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Prepared for:

MINISTRY OF ELECTRICITY AND ENERGY
Egyptian Electricity Authority
Arab Republic of Egypt

POLICY REFORM AND INSTITUTIONAL DEVELOPMENT ASSESSMENT FOR COMPETITIVE MARKET ADAPTATION OF THE EGYPTIAN POWER SECTOR

VOLUME I: EGYPTIAN ELECTRICITY AUTHORITY

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VOLUME I:

EGYPTIAN ELECTRIC AUTHORITY

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GLOSSARY OF TERMS

SECTION A

GENERAL ACRONYMS & ABBREVIATIONS

ANSI -	American National Standards Institute
BOO -	Build-Own-Operate
BOT -	Build-Operate-Transfer
CAA -	Center of Auditing Agencies
CAPMAS -	Central Authority to Planning Mobilization and Statistics
CIDA -	Canada International Development Assistance
CIGRE -	Circuit Integré du Grande Resources Electricité
ECB -	Egyptian Central Bank
EDCO -	Electric Distribution Company
EEA -	Egyptian Electricity Authority
EUSA -	Egyptian Uniform System of Accounts
FATC -	Finance and Administrative Training Center.
FERC -	Federal Energy Regulatory Commission
FPC -	US Federal Power Commission
GAO -	General Accounting Office
GEEC -	General Egyptian Electric Corporation
GNP -	Gross National Product
GOE -	Government of Egypt
HCCDEP -	Holding Company for Construction and Distribution of Electric Power
HCDE -	The Holding Company for Distribution of Electricity
IBRD -	International Bank for Reconstruction and Development
ILO -	International Labor Organization
K&M -	K&M Engineering and Consulting Corporation
LE	Egyptian Pound
MIS -	Management Information Systems
MOEE -	Ministry of Electricity and Energy
NECC -	National Energy Control Center
O&M -	Operations and Maintenance
P&L -	Profit and Loss
PSED -	Private Sector Energy Development
TMDP -	Top Management Development Plan
UN	United Nations
UNDP -	United Nations Development Program
USAID -	United States Agency for International Development

GLOSSARY OF TERMS

SECTION B

TECHNICAL ACRONYMS & ABBREVIATIONS

ACSR -	Aluminum Conductor Steel Reinforced
APPA -	The Anual Peak Profile Analysis
BASIS -	Base
DSM -	Demand Side Management
ECEP -	Energy Conservation and Efficiency Project
EGEAS -	Computer Program
EHV -	Extra High Voltage
EMTP -	Electromagnetic Transients Simulation
FSA -	Full Supply Agreement
GRSC -	Growth Rate Specific Consumption
HV -	High Voltage
I&C -	Instrumentation & Controls
IEEE -	Institute of Electrical & Electronic Engineers
kVA -	Kilo Volt Amps
kW -	Kilo Watt
LT -	Low Tension
MT -	Medium Tension
MV -	Medium Voltage
Mva -	Mega Volt Amps
MW -	Mega Watts
NUS -	National Unified System
RATS -	Regression Analysis for Time Series
REA -	Rural Electrification Authority
RPI -	Retail Price Index
RTU -	Remote Terminal Units
SCADA -	System Control and Data Acquisition
VHV -	Very High Voltage
WASP -	A Computer Program for Least Cost System Expansion Planning

PART I: EXECUTIVE SUMMARY

USAID/Office of Energy and Infrastructure and the USAID/Cairo awarded K&M Engineering and Consulting Corporation a technical assistance contract to perform a Policy Reform and Institutional Development Assessment of the Egyptian Power Sector under the direction of the Private Sector Energy Development (PSED) program. This part of the report, Volume I, focuses on the Egyptian Electricity Authority (EEA) while Volume II concentrates on the distribution of electricity.

USAID has provided funding for various projects in the Electric Power Sector of Egypt for the past 17 years. This sector falls under the jurisdiction of the Ministry of Electricity and Energy. USAID funds have contributed to the development of this vital sector of the Egyptian economy and enabled it to close the gap between demand and supply with a margin of safety. Over 95% of the Egyptian population now have access to electricity. A recently completed Energy Pricing Strategy Study, also financed by USAID, is being implemented in stages and is providing EEA with increased revenues. These revenues will help finance new investments and enable EEA to achieve a greater degree of financial independence better planning, and higher productivity.

USAID, with the approval and cooperation of the Ministry of Electricity and Energy, wishes now to proceed with an analysis and assessment or the organizational and operational efficiencies of the EEA and the distribution companies, as well as their respective expansion plans. Such a study will help the Egyptian Electric Power Sector, USAID and the other bilateral and multilateral financing institutions to develop a set of priorities for the allocation of available financial resources.

The objectives of this study are to assess the current status of the Egyptian power sector and to produce tangible recommendations for achieving a transition to its operation on a commercial basis through:

- Increased operational and financial independence
- Increased operational efficiency
- Improved profitability and return on investments
- Recognition of the customer and the competitive market place as the ultimate commercial concerns.

The Executive Summary represents a compilation and summary of the recommendations made in the various chapters of the report. These recommendations are categorized below according to the level of government authority required for their implementation. The classification is as follows:

- EEA OPERATIONAL ISSUES
- POWER SECTOR POLICY ISSUES
- GOE ISSUES

EEA Operational Issues

The recommendations in this category involve changes that EEA's management can implement without external permission or supervision. These recommendations concern the overall management, organization and functioning of the Egyptian power sector. They include:

Organization

- Commercial operation at EEA will require that all current procedures be reviewed and significantly modified to establish a clear pattern of delegation and accountability. In areas such as procurement and recruiting of personnel, Deputy Chairmen, Zone Presidents, and Plant Managers should be given specific authorities with guidelines and ceilings. Such authorities should be consistent with policies formulated and amounts budgeted in the Business Plan with accountability for costs.

- While a large number of technical oriented staff is not unusual in electric utilities, there is still the need for skilled administrators, accountants, economists, etc. as in every business enterprise. It is therefore recommended that in the future a more varied mix of professional backgrounds be represented among EEA's top management personnel.

Human Resource Management

- Gradually reduce personnel as outlined in the recommendation under POWER SECTOR POLICY ISSUES.

- In view of the new policy of independence and financial profitability it will be of prime importance to reorient the management of EEA toward commercialization. This will

require executive training geared toward the operation of a profit-driven utility. Training should also include the fostering of:

- A more customer-oriented attitude (see Chapter 8);

- A better understanding of the cost structure of EEA's operations; and

- A particular attention to the training of accounting and financial personnel should be given. It should include the operation of modern accounting systems, computerization, and international financial issues such as foreign exchange risks, foreign and international lenders' requirements, etc.

- EEA should utilize to the maximum extent possible existing management, development programs offered by U.S. universities, the American Management Association, the Edison Electric Institute and industry consultants that deal with personnel compensation. Compensation of employees needs to be restructured at EEA. Incentives and profit sharing should be increased at all levels in order to motivate personnel. These incentives, however, should be made commensurate with results and not distributed across the board.

Management Information Systems

- Increase divisional dependence on computer-based operation by designing a phased transition plan to automate operations. This plan should be given a high priority and treated as a project with a responsible project manager to supervise its design and implementation. This plan should include extensive training especially to the department managers and supervisors.

- Re-evaluate and revise divisional operational policies on the integration of manual and automated systems. Support and direction for this change should come from Deputy Chairmen through clear and unequivocal mandates to all departments within their respective divisions.

- The data-entry and data-verification process should be incorporated into each department. Each department will then increase its staff by one or two or use one or two of its existing staff for data entry and verification. The departments should then be made accountable for the availability of accurate data on a timely basis.

- Departmental Staff should receive specialized training on the benefits of an MIS systems and how one is created. This training should be carried out by the Data Bank staff.

- Linkage between Al-Ahram historical statistical consumption information and the Data Bank should be established to facilitate data flow between EEA and the distribution sector.

- The proposed linkage of the Zones to the Data Bank is highly recommended to allow data flow from its source. It will allow EEA divisions to conduct their operations efficiently without delays caused by manual transfer of data or data discrepancy. Furthermore, it is also vital to allow cross-pollination of new data in the system to ensure consistency and accuracy.

- The Financial Affairs and Accounting division should re-evaluate and revise its policy concerning integration of its manually-recorded and computer-generated records, and the organizational structure which it supports.

Thermal and Hydroelectric Generation

- Consistent monitoring of fuel consumption and periodic testing of heat rate of all units at all plants.

- Adoption of a uniform preventive maintenance program for all plants. The system presently introduced at the Ataka plant is the primary candidate as a model for other plants.

- Training of personnel should be expanded to emphasize preventive maintenance programs.

- Continue enforcement of environmental protection regulations and upgrade older plants to bring them in line with those regulations. Should the cost of improving some of the older plants prove to be uneconomical then further consideration should be given to accelerating the phasing out of such plants.

- A work group including people from each Zone and Headquarters should be formed to:

  - Exchange experiences concerning solutions to maintenance and procurement problems;

  - Establish criteria and medium term plans to standardize station components wherever possible;

  - Identify individuals that can contribute positively to the determination of inventory levels;

  - Establish a program to computerize maintenance and spare parts control for plants that will **not** be retired shortly; and

  - Establish mechanisms that will enable plants to consult each others' (computerized) inventory records in order to reduce stocking levels and duplication.

- A budgeting and procurement system should be established to anticipate the need for spare parts and speed-up the procurement of parts that have been included in the budget.

- The methods used to purchase mazout for power generation should be refined to more accurately reflect the characteristics and price of the fuel.

- It is recommended that EEA investigate a large number of past mazout sample analyses in order to determine the uniformity of heat content.

- An immediate investigation should be initiated to determine expected variations in the heat content of the natural gas purchased by EEA, so that negotiations to adjust the price of this gas according to its heat content can be pursued.

- A study should be carried out to determine if the methods used to measure gas are adequate, and to ascertain what improvements are required.

- EEA should survey its present natural gas heat content testing capabilities in order to determine what changes are required to allow comprehensive control of natural gas purchasing. This survey would also ascertain whether or not permanent testing facilities should be installed at the larger power plants.

- To maximize unit efficiency and therefore system efficiency, Automatic Generation Control should be installed and operated on all units.

Transmission System

- EEA should reconsider its decision to build 500 kV lines and substations between Cairo and Alexandria as part of the planned expansion of Sidi Krir power plant by the addition of two 300 MW units (Numbers 3 and 4). Based on network studies it appears that the existing 220 kV facilities will deliver this additional power with only a small short time limitation on the maximum generation possible at Sidi Krir under a double line outage condition. This decision would postpone a very large capital expenditure for several years.

- EEA should study the use of less expensive substation designs, such as ring bus configurations for its 500 kV substations, and continue investigating alternate methods for cleaning insulators while the equipment is energized.

