-Chalmers' proposal price is reasonable. This would then permit formal negotiations between GOE and Allis-Chalmers to begin. The final price negotiated in the contract would again be reviewed by AID and subject to a finding of price reasonableness.

/s/ M. Peter McPherson

Approved: _____

Disapproved: _____

Date: _____

Attachments:

1. Technical Memorandum (by J. Stephenson), 9/17/81
2. BuRec Report, 8/26/81

Clearances:

GC:JBolton
A/AA/SER:JOwens
A/AA/PPC:LSmucker
NEA/EGY:KStammerman
NE/PD:SATaubenblatt
NE/PD/E:TASterner (subs)
NE/PD/ENGR:JHabron (subs)
D-AA/NE:BLangmaid
GC/NE:JKessler (su
GC/NE:TCarter (sub
NE/EI:GGower (subs
SER/COM/NE:RLooper (sub

NE/PD:RHBell:gjg:sa 9/23/81 x29134

United States Department of the Interior
BUREAU OF RECLAMATION
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
WASHINGTON, D.C. 20240

5, Latin America Street
Garden City
December 13, 1981

Eng. Abdel Hamid El Sayyad
Chairman
Egyptian Electricity Authority
Nasr City
Abbassia
Cairo

Subject: Memorandum of assistance provided in the preparation of contract documents and negotiations of a contract for the Rehabilitation and Modernization of Hydro-turbines at Aswan High Dam Power Station.

Dear Eng. El Sayyad:

In accordance with the agreement between the U.S. Bureau of Reclamation (BUREC) and USAID/Cairo dated Dec. 8, 1981, Messrs Gene Rickett and Sam Guy have provided the subject assistance and recommend that the Egyptian Electricity Authority (EEA) enter into the contract as proposed by Allis Chalmers' (A/C) letter of Dec. 7, 1981, as further revised by revision A dated Dec. 8, 1981 and Revision B dated Dec 9, 1981. It is recognized that additional revisions will be necessary as a result of the meetings with EEA and A/C on Dec. 12 and 13, 1981. However we believe the negotiated contract price to be reasonable and that the contract language is equitable to the parties and appropriate for the scope of work to be accomplished under this contract. At least two of the revisions currently being discussed by the negotiating committee, if adopted, will increase the contract price. This memorandum describes the basis for our recommendation and documents our assistance during the preparation of the contract documents and the negotiations. A draft of this memorandum was given to EEA on Dec. 9, 1981, to facilitate the Dec. 12 and 13 meetings. A translation of this draft was distributed to the

committee on Dec. 12 1981. Any significant differences between that draft and this memorandum are a result of continuing negotiations with A/C and changes to the contract documents requested at the Dec. 12, 1981, meeting.

After numerous visits to the Aswan High Dam by Allis Chalmers. A/C submitted an unsolicited proposal dated July 19, 1981. A BUREC team visited the High Dam in August 1981 and recommended replacement of the runners.
The July 9, 1981, A/C proposal was received by BUREC at a meeting in Washington D.C. on Oct 27, 1981. The proposal was reviewed in the Engineering and Research Center of BUREC in Denver, Colorado, and prelimenary comments and questions on the proposal were forwarded to AID's Washington office and hand carried by the BUREC team to AID's Cairo office. These comments were contained in the BUREC Assistant Commissioner for Engineering and Research's memo dated Nov. 13, 1981, (copy attached). The areas of concern expressed in this memo have been satsfied by the recommended contract package.

One of the major tasks was to develop appropriate contract language. It was initially felt and later agreed by all parties that the contract language contained in the proposal, while generally consistant with international industry practice, was deficient in many areas of required contract language and recommended practice.

After examination of contract documents, from three EEA contracts involving AID funding, the team recommended and both EEA and AID agreed that the contract format being utilized for equipment procurement documents for the Shoubrah El Kheima Power Station, document No. 13359-CP-041, be adapted for this contract. Both the General Conditions and Special Conditions have been modified to be consistent with the High Dam Project as described below By using the format of a recently reviewed and executed contract it was hoped that the the review process could be expedited. Modifications, deletions and additions are referred to by the indexing system used in the Shoubrah contract.

Some concerns were expressed by Dr. Hamdy El Shaer over using the format of the Shoubrah contract. However it appears that the requested changes can be accomplished by minor revisions to the contract documents and the schedule of prices as appropriate.

General Comments

All references to the Shoubrah Power Station were replaced by appropriate references to the "High Dam Power Plant". References to Overseas Bechtel Incorporated (OBI) were changed to "the Owner and/or his authorized representatives". References to and clauses pertaining to strictly construction contracting were eliminated or noted as "Not Applicable".

Exhibit A GENERAL CONDITIONS.

GC-2 Definitions: Number 19 "Warranty Period" was extended to 60 months of cumulative time after the units were available for operation by the owner. The time was extended 48 months to provide additional assurance of the quality of the work provided by the contractor. The phrase "available for operation" was included to prevent the warranty period from extending beyond 60 months due to failure by the owner to operate any unit when it is in operable condition i.e. shutdown for routine maintainence.

GC-3 Contract Ratification - Footnote added to indicate that the contractor, in the interest of the contract, intends to begin work at his own risk before contract ratification.

GC-4 Owner's Authorized Representative - Since EEA has not retained a consulting engineer, these changes reserve to the owner the right to name anyone for any part or all of the contract as the authorized representative.

GC-10 Conflicts, Errors, Omissions, or Discrepancies - Changed the order of precedence to stress the imporatance of the contract schedule and adds additional documents.

GC-12 thru 14 - Not applicable since there is no construction work in this contract.

GC-26 Cooperation With Others - It is not anticipated that other contractors will be on site during the life of this contract but reserves the right to the owner.

GC-27 Owner Caused Delays - Revisions take the risk from the contractor for the owner being able to delay the contractor's progress for a period of up to 30 days without the contractor being allowed a time extension. The clause as written would

have required the contractor to prepare a very conservative schedule and also to add excessive contingencies.

GC-31 Suspension - Revisions reduce contractor's risk when the owner suspends the work after 50 percent completion of the work to a level consistent with good contracting practices and it is felt that acceptable contingencies will result. Also provides for a Surety Bond, which is cheaper than a bank guarantee and just as enforceable, for the U.S. dollar portion of the contract but leaves the requirement for Bank Guarantee for the Egyptian Pound portion.