- EEA should change its policy and reduce the number of transformers installed in each substation until such time (probably many years) as the 66 kV transmission system is not able to carry the load from adjoining substations.

- EEA should change its policy and initially install only one 25 MVA transformer in each substation until such time (probably many years) as the 11 kV distribution system is not able to carry the load from adjoining substations. The same logic applies when considering the addition of third and fourth transformers to these substations.

- EEA should consider developing a program to identify under-loaded transformer capacity on its system with the objective of moving such excess transformer capacity to areas of higher loads.

- EEA should encourage the development among Zones of common specifications for equipment, tools, and construction materials across zones.

- EEA should implement a patrolling system to identify obstructions to the right-of-way and remove them before they become very difficult to overcome.

Customer Service Operations

- EEA should consider replacing most of the existing electromechanical meters with multifunction electronic meters, which are much more precise.

- EEA should appraise the adequacy of the existing meter installation testing program and initiate procedures to inspect and recondition all of them as needed.

- EEA should survey the location of the instrument transformers in the customer metering installations to insure that they measure the energy delivered at the highest tension point of the power transformers.

- It is important for EEA to become more customer-oriented. Therefore, we believe that it is essential to create a customer service department designed to meet the needs of the 42 EHV and HV customers. This department's duties would include:

  - Maintaining close, frequent contact with the customers, and identifying their problems;

  - Assisting customers with their forecasts, thereby providing better inputs to EEA's planning; and

  - Developing new approaches to tariff structures and service that will benefit both EEA and its customers.

  - All expansion planning should include economic and financial assessments of expansion alternatives.

Expansion Planning and Forecasting

- EEA's planning and forecasting personnel are very capable but need specialized training in economics, forecasting, and statistical analysis. All expansion planning should include economic and financial assessments of expansion alternatives.

- Data inputs need to be improved. This can be partially achieved by:

  - active EDCO participation in the forecasting process;

  - closer cooperation with the large EHV and HV industrial consumers to obtain the impact of their production planning on their product demand

- The computer models currently in use require upgrading

- The forecast scenarios should take into consideration the following factors:

  - The elasticity of price and demand

  - The EEA demand side management programs

  - Privatization of industry which should result in greater attention to production costs and profitability

  - Energy conservation programs in both the Public & Private Sectors financed by USAID

- The expansion plan for generation to the year 2000 should be revised to take into consider all options, including:

  - New plants;

  - The refurbishment & upgrading of existing plants;

  - The retirement of old and high cost units.

System Dispatch

- The National Energy Control Center should run simulations to identify fuel savings that could be achieved by running the EEA system under true least cost dispatching.

- EEA should consider the possibility of converting aging plants into different facilities, training their present employees to perform different duties, and retiring obsolete equipment.

- Instrumentation should be acquired, and personnel trained to run periodic efficiency tests on all the generating units.

- EEA should consider installing full remote control breakers in the Control Center, and transformer operations in all substations.

Finance and Accounting

- EEA should adopt a specific plan for the automation of its accounting records. The plan should be implemented in phases, with automated systems operating in parallel with the manual system before each phase is finalized. The automated system should be designed with substantial input from management and other prospective users throughout EEA.

- EEA should prepare annual construction and operation budgets after guidelines and goals are provided by upper management, beginning at the lowest departmental level. Departmental budgets should be prepared to a level of detail which is controllable by the department head, who should receive periodic reports comparing budget to actual performance, and be held accountable for the department's performance relative to established goals. Five-year projections should also be prepared each year to plan cash flow, revenue requirements, and financing requirements.

- EEA should maintain fixed asset records in greater detail to provide cost information by major component within generating stations, substations, etc. Detailed information should be collected first with respect to new construction, but should eventually include (through allocations, if necessary) existing fixed assets. This would allow the cost of retired assets to be removed from the accounting records accurately, and would facilitate the depreciation study recommended below.

- First, the cost or value of energy transferred between zones should be recorded in the accounts of the zones. Second, the costs of the Operations Department and the Headquarters Office should be allocated to the zones in order to accurately evaluate zone performance. EEA should make allocations of these two significant cost areas between zones to make the accounting results of operations for such zones more representative of their actual performance.

- EEA should conduct a depreciation study to establish depreciation rates more reflective of the economic consumption of the fixed asset costs.

- EEA should seek approval to discontinue the procedure of continuing charging depreciation at the level of 50% of the normal rate after fixed assets are fully depreciated, since this method does not achieve the stated goal.

Sector Policy Issues

These are recommendations involving policies which generally require approval at the Ministerial or Cabinet level, or at least co-ordination with other government bodies. Accordingly, EEA may not be free to implement the recommendations in this category of its own accord. The recommended sector policy actions are:

- The retirement of inefficient plants
- The management and utilization of personnel
- The gradual reduction of excess personnel by several measures such as:
  - Freezing hiring for a set period of time, and thereby reducing total employment through attrition. New plants can be manned by transferring employees from existing facilities;
  - Offering early retirement with full benefits;
  - Making a special effort to train personnel in skills which are in demand in Arab countries. Training should include English, which is sought by most foreign firms operating in those countries; and
  - Encouraging or participating in Egyptian private companies that will bid for Operations and Maintenance contracts in the Gulf. Most of the government plants in Arab countries are operated by private firms for periods of 3 to 5 years. Egyptian companies with a qualified and well-trained personnel should have an advantage over foreign companies employing largely Asian labor.
- The improvement of the current structure of remuneration including profit sharing, and the present charter.
- The appointment of non-government directors with business and financial expertise.

G.O.E. Policy Issues

This last category is composed of recommendations concerning issues which affect EEA directly but are not within its authority. These include:

- Changes to EEA's charter to allow more operational and financial independence
- The establishment of an independent regulatory agency with authority over both public and private electric entities. This agency would play a leading role in setting transfer prices between EEA and the EDCOs, and in determining tariffs to end-users and in monitoring quality of service.
- The removal of hidden and cross subsidies
- The enforcement of payment for energy consumed by government agencies; that is, the reduction of EEA's accounts receivable to within financially acceptable limits
- An increase in EEA's capital base in order to bring its debt-equity ratio further into line with levels acceptable to financial institutions.

PART II: PROPOSED IMPLEMENTATION PLAN

In this section we have attempted to integrate and prioritize the many recommendations made in this report. The order of priority is based primarily upon the extent of the financial impact an implemented recommendation is expected to have on EEA, wherever this criterion is applicable. Otherwise, the priority is based mainly on the expected contribution to commercial operation and accountability.

To reinforce the implementation plan, and to provide a means to measure its progress by defining milestones, we have selected what we consider to be the twelve recommendations (Actions Items) that will either have the greatest immediate impact on EEA's balance sheet, or will make the most immediate contribution to the achievement of significant commercialization, improved service to the public, and increased accountability. These twelve recommendations can, we believe, be achieved within one to five years. The other recommendations contained in this report are tabulated separately in Part II above, and can later be grouped together for implementation simultaneously with the high priority "Action Items", or independently, but still within the five year time frame.

The following action items for the implementation plan can be summarized under two major objectives:

A. Action Plan to Reduce Present Costs of EEA

Action Items

[1] Reduction of EEA's Accounts Receivable

The Financial viability of EEA can only be achieved if the bills for supply of electric energy are collected. Accounts Receivable can only be reduced if the various GOE entities (Administrations and Public Sector companies) are forced to meet their obligations regarding outstanding bills to EEA. EEA has 42 direct customers of which the public sector accounts for the following:

	Total
EHV	16.4%
HV	5.6%
MV (Industry and Agriculture)	0.58%
EDCOs	77.33%[1]

[1]Source: Annual Report of Electric Statistics 1991/1992, EEA, p.45. HV figure excludes Dekhela Port.

The Distribution Companies, in turn, have large outstanding receivables with the EEA. This situation must be remedied and the various public sector entities forced to pay their debts for electric energy. Otherwise, EEA and the EDCOs will continue to face serious cash-flow problems. Furthermore, EEA must pay interest on its own debts, while unable to impose penalties or interest on delinquent accounts. It is estimated that if EEA could bring its receivables from the present level of about 6.4 months to the equivalent of 60 days of annual energy sales, it could save as much as L.E. 140 million a year (using 1991/92 figures and 16% interest rate) in interest payments.

Suggested Actions:

Notice should be given to all public and private customers that receivables must be paid within a certain time limit. Failure to do so should result in one or both of the following actions:

- Interruption of service;
- Consolidation of debts and debt-swap performed by the Ministry of Finance. Amounts due from some of the larger public sector industries such as the Aluminum Company and Kima could be consolidated and deducted from the amounts due to the Ministry of Finance from EEA.

In any event, it is imperative both to EEA's balance sheet, and to meet the covenants of outstanding loans and grants from international institutions, that receivables be brought down to no more than 90 days.

[2] Economic Dispatch

As EEA is now in a more comfortable position regarding its generation capacity as compared to its peak demand, it is becoming imperative to dispatch the generating plants based on purely economic considerations. With the present mix of old plants (commissioned as early as 1951), modern plants (commissioned between 1985-1992), comprising gas turbine simple cycle, combined cycle, as well as steam plants, efficiencies vary widely from plant to plant. For example, some of the older plants such as El-Max (gas), El-Suif (gas), and Suez (gas) have fuel consumptions in the range of 407-430 equivalent grams of Mazout/kWh, while newer plants such as Shoubra (steam), Ataka (steam), and Abu Quir (steam) have consumptions in the range of 221-229 grams of Mazout/kWh. In Chapter 6, we demonstrated that if Cairo North had been put on cold reserve during 1991/1992, and its loading picked up instead by the Shoubra station located nearby, the savings would have been substantial (approximately 51,000 MT of mazout equivalent). If this type of rationalization can be generalized and more inefficient plants retired or kept on cold reserve, substantial annual savings can be achieved. For this reason economic dispatch is high on the list of priorities. Furthermore, by placing plants on cold reserve, employment issues do not arise immediately and can be dealt with over time.

[3] Phasing out of Inefficient Plants

As new plants come into operation, or as new expansions are being considered, the closing of inefficient plants must always be considered among the available options. However, employment issues demand special consideration in this regard. The prime candidates for retirement are the plants mention in number 2 of this section.

[4] Implementation of Modern Preventive Maintenance

With the large capital investments being made in new plants and machinery, it is important that EEA maintain each plant in the best possible operating condition and able to deliver energy when and as required. This would reduce the expenses associated with outages and reduce investment in redundant capacity. Preventive maintenance, therefore, is of utmost importance. There is wide variation in the quality of maintenance programs employed by EEA at its different plants. A new Swedish-designed system is currently being introduced at Ataka. It is therefore natural to select a modern system to be applied uniformly throughout the Egyptian UPS. Such a standardized system holds great benefits for EEA, and its implementation should therefore be given high priority.

[5] Increase EEA's Capital Base

EEA's financial independence and ability to secure financing on the strength of its own balance sheet without GOE guarantees requires that its capital base be increased in line with the requirements of international lending institutions. This could be partially achieved through a debt-equity swap by GOE.

[6] Reduce Over-employment

Gradually reduce the overemployment at EEA through a variety of measures such as:

- a freeze on new hiring
- early retirement
- financial incentives
- participating in encouraging the establishment of companies to undertake O&M of plants in the countries of the Gulf.

B. Action Strategies to Improve Future Planning of EEA

[7] Development of Realistic Forecasts for Energy Sales and Peak Demand

It is essential to both expansion plans and the development of a business plan that new forecasting procedures be implemented to produce a reliable forecast for the next five to ten years. This forecast should be based on better data-input than in the past, and should try to integrate the plans and forecasts of the 42 EEA customers. It should also take into account anticipated energy price elasticities and the demand-side management program to be implemented by EEA.

[8] Determine Least-Cost Expansion Plans

With the establishment of new load and energy forecasts a new study to determine the least-cost expansion required to meet anticipated energy demand is needed. New investments in generation and transmission should be weighed on an equal footing against refurbishment and upgrading existing plants. Furthermore, when considering new generation capacity, new grassroots plants should be carefully weighed against expansion of existing plants.

[7] Business Plan

The major recommendations made in this report need to be assembled and integrated into a cohesive business plan. This report has attempted to outline the general framework for such a plan and the steps required to develop it. EEA will require assistance developing the first such plan.

[9] Management Training

EEA has for many years provided training programs for its technical personnel. In view of the new emphasis on commercial viability, profitability and cash-flow, it is essential that top management receive the appropriate training. Special training and re-orientation of top managerial staff will facilitate the implementation of EEA's new policies.

[11] Changes to the EEA Charter

The transformation of EEA into a commercially viable utility incorporating appropriate accountability for its financial results requires that it be better able to manage its resources, human and otherwise. The present charter does not provide the flexibility and independence necessary for EEA's operation under the new commercial objectives. Therefore, a new charter should be drawn, as discussed in Chapter 4, which might follow the example of the Suez Canal Authority or apply the provisions of Law 203 of 1991, which would be more expeditious.

[10] Establishment of an Independent Regulatory Framework

This issue has been discussed in Chapter 4. As the EDCOs are separated from the MOEE, transfer pricing must be independently and equitably decided. Furthermore, electric energy prices will require periodic revision in order to take into account the changing cost structure of the energy sector and the overall economic conditions. Hence the importance of establishing a mechanism for price revisions.

2 INTRODUCTION AND BACKGROUND

Over the last 17 years, USAID has provided funding to the Electric Power Sector in Egypt for various projects on an ongoing basis. This sector, until recently, came entirely under the jurisdiction of the Ministry of Electricity and Energy (MOEE). The USAID funds have contributed to the development of this vital sector of the Egyptian economy and has enabled it to close the gap between demand and supply with a margin of safety. Over 95% of all urban and rural areas of Egypt are now electrified. A recently completed Energy Pricing Strategy Study, also financed by USAID, is being implemented in stages and is providing EEA with increased revenues that will help finance a larger portion of its new investments, and therefore enable it to achieve a greater degree of financial independence and, consequently, better planning and higher productivity.

USAID, with the approval and cooperation of the Ministry of Electricity and Energy, is now proceeding with analysis and assessment of the organizational and operational efficiencies of the Egyptian Electricity Authority (EEA) and the distribution companies, as well as their respective expansion plans. Such a study will help the Electric Power Sector, USAID and the other international financing institutions to focus on a set of priorities and be able to better allocate the available financial resources.

USAID has entrusted to K&M Engineering and Consulting Corporation (K&M), which manages the Private Power Sector Development program under contract to the Office of Energy and Infrastructure of USAID in Washington DC, the task to carry out this study, which has been named "**POLICY REFORM AND INSTITUTIONAL DEVELOPMENT ASSESSMENT FOR COMPETITIVE MARKET ADAPTATION OF THE EGYPTIAN ELECTRIC POWER SECTOR**".

K&M is involved in several projects with EEA and many of its senior management and staff members have a long association with Egypt and its Electric Power Sector. Furthermore, K&M is involved with efforts in several countries, providing technical assistance in restructuring their power sectors, and developing and adopting new policies to encourage a more commercially-oriented operation of government utilities and increased participation by the private sector. Using the company's experience on these and other related projects, the K&M study team was formed to review the present conditions in the power sector. This review was conducted taking into consideration USAID's, EEA's and the Holding Company for Construction and Distribution of Electric Power's (HCCDEP) ultimate objective of increasing commercialization and efficiency of operations.

This report contains the cumulative analysis of the various members of the study team in the different areas of concern. Reflecting the fact that the distribution operations are no longer under the Ministry of Electricity, but rather, under the Prime Minister, the report is divided into two separate volumes. Volume I discusses technical and financial issues concerning the EEA; Volume II discusses technical and financial issues concerning the Holding Company for Construction and Distribution of Electric Power and the eight regional Distribution Companies.

2.1 OBJECTIVES AND SCOPE OF THE STUDY

The primary objective of the study is to undertake an assessment of the Electric Power Sector in Egypt in order to provide guidelines and recommendations for the formulation of a plan which will facilitate the necessary growth to meet demand, while maintaining a high degree of financial independence.

The effective implementation of such a plan for the Egyptian Power Sector should result in more commercially-oriented operations with reduced dependency on GOE funds and grants for financing of system expansion.

The study shall also attempt to identify specific areas of assistance which would facilitate the optimization of the EEA and Distribution Companies' operations. Specifically,

- Increase Operational Efficiency;
- Improve Returns On Investments and Profitability;
- Increase Operational and Financial Independence.

In order to accomplish these objectives, the study will encompass technical, financial, organizational, commercial and legal aspects of both the EEA and the HCCDEP, as shown in Figure 2-1. The following sections describe the overall scope of this work in detail.

2.1.1 General Requirements

2.1.1.1 Review of Existing Laws, Policies, Procedures and Regulations

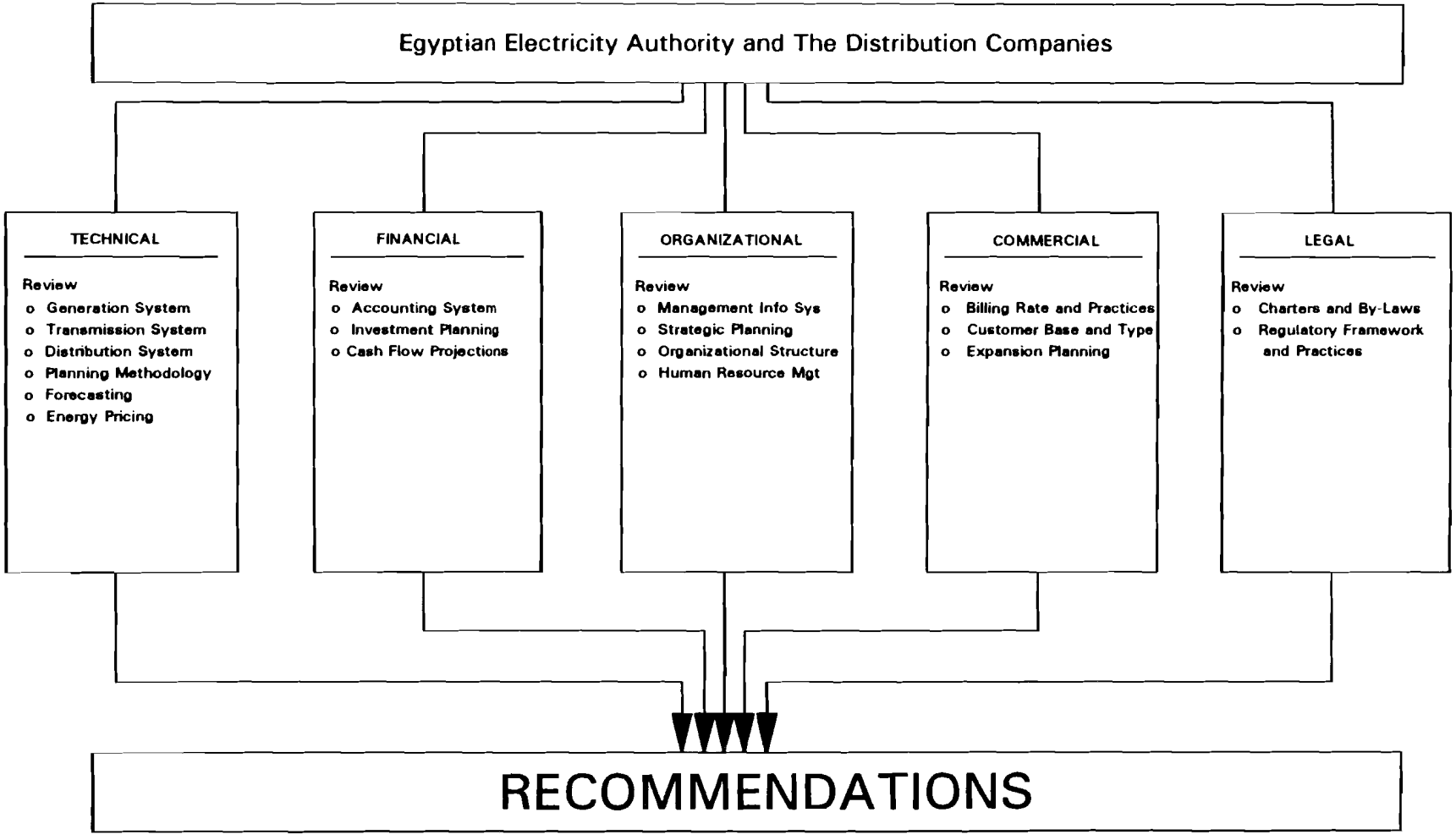
The K&M project team shall provide a comprehensive review of the issues, opportunities, and impediments which affect the energy sector to determine if change could be made to increase interest and investment in the power sector. This would include but not be limited to:

REGULATORY FRAMEWORK: The K&M project team shall investigate the present Egyptian regulations concerning the generation, transmission and distribution of electric power in Egypt and identify any restrictions or limitations to these activities.

The K&M project team shall investigate the need to establish a Governmental institution with regulatory jurisdiction over utilities and responsibilities in determining the reasonableness of rates, quality of service and utility operations for all utilities.

Figure 2-1

SCOPE OF THE STUDY



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LEGAL FRAMEWORK: The K&M project team shall review and analyze the legal framework under which the EEA, the Holding Companies and the distribution companies established, and are currently operating. This will include a review of the relevant charters, by-laws, and other regulations.