GC-39 Force Majeure - Eliminates the provision to compensate the contractor for Force Majeure (excuseable delays) in excess of 60 calender days per delay. This risk is normally borne by the contractor and should also be in this contract.

GC-37 Warranty - Revision clarifies that the contractor should bear the cost of disassembly and reassembly to make warranty repairs and the owner will dewater the turbines for these repairs. Also clarifies the statement that the owner will receive at least 12 months of additional warranty on any equipment that requires repairs under the warranty clause.

GC-40 Changes to the Works - Eliminates the reference to a provisional sum which is not included in this contract. Reasons for eliminating Provisional sum are given under SC-17 below. The language provides a method of allocating equipment cost on changed work and eliminates reference to preset equipment rental rates which are not included in this contract. The additional equipment that could be used on changed work under this contract cannot be forecast. Therefore equipment rental rates cannot be reasonably set.

Since any changes to the contract will likely occur in the disassembly - reassembly stage which is totally subcontracted, the modifications limits the prime and intermediate, if any, subcontractors, to an administration fee of 10% on the subcontractors cost.

The elimination of the last paragraph makes the changes clause operatable for both additions as well as deletions which is equitable to both parties.

Exhibit B SPECIAL CONDITIONS:

General Comments: The Special Conditions have been adjusted to the conditions at the High Dam. Attachments not applicable to this contract have been deleted and additional clauses and attachments have been added.

SC-1 Extent of the Contract - modified to the conditions at High Dam. Two important additions are the requirement for the contractor to coordinate his work schedule with the ongoing operations within the power station and that the owner will only furnish the equipment currently existing at the power station. Another addition is the appropriate referenced Index Test standard.

SC-4 Owner Furnished Utilities and Facilities

d. Potable water - which is available at the High Dam will be furnished by the owner rather than the contractor. (this change was reversed at the Dec. 12, 1981, meeting. See item 7 - Revisions, below)

a. Laydown space - Owner will provide the 900 m^2 laydown space that is currently available.

f. Powerplant Bridge Crane - this subclause makes contractor responsible for crane operations and maintenance.

g. The contractor is given permission to dispose of original parts in owner's dump.

h. This subclause obligates the owner to allow power plant employees to work for the contractor or subcontractor and requires the owner to make approximately 40 skilled employees available to the contractor or subcontractor.

SC-7 Liquidated Damages Schedule - The $10,000 per calendar days per pair of units is a negotiated figure which represents a reasonable allowance to the owner for each pair of units being out of service longer than the agreed to schedule. The value per day was determined by calculating the cost of replacement power for the two units and adjusted by an evaluation of the possibility that an additional two units might go out of service while the pair of units are being rehabilitated and by BUREC practices and Industry standards.

(This clause was further revised at the Dec. 12, 1981, meeting. See Item 9 - Revisions - below)

SC-8 Failure to meet Technical Guarantees - The revised language is a result of the negotiations with A/C and is consistent with BUREC and industry practice . The value of the liquidated damages were based on the owners actual losses if the technical guarantees were not met.

SC-9 Schedule submittals - The 90 day/daily Engineering and Construction Schedules were eliminated because this contract doesn't have onsite construction nor coordination with other ongoing contracts.

SC-10 Contractor Reports - The subclause on Quarterly Cash Flow Report was revised to indicate that it would be submitted to the owner within 60 calendar days after date of receipt of notification that the contract has been ratified in accordance with SC-20D. Revision B reinstated subpragraph a. and b. because the onsite installation work will be cost reimbursable which requires additional documentation.

SC-12 Security - The clause has been revised to indicate that an owner security program is permissable rather than manadatory.

SC-14 Site Work Rules - The change obligates the contractor to comply with site work Rules that may be manadated in the future by the owner.

SC-16 Advance Payment Gurantees - The changes require that the Egyptian Pound portion of the Advance Payment be guaranteed by a Bank Guarantee and the U.S. portion of the advance Payment be guaranteed by a Surety Bond. In the United States a Surety Bond guarantee is much cheaper than a Bank Guarantee and provides adequate protection to the owner and AID

SC-17 Provisional Sum - The clause was deleted since the contract will not have a provisional sum. It is recognized that additional compensation will be due the contractor because of escalation payments (SC-24), Changes (GC-40), Suspensions of work (GC-31), and other contract requirements. An estimate is being made of these costs and will be the basis for the agreeement between AID and EEA. However since this estimated sum will probably be in the order 20-25 million U.S. Dollars,

it does not seem appropriate to include a provisional sum of that magnitude in the contract.

SC-18 Manner and Documentation for Payment - AID will use a Bank Letter of Commitment and the clause has been modified accordingly. The deleted part of the clause is replaced by part of the new clause SC-20.

SC-19 Warranty Guarantee - This clause was adjusted to provide the same division between the Egyptian pound and American dollar guarantee as is provided in SC-16.

SC-20 Measurement of and Payment for the works. The language of this clause is a good compromise between practices in Egypt, the United Staes and the authors experience with BUREC contracts. The 10% advance payment will provide the contractor with compensation for mobilization or startup costs when little tangible progress can be show. Monthly progress payments are provided rather than milestone dates to provide a better cash flow for the contractor which results in a better price to the owner. The payments will be monitored by the owner's authorized representative and approved on the basis of the price breakdown required by subparagraph D. of SC-20 below. Eighty five percent of the actual earnings will be paid monthly which incremently reduces the advance payment to zero when the work has been completed and provides the owner with a 5% retention. By comparison the BUREC's normal practice for an installation project would reduce the retention to 1 1/2% by the time all of the work was complete. The authors feel the owner's interest is well protected with this payment clause. The conditions precedent for the advance payment are the same as the Shoubrah contract.

This clause was further modified by revisions A and B as a result of decision by EEA on Dec. 7, 1981 to use a cost plus fixed fee subcontract for the onsite work. We support this decision due to the difficulty of adequately defining the site work.

SC-22 Performance Guarantee - This clause is standard and is usually continued in the invitation to bidders, as it was in the Shoubrah contract. It contains the same division between pounds and dollars as the other guarantee paragraphs.