2.1.2 Technical and Financial Information

2.1.2.1 Demand and Energy Growth

The K&M project team shall review the policies and procedures for the short and long term forecasting of demand and energy sales including:

- forecasting methodology;
- EEA's most recent 10 year load and energy forecast;
- system load shape characteristics;
- load diversity;
- elasticities between GNP and demand;
- elasticities between GNP and energy sales;
- peak shaving strategies;
- load management applications.

2.1.2.2 Generation

The K&M project team shall review the capacity planning policies and practices and operating and maintenance procedures for the generation of electricity. The K&M project team should review and determine the appropriateness of:

- capacity planning criteria including reliability and installed reserve level;
- fuel availability;
- expansion planning methodology;
- planning models utilized for capacity need and least cost expansion planning;
- environmental regulations, policies and procedures;
- capacity mix policies;
- hydraulic constraints;
- electric plant investment segregated by land structures, boiler plant or reservoir, turbine generators, accessory equipment and miscellaneous;
- operating reserve policies and practices;
- unit commitment policies and practices;
- maintenance policies and scheduling practices;
- equipment retirement policies and practices;
- fixed and variable operating costs for units and plants segregated by operation and supervision, fuel, stem expenses, electric expenses, miscellaneous stem plant expenses;
- fixed and variable maintenance costs for units and plants segregated by maintenance supervision and engineering, maintenance of structures, maintenance of boiler or reservoirs, maintenance of electric plant.

2.1.2.3 Transmission

The K&M project team will investigate and review the operational policies and procedures utilized for the planning and operation of the distribution networks that supply electricity to the end users including:

- reliability criteria used in planning;
- system design;
- safety standards;
- energy losses;
- system performance by voltage level;
- operation and maintenance staffing and costs;
- extension of the systems.

2.1.3 Energy Pricing (Tariffs)

The K&M project team will review:

- the recently completed USAID financial tariff study and the degree of implementation;
- methods of collecting payments for energy sold by EEA and the distribution companies including:
  - successful rate of collection by types of consumers and by geographic areas as measured by Accounts Receivable
  - cost of collections and cash flow

2.1.4 Real Property Ownership

The K&M project team shall assess the value of real property owned by EEA and the distribution companies and determine the cost effect of the usage of real property and the various options available to maximize the financial return on such assets.

2.1.5 Accounting Procedures and Systems

The K&M project team will review the accounting procedures and systems used by EEA and the distribution companies to determine their adequacy under present conditions and identify areas for improvements whenever warranted.

The K&M project team shall review the long range plans and budget projections that have been established for EEA and the distribution companies and shall identify in particular:

- present and projected return on investment and projected balance sheets;

- estimated requirements in foreign exchange over the projected time frame of the projections;

- the availability of sources of financing for EEA and the distribution from multilateral and bilateral agencies as well as commercial banks;

- the scope and use of Management Information Systems (MIS) in monitoring performance.

2.1.6 Review of Existing Organizational Structures and Operations

The K&M project team will assess those institutions which directly or indirectly affect the electrical power generation, transmission or distribution. Focus shall be on identifying those areas where change could enhance efficiency, flexibility, overall system reliability, cost savings and increased revenue generation.

The following aspects should be given particular attention:

- personnel policies and compensation;
- organizational development plans and objectives;
- management development programs and objectives;
- skill development training programs and facilities.

Organizations to be evaluated include:

- Egyptian Electrical Authority Headquarters and Regional Zone Operations;
- distribution organization(s);
- other organization and departments of the Ministry of Electricity and Energy which have direct effect on EEA and the HCCDEP.

2.1.7 Review of Previously Prepared Studies

In parallel with the assessment of policy and institution, a review of previous related studies/assessments shall be made. Significant differences between these studies and this current assessment should be reconciled. (See Appendix E)

2.1.8 Recommendations

Based on the results of the regulatory and legal framework, technical and financial information, energy pricing, real property ownership, accounting system, organizational structure and literature survey investigations, recommendations are to be provided which would enhance interest in investment and expansion of the electric power industry. Recommendations would include but not be limited to:

- improvement in overall financial performance;
- changes in policy/regulation;
- organization operating structure;
- operating procedures;
- investment structure and financing approaches;
- relationship among institutions;
- delineation of a plan to implement and integrate recommendations;
- tentative schedule for implementation;
- quantification of benefits of proposed changes;
- risk/reward allocation;
- insurance issues;
- deal structure options;
- investment attraction.

2.1.9 Methodology

In order to conduct the assessment of the power sector in Egypt and accommodate USAID's need for an early presentation of preliminary findings, the study will be divided into two phases:

Phase I will consist of a broad review of present systems and conditions and analysis of present operating environment utilizing the following resources:

- formulation and distribution of questionnaires, analysis of responses;
- literature survey (previous studies and related documents);
- K&M team member interviews of EEA and HCCDEP personnel;
- field trips.

Figure 2-2 shows the overall methodology divided into i) an assessment of current operations and ii) a review and analysis of expansion plans for both the EEA and the HCCDEP. Figure 2-3 shows a breakdown of the methodology for assessment of the present situation for EEA, while Figure 2-4 shows a breakdown of the review and analysis of expansion plans. Figures 2-5 and 2-6 provide the same breakdowns for assessment of the present situation and review and analysis of expansion plans for the HCCDEP.

This phase will span the first 10 weeks of the project, and presentations will include the following:

- April 29: review of work plan and highlights of findings to date;
- May 29: presentation of preliminary findings and recommendations, discussion of issues targeted for further study.

After review and discussion of the preliminary findings and recommendations with USAID, EEA and the EDCOs, specific issues of particular interest and importance will be identified and prioritized for further study in Phase II. Generally, tasks one through nine will be conducted in parallel during both phases, but in a broader context in Phase I; more specific issues will be addressed in Phase II.

Phase II will address the issues identified by USAID during the preliminary findings presentation. For example, one area of focus will be an investigation of the legal ramifications of recent changes in the structure of the HCCDEP that were identified in Phase I.

At the conclusion of Phase II (scheduled for early September), a final draft report and presentation will be given to USAID, EEA and HCCDEP. The draft report will incorporate the findings and recommendations identified throughout both phases of the project. Copies are to be submitted to USAID/Egypt, who will distribute copies to EEA in sufficient time for review before meeting for discussions.

2.1.10 Performance Schedule

The following is an implementation schedule for the overall effort. More detail will be provided on Phase II once the preliminary findings are completed and priority areas of interest are identified.

PRELIMINARY WORK PLAN: Phase I

TASK/TASK ELEMENT	K&M	EEA/ HCC DEP	CRITICAL ACTIVITY	KEY COMPLETION DATE
TASK 1: PRELIMINARY MOBILIZATION EFFORT				
1.1 Prepare office space and equip.	x			01 FEB 93 A
1.2 Identify counterpart team		x	x	21 JAN 93 A
1.3 Develop communication and coordination channels	x	x		01 FEB 93 A
TASK 2: PREPARATION OF QUESTIONNAIRES				
2.1 Prepare questionnaires and request technical and financial information	x			20 MAR 93 A
2.2 Prepare any special request for additional information or site visited as necessary	x			20 MAR 93 A
TASK 3: ASSEMBLE DOCUMENTS AND INFORMATION				
3.1 Submit information questionnaire	x			DURATION
3.2 Process and provide requested information - Make appointment with selected plant managers and technical staff - Arrange for T/D routes and facilities visits		x	x	DURATION OF PROJECT
TASK 4: REVIEW PRESENT GENERATION SYSTEM				
4.1 Conduct visit of selected sites	x	x		15 MAY 93 A
4.3 Conduct technical analysis of assembled information	x			26 APR 93
4.4 Conduct an evaluation of plant operation policies from assembled information	x			15 May 93 A
4.5 Review technical forecasting systems and criteria	x	x	x	02 APR 93 A
4.6 Prepare generation system review draft report	x			18 MAY 93
TASK 5: REVIEW PRESENT TRANSMISSION SYSTEM				
5.1 Conduct visit of selected sites	x	x		03 APR 93 A
5.2 Obtain clarification of assembled information as necessary	x	x	x	05 APR 93 A
5.3 Conduct system operations analysis of this info	x			07 APR 93 A
5.4 Prepare transmission system review report	x			10 APR 93 A

PRELIMINARY WORK PLAN: Phase I

TASK/TASK ELEMENT	K&M	EEA/ HCC DEP	CRITICAL ACTIVITY	KEY COMPLETION DATE
TASK 6: REVIEW PRESENT DISTRIBUTION SYSTEM				
6.1 Conduct visit of selected sites as necessary	x	x		27 MAR 93 A
6.2 Obtain clarification on assembled information as necessary	x	x	x	27 MAR 93 A
6.3 Conduct system operations evaluation of this info	x			30 APR 93 A
6.4 Prepare distribution system draft report	x			15 MAY 93 A
TASK 7: REVIEW PRESENT COMPUTER AND ACCOUNTING SYSTEMS				
7.1 Review assembled information	x			18 MAR 93 A
7.2 Obtain clarification on assembled information	x	x	x	27 MAR 93 A
7.3 Review and analyze computer applications in accounting				
7.4 Prepare draft report	x			09 APR 93 A
TASK 8: REVIEW PROFITABILITY AND FINANCIAL FRAMEWORK				
8.1 Review assembled information	x			15 MAR 93 A
8.2 Obtain clarification on assembled information as necessary		x		27 MAR 93 A
8.3 Review energy demand and involvement, and pricing strategies	x	x	x	30 MAR 93 A
8.4 Interview selected EEA officials on relevant financial issues	x			31 MAR 93 A
8.5 Prepare draft report	x			29 MAR 93 A
TASK 9: REVIEW OF OVERALL INSTITUTIONAL STRUCTURE				
9.1 Review assembled information	x			17 APR 93 A
9.2 Obtain clarifications on assembled information as necessary	x	x	x	21 APR 93 A
9.3 Review human resources development strategies, organizational structure and objectives, and other management development programs	x			26 APR 93 A
9.4 Interview selected EEA officials on relevant management practices and structural issues	x	x	x	26 APR 93 A
9.5 Prepare draft report	x			10 MAY 93 A
PRESENTATION: WORK PLAN AND PROGRESS REPORT	x	x	x	29 APR 93 A
PREPARE PRELIMINARY FINDINGS REPORT	x		x	26 MAY 93
PRESENTATION: Preliminary Findings Report	x		x	26 MAY 93

PRELIMINARY WORK PLAN: Phase II

TASK/TASK ELEMENT	K&M	EEA/ HCCDEP	CRITICAL ACTIVITY	KEY COMPLETION DATES
TASK 3-9:				
Most activities initiated during Phase I were continued under Phase II as well as further investigation and analysis of: - limitations in charters of EEA & EDCOs - regulatory framework for EEA & EDCOs - preventive maintenance practices and suggest possible improvements - existing MIS and make recommendations - process for commercial business planning for EEA & EDCOs	x	x		6 July 93
TASK 10: PREPARATION OF DRAFT FINAL REPORT	x			19 July 93
TASK 11: PRESENTATION OF FINDINGS				
11.1 Send draft report to Office of Energy and Infrastructure, USAID/Cairo followed by copies to EEA and the Holding Company for Electricity Distribution.	x		x	13 Aug 93
11.2 Presentation of Draft to all concerned at EEA headquarters (MOEE, USAID, Distribution Companies, etc...)	x		x	1st week of October 93
TASK 12: FINAL REPORT	x		x	31 Oct 93

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2.2 INFORMATION REQUESTED

Acquisition of previously performed sector studies, operational and financial/accounting documentation, and planning/forecasting information is crucial to the study effort. Required documents will include the following:

Generation:

- Verification of all plants
- Efficiency, output in last three years, fuel type, outages for all plants
- Equipment conditions
- Operating standards & procedures
- Maintenance standards, procedures and expenses
- Preventive maintenance program
- Yearly forced outages, indicating the possible cause(s) of failure (event recorder charts)
- Spare parts and consumable - replacement parts and consumable procedures
- Environmental plant condition(s)
- Plant location, such as population in area, etc.
- Start-up, maintenance and operating logs for the last year (1992)
- Personnel training (operation, I&C, and maintenance)
- Drawings from major system such as flowsheets, etc.
- Fuel consumptions of units to be visited. Also obtain information for kw hours, kw/kVA and operating hours of these units.
- Plant personnel organizational charts.

Transmission:

- Planning Studies
  a) Load Flow
  b) Short Circuit
  c) Stability
  d) EEA 5-Year Expansion Plan
  e) A Copy of the Swedish Study to build the 500 kV ring around Cairo
  f) A copy of the studies relating to the decision to build 220 kV lines, Cairo to Aswan.

- Design Studies
  a) EEA Standard Tower Design and Spotting (500kV and 220 kV)
  b) Conductor Sizing
  c) Insulation Levels
  d) Rights of way
  e) Sample load flow diagram and 1992 peak case

- Operations
  a) Outage records
  b) Load Shedding
  c) Restoration procedures
  d) Equipment Maintenance
  e) Energy Loss records
  f) O&M Costs
  g) Plant Investment
  h) Expected increases in "firm" transfer capability between Aswan and Cairo as a result of the new 220 kV line

Distribution:

- System design
- Safety standards
- System performance by voltage level
- Fixed and variable operations and maintenance costs
- System extension plan

Accounting:

General Accounting:

- Detailed organization charts for accounting and financial areas of EEA and the EDCOs
- Accounting Manual or other documentation of accounting procedures and internal controls
- Internal monthly financial reports for EEA and the EDCOs
- Chart of Accounts including expense classifications and the extent to which expenses are maintained by individual generating unit, transmission system, etc.
- Budget Manual or other documentation of budget procedures
- Budgets or projections prepared for future years
- Detailed listings of long-term debt showing sources, terms, and maturities
- Samples of management reports produced by Management Information Systems
- Reports on Financial Statements or on Internal Controls issued by Government Accounting Office, Central Audit Agency or other external auditors

Property Accounting:

- Detail property records including cost basis, age, estimated useful life, and accumulated depreciation
- Depreciation policies and procedures
- Itemization of types of costs which are capitalized on self-constructed assets

- Information regarding physical inventories of fixed assets
- Any appraisals or other market valuations or major properties

Customer Accounting

- Aged detail of customer accounts receivable
- Description of collection procedures and write-off policies
- USAID financial tariff study
- Manager(s) with responsibility for General Accounting, Property Accounting, Customer Accounting, Budgeting, and Internal Audit
- Legal Department personnel with expertise with respect to financing and property ownership
- Management level representative of external audit agency (if practical)

Energy Economics:

- Forecasting Methodology
- Most recent 10-year load and energy forecast
- System load shape characteristics
- Most recent USAID financed tariff studies
- Methods of payments collection and dispersal

Computer Systems:

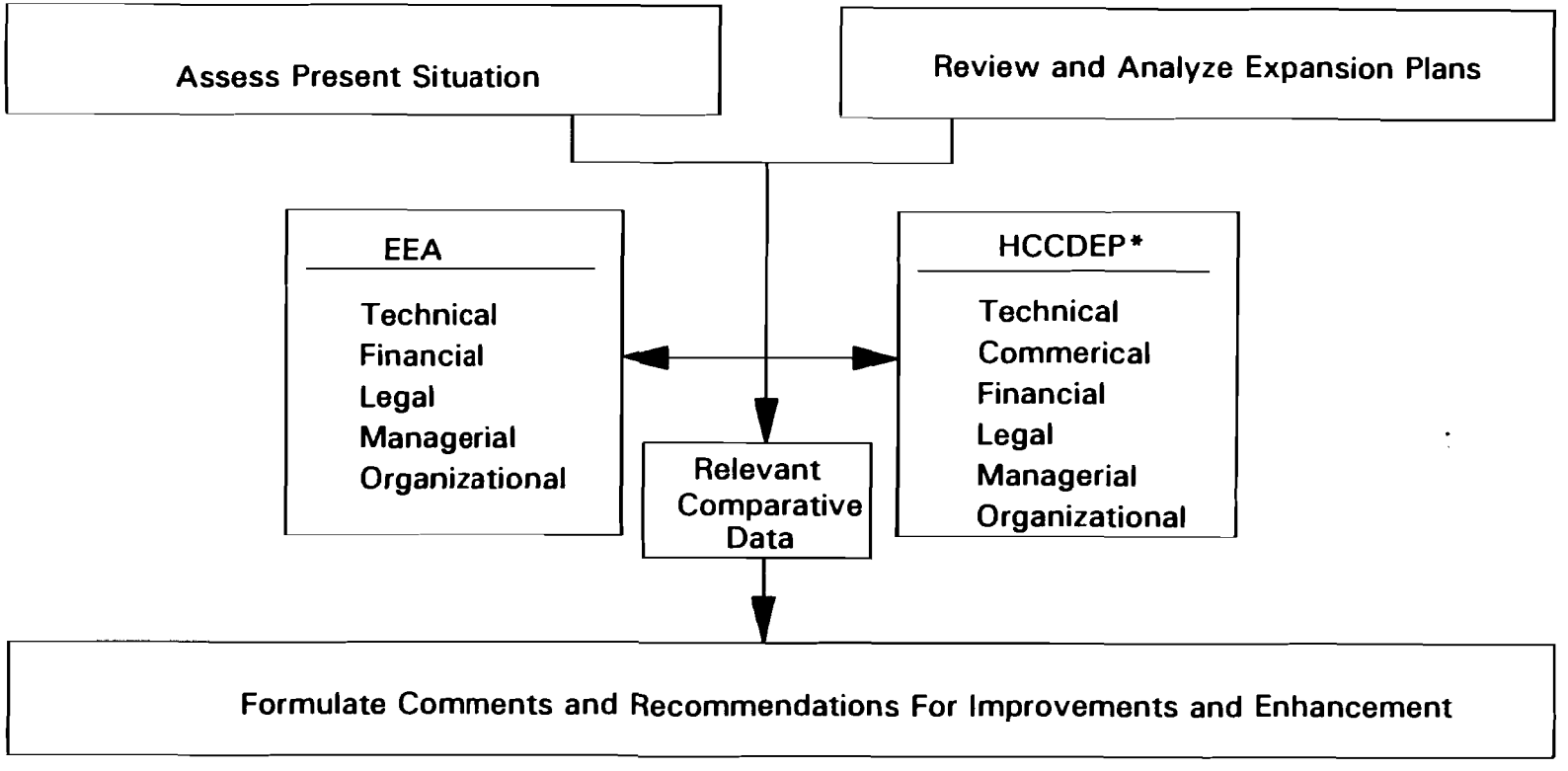
- Information in existing Management information system and their uses
- Existing library of software

Organizational/Structural/Managerial:

- Existing human resource development policies and procedures
- Existing training programs and methodology
- Compensation policies
- Retention of staff
- Existing Management development programs and methods
- Peak load control
- Repowering and life extension plans
- Existing regulatory goals and climate
- "System-wide" policies
- Criteria of maximizing returns on investments
- Compensation
- Retention

Figure 2-2

METHODOLOGY



* HCCDEP = Holding Company for Construction and Distribution of Electric Power

2.2.1 Representative Plants to be Reviewed

Site visits and personnel interviews are planned for the following:

Power Station	No. of Units	MW Output	Fuel Type	Commission Date
CAIRO ZONE:				
Cairo South (st)	4x60 + 2x7.5MW	250	Mazout	1957-1965
Cairo North (st)	2x30 + 1x20 +	100	Mazout	1952-1955
El Tebeen (gas)	2x23MW	46	Solar, NG	1979
El Tebeen (st)	3x15MW	45	Mazout	1958
MIDDLE DELTA:				
Damietta (gas)	6x125MW	750	Solar, NG	1989
Talkha (gas)	8x24.2MW	193.5	Solar, NG	1997-1980
New Talkha (st)	3x30MW	90	Mazout	1966-1967
Old Talkha (st)	3x12.5MW	37.5	Mazout	1955-1956
Talkha Comb	2x45MW	90	Comb. Cycle	1989
WEST DELTA:				
Kafr El Dawar (st)	4x110MW	440	Mazout	1983-1991
Mahmoudia (gas)	4x45 + 8x24.5MW	376	Solar, NG	1989
Damanhour (st)	1x300MW	300	Mazout, NG	1991
Damanhour (gas)	4x24.5MW	97	Solar, NG	1985
New Damanhour (st)	3x65MW	195	Mazout, NG	1986
Old Damanhour (st)	2x15MW	30	Mazout	1960
ALEXANDRIA ZONE				
Suif (st)	2x26.5 + 2x30MW	113	Mazout	1961-1969
CANAL ZONE				
Attaka (st)	2x150 + 2x300MW	900	Mazout, NG	1985-1989
Ismalia (st)	4x150	600	Mazout, NG	
NORTH UPPER				
Assuit (st)	3x30MW	90	Mazout	1966-1967
SOUTH UPPER				
High Dam	12x175MW	2100		1967
Aswan Dam I	7x46 + 2x11.5MW	345		1960
Aswan Dam II	4x67.5MW	270		1985-1985

2.3 PROJECT TEAM AND COUNTERPARTS

Figure 2-7 shows the project organizational chart, including EEA, EDCOs, and USAID; Figure 2-8 shows the project organizational chart for K&M. Figures 2-9 and 2-10 show the K&M project team and counterparts in the EEA and EDCOs, respectively.