SC-24 Price adjustment for changes in Cost - This clause was added due to long duration of the contract resulting in the

contractor's inability to quote a contract price without excessive contingencies. Only 90% of the costs resulting from escalation are reimbursed to provide extra incentative for the contractor to keep on schedule or improve his schedule which will reduce both his cost and the owner's costs. The U.S. Indices are published monthly by the Federal Government and accurately reflect inflation.

SC-25 Presumed Conditions of Existing Equipment - This clause was added during the negotiations with A/C to further clarify the scope of work.

SC-26 Cost Reimbursement for Egyptian Pound Portion of the contract - This clause was added as a result of the decision to make the onsite work cost reimburseable. The important part of the clause is the definition of reimburseable

Contract Schedule

By letter dated December 7, 1981, A/C submitted their revised proposal. Negotiating meetings between EEA, BUREC, and A/C with AID attending as observer were held on Dec. 7-8, 1981, and revised prices and portion of the proposal were submitted by A/C on Dec. 9, 1981. A Price Schedule Rationale that discusses the BUREC/Owner's estimate and the contractor's proposal is attached.

Important Results from the meetings and negotiations held on Dec. 7-9, 1981 are:

1. It was agreed that the disassembly and reassembly work at the site would be by cost reimburseable subcontract with HIDELCO due to the uncertainty of the scope of work.

2. The sandblasting and painting would be accomplish prior to and after the turbine replacement to shorten the turbine replacement schedule by 12 months.
Additional changes to the contract documents were requested or noted for future discussion at the Dec. 12, 1981, meeting. The following two lists are provided as a check list for future revisions to the contract documents and decisions that need to be made by EEA:

Items to be included in revisions:

1. Revise GC-3 to indicate that no additional compensation will be due the contractor "in the event the Contract is ratified, during the said six month period of suspension" (see top of sheet 7).

2. Revise GC-15 to eliminate one of the reference to footnote (5).

3. Revise GC-17 to eliminate the pre-approved list of subcontractors.

4. Revise GC-20 to clarify that only the owner's equipment stated in SC-4 is available for the contractor's use.

5. Revise GC-23 to be consistent with any changes that may be made to SC-2 Insurance Requirements (see #1-Items requiring a decision by EEA).

6. Revise GC-24 to give the owner 30 days notice of testing that the owner may want to observe.

7. Revise SC-4 to indicate that contractor is responsible for potable water.

8. Revise SC-6 to indicate new completion dates for the delivery of equipment at Alexandria.

9. Revise SC-7 to indicate that the liquidated damages refer to delivery of the replacement runners and associated material to the port of Alexandria Egypt.

10 Revise SC-20 if a decision is made to change the retention (see #2 - Items requiring a decision by EEA).

11 Revised Section 4 Technical Guarantee 2.0 Cavitation Guarantee to eliminate (C). Revise 3.0 Hydraulic Thrust to include the phrase "is guaranteed to be within".

12 Add a section on "cracks" in the technical guarantee

Items Requiring a Decision by EEA

1. Does EEA want to furnish the insurance as stated in Sc-2 or should the contractor furnish the insurance.

2. Does EEA want to increase the retention from 5% as provided by SC-20 to 10% or some other figure. If so, SC-20 must be revised accordingly.

3. Does EEA want a ceiling on the number of days in Item 14, Technical Direction for field dissassembly, rehabilitation and reassembly? If so the ceiling must be negotiated with A/C.

Price Schedule Rationale

Item
No.

1 Model Testing
A/C price $392,000
BUREC estimate 300,000
Difference of $92000 is considered reasonable upon reconsideration of the unique spiral case which will probably require more testing than a model with a conventional spiral case. A/C price of $476,849 was negotiated down to $392,000 , and building and testing of model of Soviet runner was eliminated. BUREC estimate was based on conventional model which did not require special adaptors to fit spiral case to test stand.

2 Twelve Runners
A/C price $40,262,381
BUREC estimate 40,068,000
Difference of $194,981 is less than 0.5% A/C is considered appropriate. BUREC estimated based on recent bid costs adjusted to current price and allowing for extra cost of transporting equipment of this magnitude.

3 Twelve Sets of Upper and Lower Stationary Runner Wearing Rings
A/C price $2,037,244
Burec estimate.....2,490,000
A/C price is $452,756 less than Burec estimate.
A/C price is reasonable: Difference is in material labour costs for upper wearing ring support. A unit price of $5 per pound was used. Since part of the fabrication for the support will be onsite a unit price of $4 per pound is more reasonable.

4 Two Sets of Turbine Gates
A/C price $3,760,485
BUREC estimate .3,680,000
Difference of $80,485 is 2.2%. A/C price is considered reasonable.

5 Temporary Platforms
A/C Price $35,000
BUREC estimate....30,000
A/C price is considered appropriate.

6 Twelve Sets of Governor Equipment
A/C Price $2,719,478
BUREC estimate ...2,800,000
A/C price is approximately 4% less than BUREC estimate.
This price is a quoted price from the only U.S. supplier of goverrors for hydroelectric turbines. BUREC experience with this supplier has been very good. Equipment has been reliable and service has been prompt and dependable. This equipment will be purchased from Woodward Governor Company because they are sole source of equipment.

7 One Engine Lathe
A/C price $332,400
BUREC estimate 200,000
Difference of $132400 is reasonable. A/C price based on competitive quotes. BUREC estimate was made without catalogue pricing data and did not include tools and accessories. This item was added to scope after BUREC arrived in Egypt.

8 Air Compressors
A/C price 171,604
BUREC estimate...100,000
A/C is based on competitive quotes. BUREC estimate probably misunderstanding during phone conversation and price for one compressor taken as price for two compressors.

9 Slings
A/C price $43,794
BUREC estimate 50,000
A/C price based on competitive quotes. A/C price is reasonable.

10 Recording Equipment
A/C price $236,522
BUREC estimate 120,000
A/C price based on competitive quotes for thirty point recorders. BUREC estimate made without catalogue pricing data for twenty point recorders.