Figure 2-3

METHODOLOGY: EGYPTIAN ELECTRICITY AUTHORITY

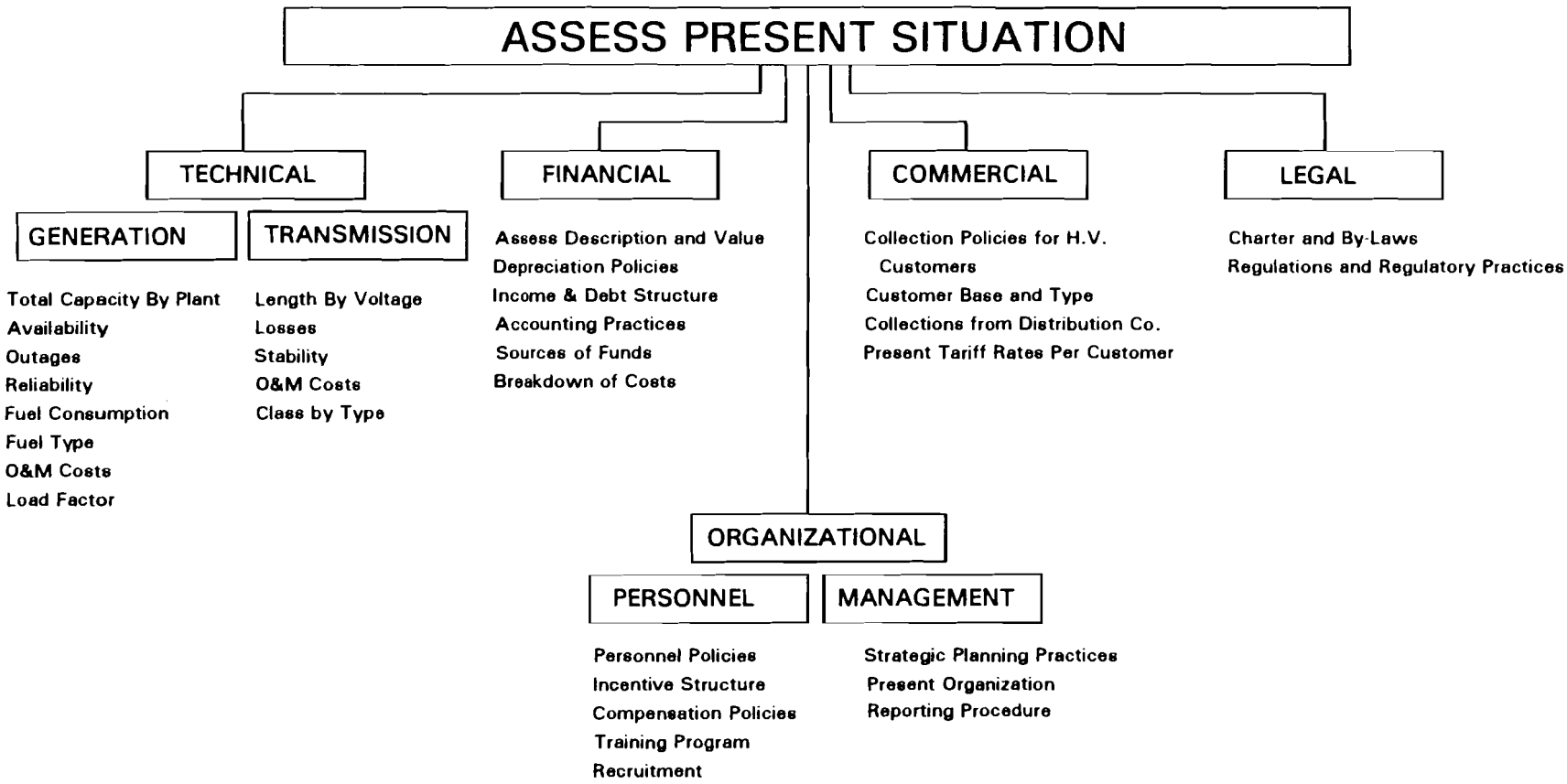


Figure 2-4

METHODOLOGY: EGYPTIAN ELECTRICITY AUTHORITY

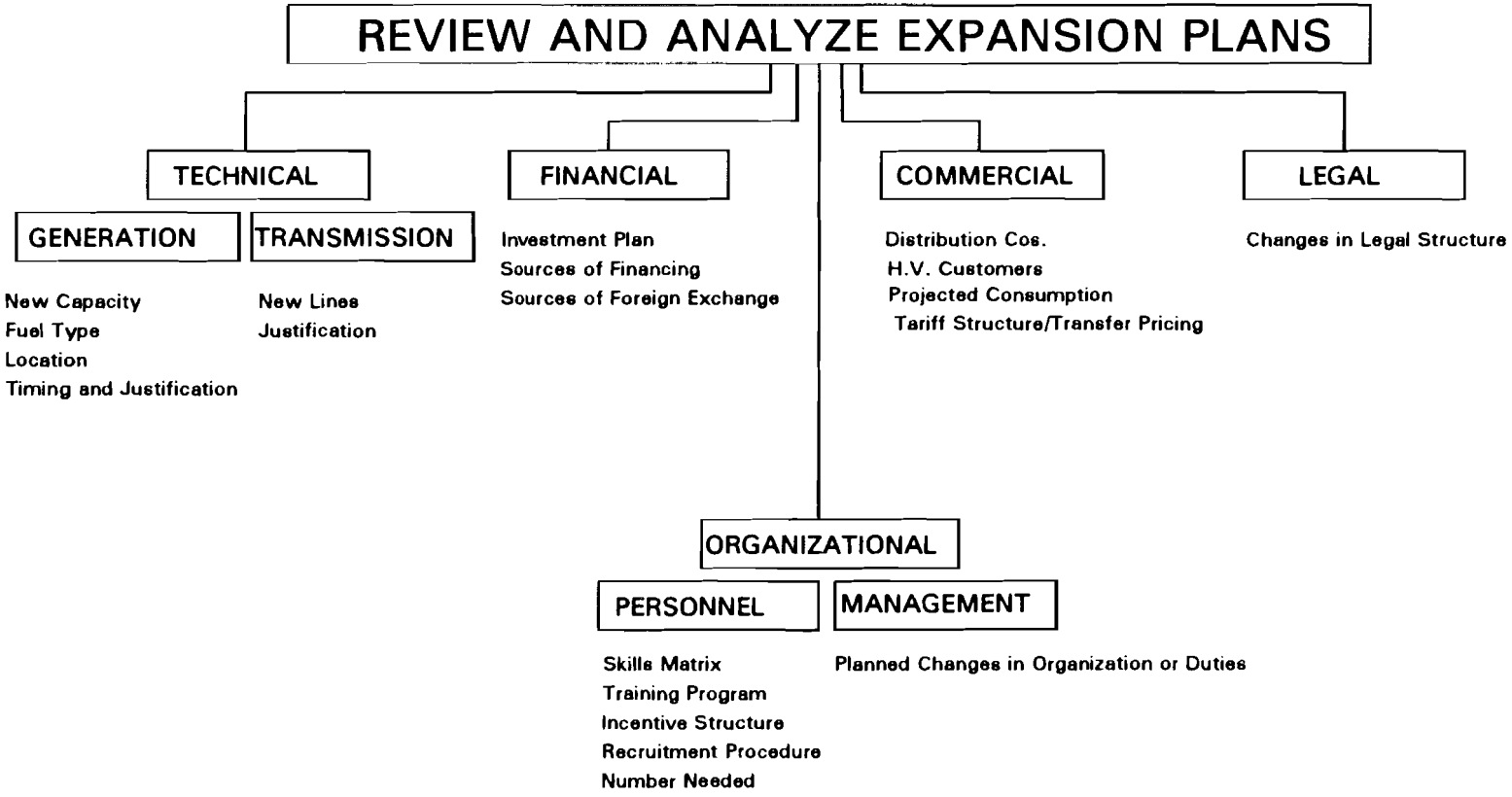


Figure 2-5

METHODOLOGY:
THE HOLDING COMPANY FOR CONSTRUCTION AND DISTRIBUTION OF ELECTRIC POWER