11. Scaffolding
A/C price $145,167
BUREC estimate 20,000
A/C price based on competitive quotes to completely scaffold spiral case and spiral case extension (80 meters.) Burec estimate was made without catalog pricing data for scaffolding only a portion of work area. A/C price is appropriate since moving scaffolding to cover entire spiral case and extension would not be cost effective.

12 Coal Tar Epoxy
A/C price $87,453
BUREC estimate.....30,000
BUREC estimate is based on 6 mil paint thickness whereas A/C price is based on 16 mil paint thickness. For 16 mil thickness BUREC estimate would adjust up to $80000. A/C price is based on competitive quotes and is considered appropriate. Two coats, each 8 mils thick are required. Painting will be done before or after the turbine runner replacement to shorten the runner replacement schedule by 12 months.

13 Training (U.S.)
A/C price $118,411
BUREC estimte .. 90,000
A/C price is approximately 20% greater than BUREC estimate, but the price is considered reasonable after a detail review of the scope of services.

14A Mobilization
A/C price $529,032
BUREC estimate 300,000
BUREC has reviewed itemized list of costs for mobilizing and demobilizing A/C personnel and costs are appropriate.

14B Technical Direction
A/C price $5,346,000
BUREC estimate ...5,800,000
BUREC estimate is based on 1978 bid price for Hoover Powerplant of $367 per day escalated at 10% per year.
BUREC estimate is $488 per day for 11,880 days compared to $450 per day for the A/C price. BUREC estimate includes the Egyptian Pound per diem cost.

Total U.S. dollar cost
A/C price $56,216,971
BUREC estimate..56,078,000

Local Currency Costs

Transportation form Alexandria to HADPS
A/C price .....300,000 L.E.
BUREC estimate ...500,000 L.E.
A/C price is considered appropriate. USBR did not have sufficient data to make an accurate estimate.

Disasembling units and reassembling with new parts
A/C price .....6,633,200 L.E.
BUREC estimate ..7,000,000 L.E.

Small difference partially reflected by A/C assuming technical direction of subcontractions work force.

Sandblasting and painting spiral cases and extensions
A/C price .....700,000 L.E.
BUREC estimate ....600,000 L.E.

Total Local Currency Cost

A/C price .....7,910,000 L.E.
BUREC estimate.....8,100,000 L.E.

Local currency cost are on a cost plus fixed fee basis for the subcontractor plus a fixed management fee for A/C. The A/C fee was negotiated to approximately 3% of the subcontractors reimburseable costs plus fixed fee. The actual reimburseable costs to the subcontractor were estimated by assuming a current cost of 8,000,000L.E. escalated at 12% per year to the time that each portion of the work would actually be accomplished. This fixed fee for A/C is comparable to the fees paid construction management firms for similar work. The subcontractor's fixed fee was negotiated on the basis of approximately 15% of the actual estimated reimburseable costs. Consideration was given during the negotiation of this fee to the fact that incentatives are given to both salaried and hourly employees that will not be considered reimburseable and must therefore be covered by the overhead and profit fee.

As noted above, additional revisions are continuing to be made to the contract documents and the scope of the work, therefore the contract price must be renegotiated accordingly.

Sincerely yours,

Sammie D. Guy, P.E.
Director
Office of Liaison
Engineering & Research

A.E. Rickett, P.E.
Head, Hydraulic Machinery Section
Division of Design

DFC-11 (12-61)
WIRS

INFORMATIONAL ROUTING

RSStelzer:bkm 11-13-61

D-251

XXXXXXX
XXXXXXXX XXXXXXXXXX
Blind to: Chief, Division of Foreign Activities

FAXOGRAM

E&R Center, Denver
IN REPLY
REFER TO: D-251
330.-

Office of Project Development
Attn Mr. Taubenblatt
Bureau for Near East
Agency for International Development
International Development Cooperation Agency
Washington D.C. 20523

Re Allis-Chalmers Proposal for Furnishing Replacement Turbine Runners for Egypt's Aswan High Dam

Our comments on the Allis-Chalmers proposal are as follows:

SECTION 1

Obtaining the efficiency and power outputs indicated on the curves is realistic.

The specific speed at 62m, full gate is 66.6 ft-HP which is equal to the value given by the formula $n_s = 950/\sqrt{H}$.

SECTION 2 - Materials, Services, Prices

We recommend aluminum-bronze rotating wearing rings be furnished with the runner, item 1, instead of stainless steel wearing rings. We assume the stationary wearing rings are stainless. We need to verify this assumption. A set of spares should also be provided.

We assume item 15, lower gate stem seals, refers to the seal where the gate stem penetrates the head cover, if not, these seals should be provided.

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Item 17, main shaft packing, should include "O" rings and gaskets for the main shaft seal.

Item 19, plate steel draft tube insert, should either be stainless or have a 3mm stainless overlay on the upper 0.3m.

Will it be necessary to replace dowels and/or bolts for the turbine shaft seal and bearing, and for the generator sole plates?

A set of spare wicket gate stem bushings should be provided with the first runner, if spares are not already available.

A boring machine for boring stationary wearing rings and a boring machine for line boring the wicket gate stem bearings should be provided, if not already available at the Aswan powerplant.

The October 31, 1981, date, page 9, to which the quoted prices are valid must be extended.

Item 4.2, contract for field service, does not indicate that it is a firm price, but item 4.3, contract price which includes field service is stated as a firm price. If the field service man-years are greater or less than the 12 man-years indicated, will an adjustment be made?

The quoted cost which calculates to $263 per man-day is high compared to current estimated costs of $523. This figure is especially high if the Egyptians are furnishing housing.

Material for repair of cavitation damage of facing plates and wicket gates should be furnished by Allis-Chalmers.

SECTION 3 - Commercial Terms and Conditions

Page ~~19~~ 21, Item ~~10.4~~ 11.4 - The maximum liability limit of 5 percent of the contract price is too low. Ten percent of the contract price, which is the amount of the performance bond in item 7.0 is a more appropriate figure.

Page 27, Item 16.2 - Does "other temporary accomodation" include housing? Also, see comment in Section 2, Item 4.2 regarding field service cost.