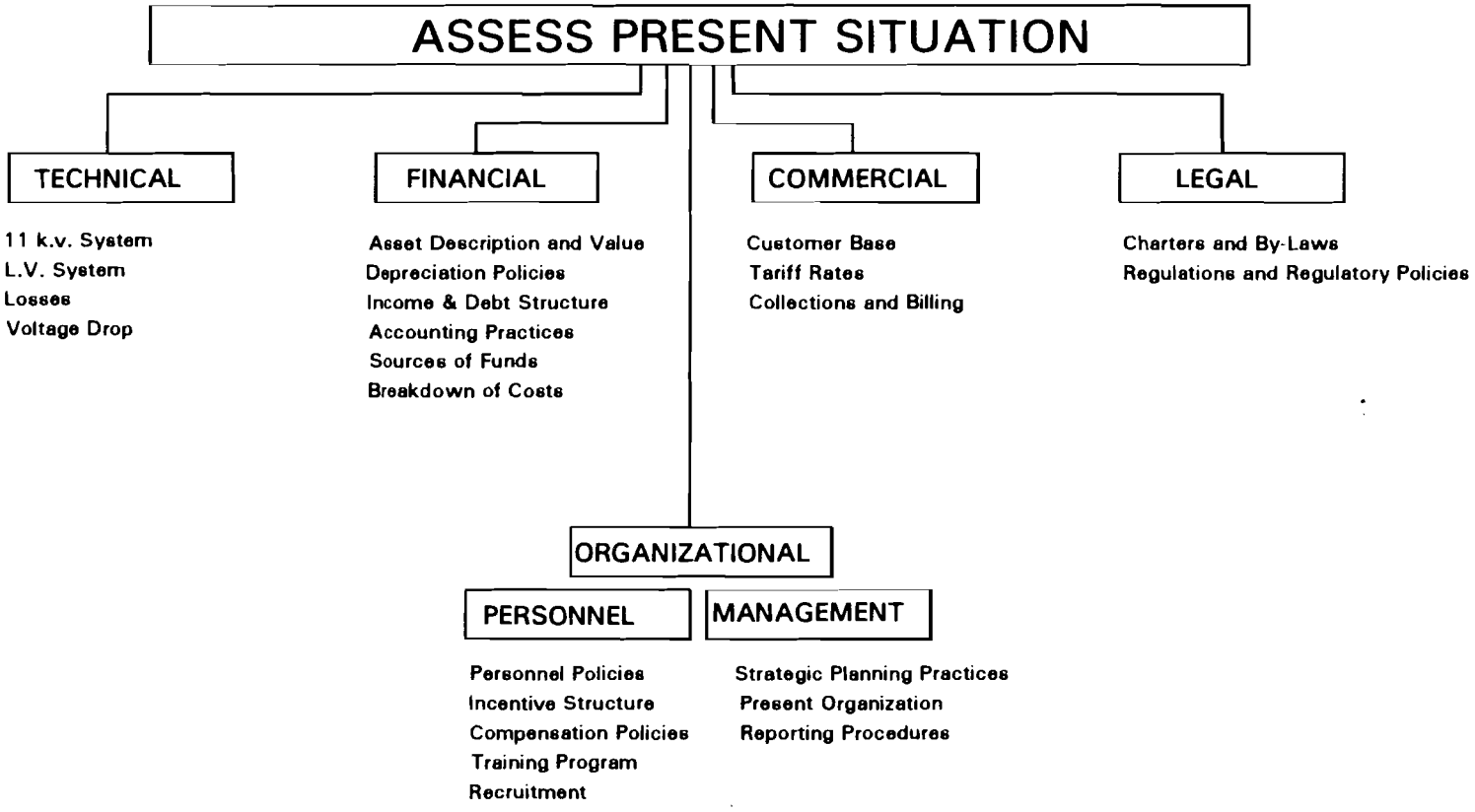


Figure 2-6

METHODOLOGY:
THE HOLDING COMPANY FOR CONSTRUCTION AND DISTRIBUTION OF ELECTRIC POWER

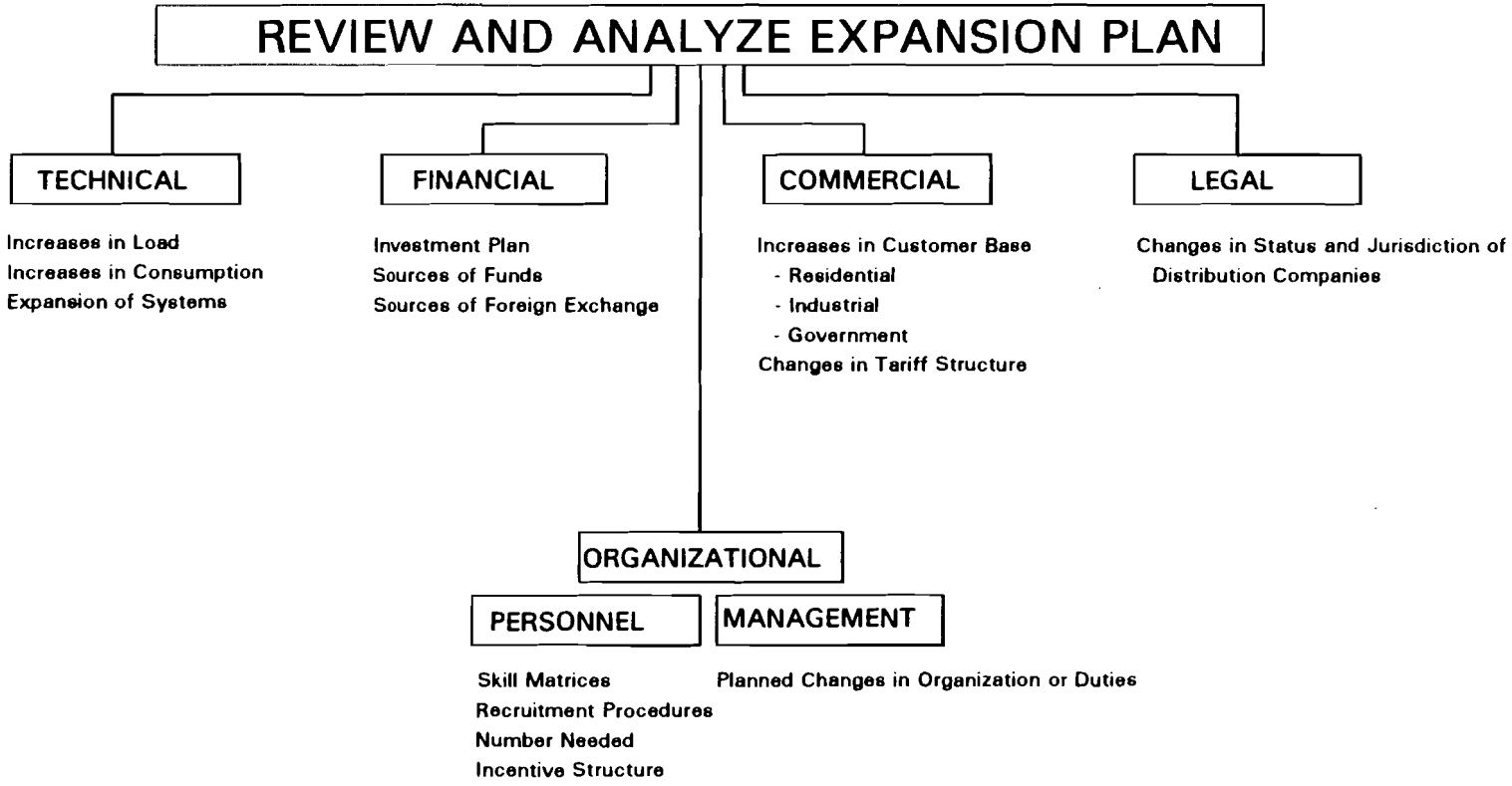


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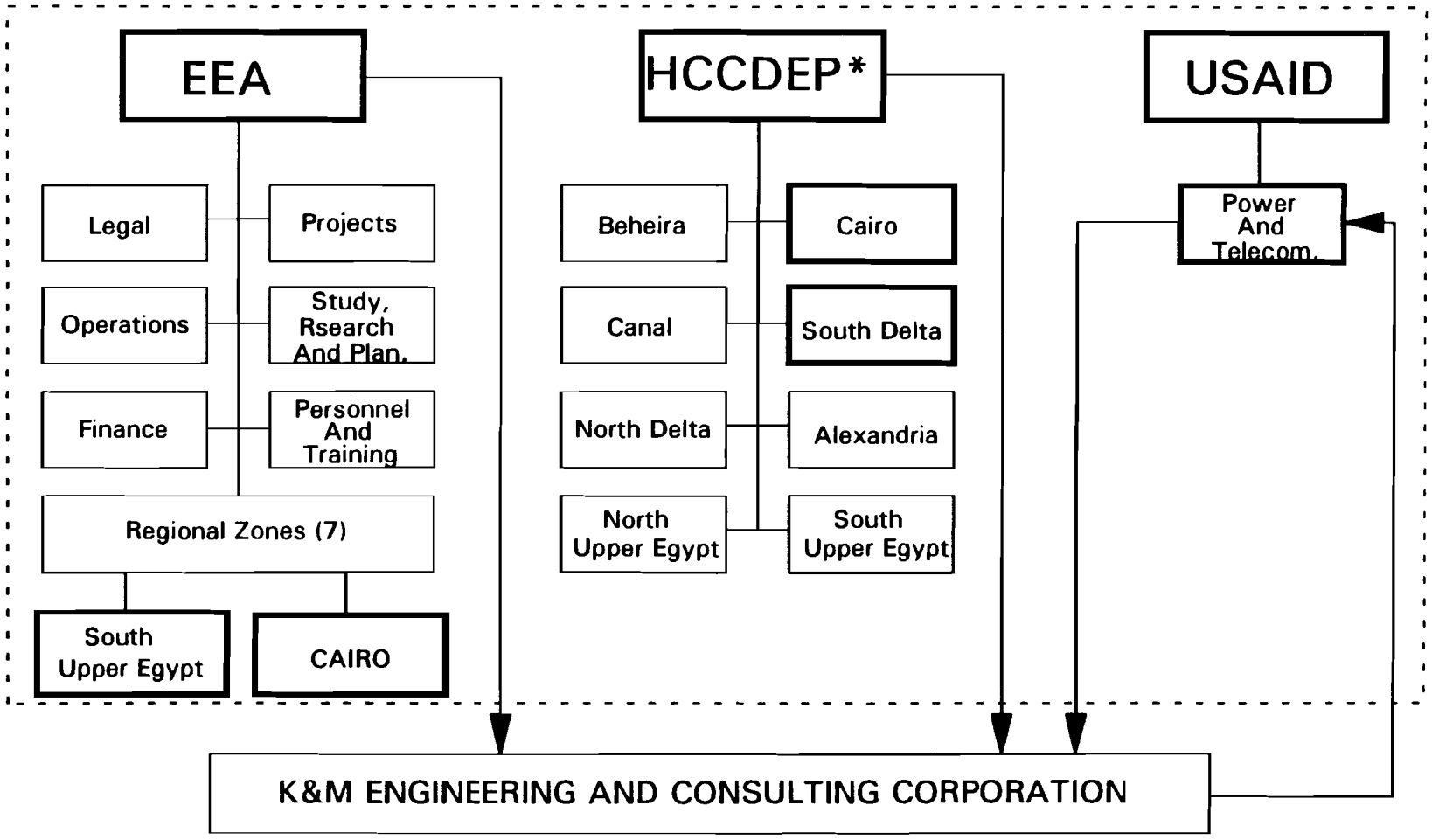
Figure 2-7