Page 35, Item 23, Liquidated Damages - The damages, as written, are merely a token and do not provide much motivation to perform the work expeditiously. Since these are liquidated damages rather

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than a penalty it should be based on an actual capacity or power loss to the Egyptians. If the $2000 per week is applied to the total of unfinished work, it is meaningless to motivate the contractor, as it would take [illegible] years to equal 5 percent of the contract price. If the $2000 per week is applied to each incomplete unit and the field service price is a firm price the cost to Allis-Chalmers is $2570 per day for each set of 2 incomplete units. This figure includes estimated field service costs along with the $2000 per week liquidated damages.

It would be desireable to include a bonus for an early finish. If the field service cost is not a firm item, perhaps Allis-Chalmers could receive one-half of the unused field service costs as a bonus.

Page 44, Item 30.0, Terms of Payment - In general, Allis-Chalmers has written this portion of the proposal so that 80 percent of the contract value for equipment and testing is paid for elapsed time intervals rather than portion of work completed. With the token liquidated damages, this arrangement could provide motivation to string out the contract.

Payment should be based on work completed. The 5 percent of contract price as startup money is reasonable, but the remainder of the value of Equipment and Testing should be paid for defined work progress, e.g. model test completed, runners delivered.

Page 52, Item 36, Liability - This item states that Allis-Chalmers is not responsible for loss of revenue. Is this statement in conflict with liquidated damages? Liquidated damages' main purpose is to cover the owner's revenue losses caused by the contractor's failure to perform.

SECTION 4 - Guarantees

Page 2, Item 1.0 - The meaning of the term "Full Load" and "(100%)" in the first column of the table is unclear.

Page 3, Item 1.0 continued - The sigma values listed are, for the higher heads, considerably less than the required sigma value of 0.212 obtained from our Monogram 20. Dick Fisher of Allis-Chalmers said their performance guarantees are based on existing models nearly identical to the runner they plan to build for Aswan.

Page 4, Item 2.0, Cavitation Guarantee - The Allis-Chalmers guarantee, not to exceed 1.25 grams per hour, is about one-fourth the value that USBR specifies.

Even though Allis-Chalmers is very confident of their ability to [illegible]

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Paragraph - 4

Page 4, 1st paragraph - The following should be added:

Index tests will be performed on the prototype.

SECTION 5 - Technical Description.

Page 3, Item 1.0, General - The draft tube cone insert should be stainless or have a 3mm stainless overlay to protect the upper 0.3m of cone from cavitation.

Smooth operation should be defined. See attached graph, Allowable Vibration Amplitudes for Transient Operation for Hydraulic Turbines and Pumps.

Page 5, Item 3.0, Runner Construction - As stated in Section 2, we recommend Aluminum Bronze wearing rings. X

Surface finishes should be as follows:

Outside finish	0.0060mm, rms
Water Passages	
Upper two-thirds	0.0030
Lower one-third	0.0015
Wearing rings	
Clearance surfaces	0.0015
All other	0.0030

The welded runner cone should be the same stainless material as the runner. The welded runner cone should allow the runner to be coupled or uncoupled from the shaft without removing the cone.

Static balance of the runner should be within quality G6.3 of International Standard ISO 1940, Balance Quality of Rotating Rigid Bodies. No eccentric cuts exposed to water will be allowed for balancing.

Page 13, Item 7, Runner Analysis - For normal conditions, the stresses should not exceed 1/3 yield or 1/5 of ultimate tensile strength. instead of the 1/4 of UTS listed. According to Allis-Chalmers' calculations, they do not exceed the 1/3 YS or 1/5 UTS for normal conditions. The 2/3 of yield stress criteria is acceptable for abnormal conditions.

SECTION 6 - Turbine Model and Model Tests

As mentioned in Section 4, Guarantees, the proposal does not address the situation of the model not meeting the guarantees.

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Paragraph - 5

Page 5, Item 4.0, Test Report - A paragraph "i" should be added. Paragraph "i" would describe the wicket gate torques over the range of gate openings and heads.

SECTION 7 - Manufacture and Installation

Page 2, Item 1, Design - Allis-Chalmers should participate in obtaining field dimensions.

Drawing No. 6-30520, Schedule - It is our opinion that installation of runners for the first two units should start about 4 months earlier, as the "learning-training" process on the first two units will cause these units to take longer for disassembly and installation than subsequent units. Also, early teardown would disclose worn or damage parts that would have to be replaced prior to assembly.

Page 5, Disassembly - Before disassembly, measurements should be taken of the air gaps, bearing and seal centers, and runouts, as necessary, to determine that the existing installation will allow reassembly of the units in accordance with NEMA standard MG5.2 - 1972. If the existing installation does not allow reassembly in accordance with the NEMA standard, the Engineer will determine whether reassembly will be done within the existing limits or corrective modifications will be made before reassembly.

Where possible the unit will be reassembled according to the NEMA standard.

Allis-Chalmers Price Justification
Aswan Runners

1. "One Time Cost" of $2,600,303 is considerable higher than we would expect. This item needs further review.

2. Base price for runners (1981 prices) of $32,000,000 appears to be O.K.

3. We would prefer a current price with escalation clause.

4. Transporting to Baltimore from York seems high. Allis-Chalmers promised to try for other bids.

5. Cost of field services seems high:

$583/man-day current estimated
$948/man-day firmed, Allis-Chalmers costs

If the Egyptians are furnishing living quarters, then prices are [illegible]

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Enclosure - 6

GENERAL COMMENTS

- In Section 3, page 34, Allis-Chalmers states that the owner will furnish labor, materials, electricity, fuel, and water for testing of the units, but there is no discussion as to who will supply station service electricity, water, and air during disassembly and assembly of the units. What kind of station service facilities are available at the plant?

  Also, how will scheduling for the use of the plant cranes, storage areas, and station service facilities be determined if the work Allis-Chalmers is directing conflicts with other O&M work in the plant?

  We need general arrangement drawings of the plant, detail drawings of the turbine and generator, and information regarding normal, maximum, and minimum head and tailwater elevations. Also, schematics of the main unit auxiliaries would be useful.

  It would be worth checking if the existing governor servo-system is adequate. The increased flow at the maximum head will increase the wicket gate torque about 25 percent. Typically, servo-systems are sufficiently over designed that this amount of increase in torque would not be a problem; however, not all servo-systems have this much surplus capacity.

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United States Department of the Interior
BUREAU OF RECLAMATION

ENGINEERING AND RESEARCH CENTER

P O BOX 25007
BUILDING 67, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

Mr. John P. Hunt
Project Officer
Agency for International Development
American Embassy
Cairo, A.R.E.

January 6, 1982

Subject: Replacement and/or Upgrading of Associated Plant Auxiliaries and Control System at Aswan High Dam

Dear Mr. Hunt:

EEA has identified the need to replace the following electrical equipment at the Aswan High Dam: (1) fourteen obsolete 500KV air-blast circuit breakers; (2) fourteen obsolete and underrated, 132-KV air-blast circuit breakers; (3) obsolete and slow operating generator, overall and 500KV bus differential relaying, and (4) obsolete and inoperable instruments and control devices. If approved as part of the Francis runner replacement project, USAID would plan for a separate competitive procurement of the above replacement electrical equipment, with installation to be coordinated with the replacement of the runners as required.

My trip to Cairo and Aswan, Egypt, was requested by USAID so that I might "review and recommend as to the need for replacement and/or upgrading of associated plant auxiliaries and control systems to include but not be limited, to major circuit breakers, relays and monitoring control systems."

The following Preliminary Report identifies the circuit breaker, relay and control instrument replacement and/or upgrading required to provide for improved reliability. The appraisal grade cost estimates and delivery schedules have been prepared by the BUREC Power System Section in response to the detailed specifications developed with the assistance of EEA engineers.

A Final Report will be submitted to USAID/Cairo in mid January.

Sincerely yours,

Signed

W. R. Roemish, P.E.
Head Power System Section

PRELIMINARY REPORT ON REPLACEMENT OF ELECTRICAL EQUIPMENT AT ASWAN HIGH DAM

W.R. Roemish
Head, Power System Section
Bureau of Reclamation
DFC, Denver, CO

I. EEA Priorities

A. Furnish eighteen 500KV breakers (14 for High Dam and 4 for Nag-Hammadi) plus spare parts for 5 breakers.

B. Furnish four terminals of 500KV line relaying and instrumentation (36 replacement control boards at High Dam and 36 replacement control boards at Nag-Hammadi). Furnish shielded control cable (130 km of cable at High Dam, 70 km of cable at Nag-Hammadi). Three replacement batteries/chargers at High Dam. Furnish drawings.

C. Furnish power system stabilizers for 12 generators at High Dam ($300 K EEA estimated total cost).

D. Furnish fourteen 132KV breakers plus spare parts for 4 breakers at High Dam.

E. Install new control boards in 132KV control room. Include control boards for 16 terminals of 132KV line protection and instrumentation (8 terminals at High Dam, 8 terminals at remote stations). Replace instrument panels on central control room desk consoles.

F. Replace 12 generator control centers (12 control boards each) and 4 block control centers (7 control boards each).

EEA requests following training:

On breakers: 4 engineers and 4 technicians employed at High Dam, and 2 engineers and 2 technicians employed at Nag-Hammadi, for 3 months.

On controls/protection/instrumentation: 4 engineers and 4 technicians employed at High Dam, and 2 engineers and 2 technicians employed at Nag-Hammadi, for 3 months.

EEA insists that American supplier of breakers and boards be responsible for commissioning of replacement equipment.

II. USAID Guidelines

A. Only existing electrical equipment at High Dam is to be considered for replacement in Modernization Program.

B. No line relaying at High Dam is to be replaced unless compatible with non-Aid-funded remote terminals.

C. Only U.S. suppliers of replacement equipment will be considered.

III. Based on the USAID Guidelines, plus input provided by EEA, I recommend that USAID consider funding replacement of the following electrical equipment at the High Dam Power Station:

A. All fourteen existing 500KV breakers plus EEA requested number of spare parts. EEA reported that no failures of existing breakers have occurred. Existing breakers are of a Russian type air-blast breaker no longer manufactured. Spare parts are not available. Existing breakers have adequate continuous current and fault interrupting ratings. Bechtel Study of transmission upgrading associated with Shoubra El-Kheima Plant did not recommend replacement of any High Dam 500KV breakers. Swedish Engineering Group (SWEDCO) study recommended replacement of four High Dam 500KV line breakers with faster (2-cycle) breakers and faster line relaying to permit scheduling of 200MW additional power flow over 500KV lines to Nag-Hammadi. (Note: EEA has obtained international tenders for circuit breaker replacement for the terminals at the High Dam and Nag-Hammadi but have delayed action awaiting AID decision on circuit breaker replacement.)

B. All ten existing 132KV breakers (total number of existing High Dam 132KV breakers) plus EEA's requested number of spare parts. Bechtel Report recommended replacement of

these breakers based on a 1986 fault study with additional generation in service at Aswan Dam. Existing breakers are of a Russian type air-blast breaker no longer manufactured. Spare parts are not available.

C. All twelve existing main generator/auxiliary generator control centers (12 control boards each). Existing electromechanical type protective relays, manual synchronizing equipment, auxiliary relays and obsolete instrumentation to be replaced with new modern devices mounted on new boards.

D. All four existing Block control centers (7 control boards each). Existing electromechanical type protective relays, autosynchronizing equipment, auxiliary relays and obsolete instrumentation to be replaced with new modern devices mounted on new boards.

E. Two existing sets of 500KV bus bar differential relays. New static high-impedance type differential relays mounted on new panels to be furnished.

F. Two existing sets of 132KV bus bar differential relays and all existing protective relays and instrumentation associated with two autotransformer banks and 15.75KV circuits to station service equipment. New modern devices mounted on new panels for installation in the 132KV control room to be furnished.

Existing problems with instrumentation: (1) large errors in numbers of meters, (2) inoperative recording type instruments, and (3) improper functioning of indicating meters due to contamination of oil-damping system.

G. The existing central control room desk console instrument panels.

H. The existing four 6.3KV station service control center panels (6 panels of relays/instruments per center).

I. The existing AC and DC unshielded control cable which must be replaced to accommodate new static type devices.

Cable length and size for cost estimating purposes only: 50 km of 19-wire, No. 10 AWG copper conductor cable.

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J. Three batteries and three chargers plus 30 spare cells. Discharging system.

IV. Appraisal-grade cost estimates for delivery of following electrical equipment to Alexandria, Egypt

A.	Fourteen 500KV breakers	$ 5,000,000
B.	Spare parts for 500KV breakers	$ 60,000
C.	Ten 132KV breakers	$ 700,000
D.	Spare parts for 132KV breakers	$ 20,000
E.	Twelve main generator/auxiliary generator control centers (12 boards each) plus EEA requested spare devices	$ 2,400,000
F.	Four Block control centers (7 boards each) plus EEA requested spare devices	$ 280,000
G.	Two sets of 500KV bus bar differential relays mounted on new panels	$ 15,000
H.	Two sets of 132KV bus bar differential relays and protective relays/instruments associated with two autotransformer banks and 15.75KV circuits to station service system, mounted on new panels, plus EEA requested spare devices	$ 45,000
I.	New instrument panels for central control room desk consoles	$ 300,000
J.	New boards for four 6.3KV station service center panels	$ 290,000
K.	50 km of shielded 19-wire No. 10 AWG copper conductor cable	$ 110,000

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L.	Three batteries/chargers and discharging system plus 30 spare cells	$ 375,000
M.	Total cost of above equipment (A -- L)	$ 9,595,000
N.	Power system stabilizers	$ 280,000

(Note: EEA has contract with Siemens to replace existing excitation system mercury arc rectifier equipment with new SCR's.)

O.	Allowance for unlisted items	$ 905,000
P.	Contingencies	$ 2,220,000
	Total	$13,000,000

V. Estimated Equipment Delivery times, Appraisal-grade Installation Costs and Training Costs and Estimated Engineering Man-day Requirements for Preparation of Specifications

A. Estimated Equipment Delivery Times:

1. For fourteen 500KV and ten 132KV breakers — 365 days

2. For control boards, panels, shield cable and batteries/chargers, etc. identified in IV (E -- L) — 500 days

B. Estimated Cost of Services of Erecting Engineer

1. For installation of fourteen 500KV breakers and ten 132KV breakers — $ 5,000/BKR
   Total cost of circuit breaker installation — $ 120,000

2. For installation of control boards, panels, shielded cable, batteries/chargers,

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etc. identified in IV (E -- L)	$ 400/day
Total cost of controls/ battery installation based on 326 days to complete installation	$ 130,000

C. Estimated Appraisal-grade Cost of Installation (US dollar equivalent)

1. Fourteen 500KV breakers and ten 132KV breakers	$1,700,000
2. Control boards, panels, shielded cable, batteries/ chargers, etc. identified in IV (E -- L)	$1,200,000
Total cost installation	$2,900,000

D. Estimated Cost of Training (not to include travel and per diem)

1. On breakers: 4 engineers and 4 technicians for 1 week	$ 5,000
2. On relays/instrumentation: 4 engineers and 4 technicians for 2 weeks	$ 10,000
Total cost training	$ 15,000

E. Estimated Man-days Required to Prepare

1. Breaker specifications	30 MD
2. Control board, shielded cable, battery/charger, etc. specifications, including single-line, wiring and schematic diagrams	800 MD

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VI. Potential US Suppliers of Breakers:

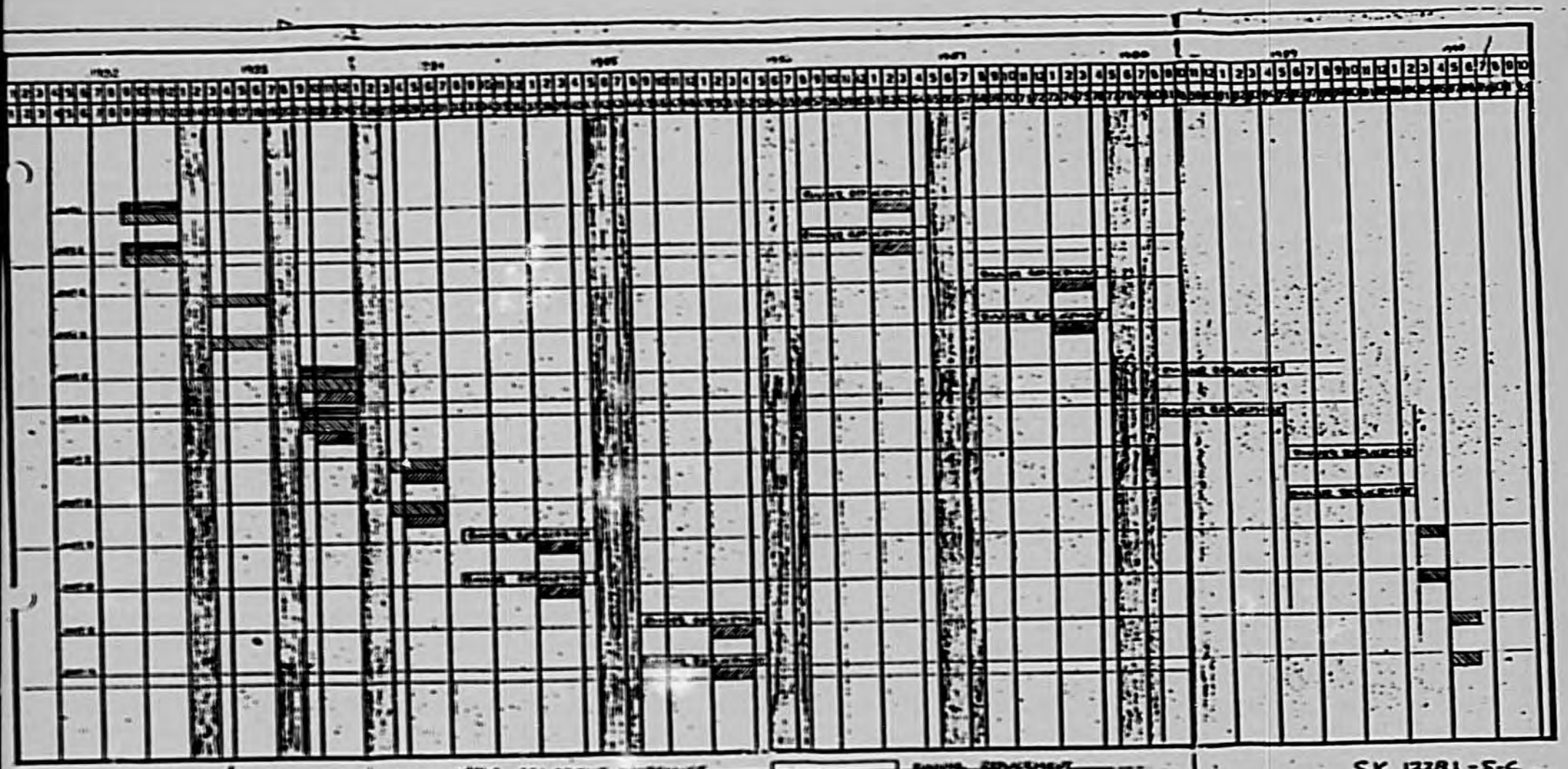
A. 500KV SF-6 Puffer, live tank design:

High Voltage Breakers, Inc.
Westinghouse Corporation
Gould Brown Boveri
Siemens-Allis

B. 132KV SF-6 Puffer, Dead Tank Design:

Westinghouse Electric COrp.
Gould Brown Boveri
McGraw Edison
Siemens-Allis

Note: Compliance of these suppliers with USAID Procurement Requirement must be determined.



SK 12281-S-C
DCI/GCP REV A-1
REV B

SUMMARY SCHEDULE FOR FIELD REHABILITATION
AND MODERNIZATION
OF
HYDRO-TURBINES
HIGH ASWAN DAM
BY
ALLIS-CHALMERS CORPORATION

ANNEX I

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IMPLEMENTATION SCHEDULE FOR FRANCIS TURBINE RUNNER REPLACEMENT
(MONTHS FROM EEA'S BOARD APPROVAL)

	ALL UNITS		UNIT 1		UNIT 2		UNIT 3		UNIT 4		UNIT 5		UNIT 6		UNIT 7		UNIT 8		UNIT 9		UNIT 10		UNIT 11		UNIT 12	
ACTIVITY	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End
Model Test	1	12																								
Pattern Development	7	8																								
Engineering	4	18																								
Wicket Gates	14	33																								
Governor Procurement	1	22																								
Material Procurement			5	12	11	15	22	26	23	27	34	38	36	40	45	49	47	51	57	61	59	63	66	70	68	72
Manufacturing			13	31	16	32	27	43	28	44	39	55	41	57	50	66	52	68	62	78	64	80	71	87	73	89
Ocean Transport			32	33	33	34	44	45	45	46	56	57	58	59	67	68	69	70	79	80	81	82	88	89	90	91
Customs Clearance Barge to Site			34	35	35	36	46	47	47	48	58	59	60	61	69	70	71	72	81	82	83	84	90	91	92	93
Water Passageway Rehabilitation			98	99	98	99	100	102	100	102	9	12	9	12	15	18	15	18	21	24	21	24	27	30	27	30
Runner Replacement			32	40	34	40	44	52	46	52	56	64	58	64	68	76	70	76	80	88	82	88	89	97	91	97
Governor Rehabilitation			37	39	37	39	49	51	49	51	61	63	61	63	73	75	73	75	22	24	22	24	28	30	28	30

NOTE: BEGIN - Month in which activity begins.
END - Month in which activity is completed.

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ANNEX U

AID 1020-25 (3-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project: From FY 82 to FY 90
Total U.S. Funding $100 million
Date Prepared: 2/23/82

Project Title & Number: HIGH DAM REHABILITATION/MODERNIZATION - 263-0160

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: 1. Provide reliable energy for continued industrial, commercial and residential expansion and economic growth. 2. Improvement of rural and urban living conditions.	Measures of Goal Achievement: 1. Increased industrial sector GDP. 2. Increased industrial employment	Government of Egypt statistical data.	Assumptions for achieving goal targets: GOE fiscal and monetary policy, price policy, and debt management will foster continued growth.
Project Purpose: To improve the reliability and economy of operation of the High Dam Hydroelectric Power Station.	Conditions that will indicate purpose has been achieved: End of project status. 1. Absence of runner cracking. 2. Increase turbine efficiency. 3. Increased power output. 4. Final acceptance 5 years after Taking Over and Acceptance Certificate issued by EEA.	1. Plant operating data and MOEE statistical data. 2. Examination and inspection of the turbine runners during warranty period and routine maintenance outages. 3. Executed Taking Over Acceptance Certificate. 4. Executed Final Certificate.	Assumptions for achieving purpose: That turbine runners can be manufactured and installed in existing turbine and spiral cases and operated without appearance of cracking. Modern circuit breakers, relays & control instrumentation is available with long term spare parts.
Outputs: Rehabilitation of hydroelectric turbine runners and replacement of circuit breakers, relays and control instrumentation.	Magnitude of Outputs: Increased operating efficiency of High Dam Hydroelectric Power Station.	1. Plant operating data and MOEE statistical data. 2. Review of all ancillary equipment contracts. 3. Contractor reports. 4. Review of disbursements made upon shipment of equipment. 5. Inspection and examination of works.	Assumptions for achieving outputs: 1. That the Aswan High Dam Power Station facilities will be made available to US contractors for necessary inspection & equipment replacements. 2. That GOE will provide all local currency required to carry out the project.
Inputs: 1. Contract for engineering advisor services for project implementation. 2. Turnkey supply and installation contract for turbine runners. 3. Contracts for supply of circuit breakers, relays and control instrumentation.	Implementation Target (Type and Quantity) 1. Shipment of first runners 32 months from EEA Broad approval of turnkey contract. 2. Installation of 1st runner completed 40 months from EEA Broad approval. 3. Shipment & installation of subsequent runners per contract schedules. 4. Ancillary equipment installation coordinated with turbine outages.	1. Contract review. 2. Comparison of cash flow to cash flow plan. 3. Delivery schedules of equipment. 4. Installation schedules of equipment.	Assumptions for providing inputs: 1. That US electrical equipment manufacturers will bid for ancilary equipment contracts. 2. That local Egyptian firms will be available for installation contracts.

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