POLICY REFORM AND INSTITUTIONAL ASSESSMENT OF THE EGYPTIAN POWER SECTOR PROJECT ORGANIZATIONAL CHART



HCCDEP = Holding Company for Construction and Distribution of Electric Power

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Figure 2-8

POLICY REFORM AND INSTITUTIONAL ASSESSMENT OF THE EGYPTIAN ELECTRICITY AUTHORITY PROJECT ORGANIZATIONAL CHART

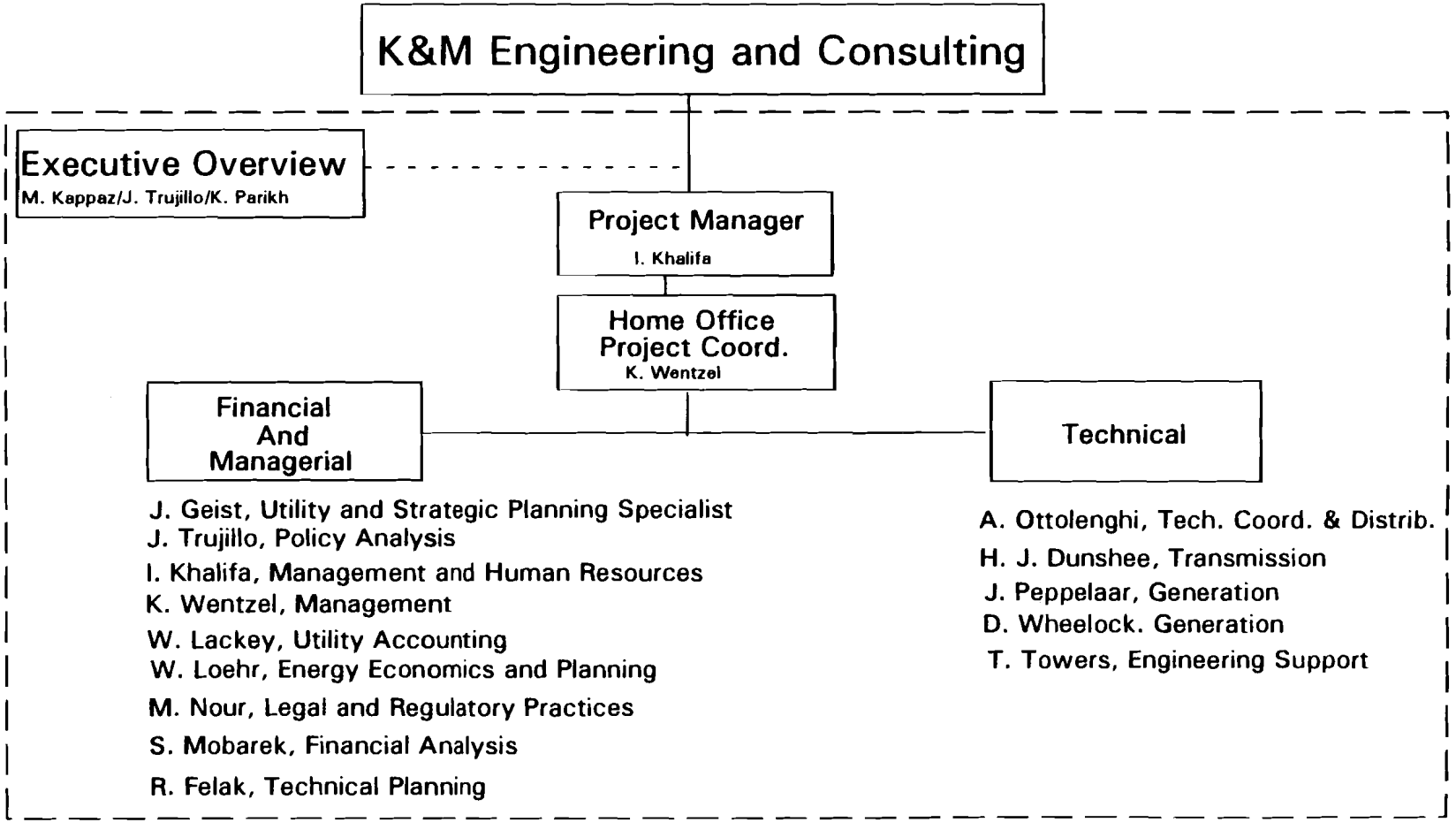

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Figure 2-9

POLICY REFORM AND INSTITUTIONAL ASSESSMENT OF THE EGYPTIAN POWER SECTOR

Project Team and EEA Counterparts

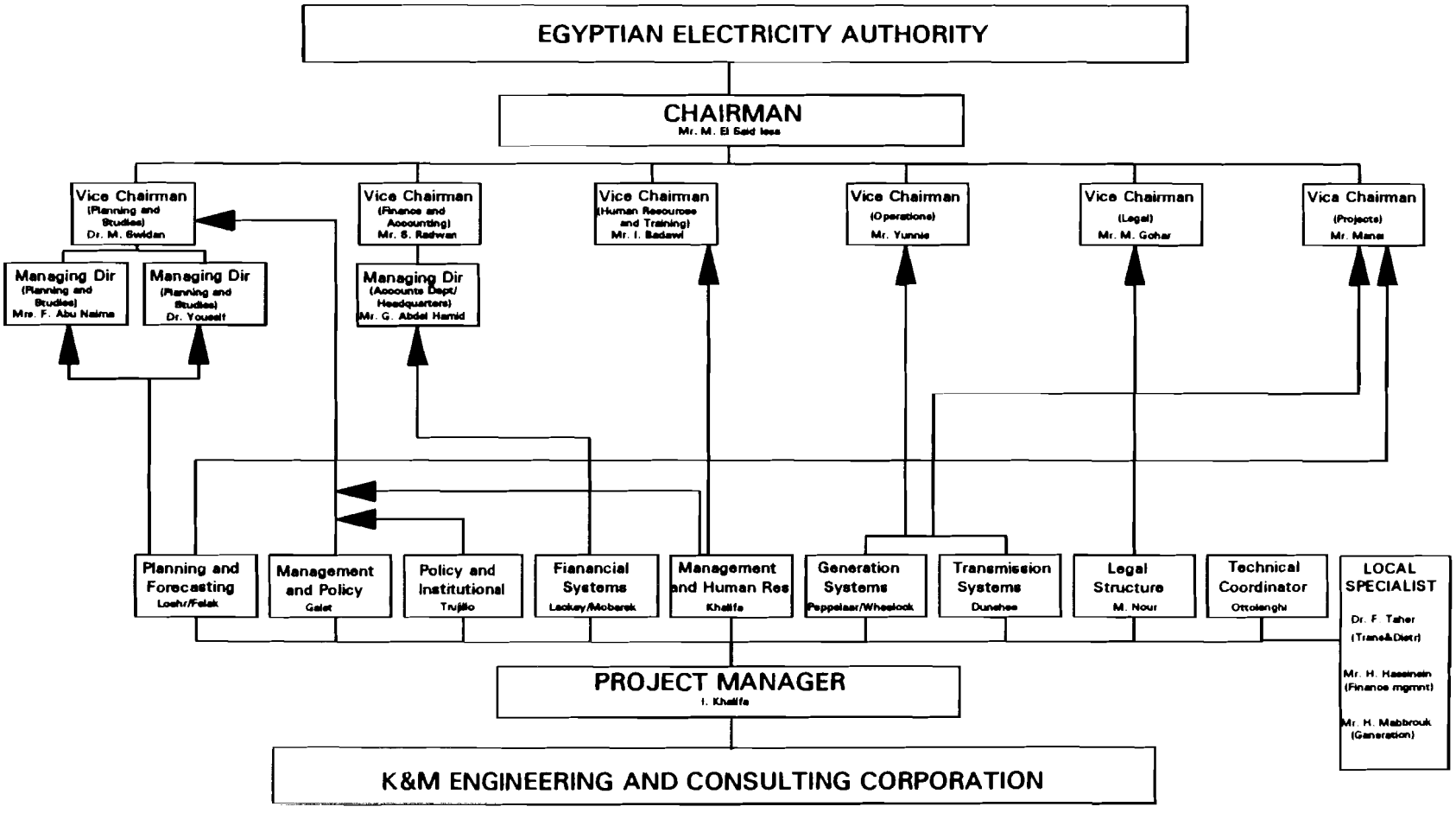
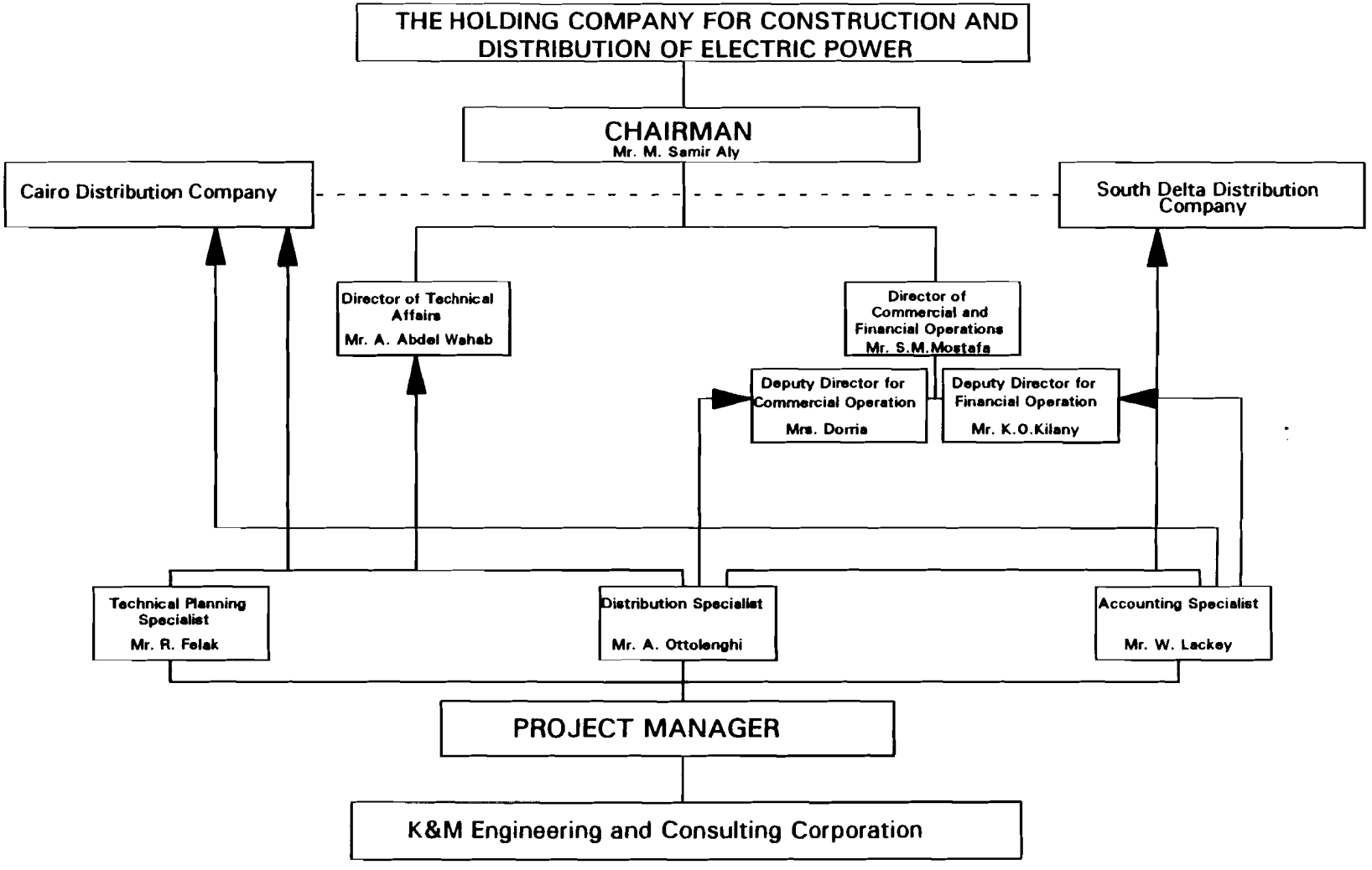


Figure 2-10

POLICY REFORM AND INSTITUTIONAL ASSESSMENT OF THE EGYPTIAN POWER SECTOR

PROJECT TEAM AND HCD COUNTERPARTS



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3 OVERVIEW OF THE ELECTRIC POWER SECTOR

3.1 SECTOR BACKGROUND

3.1.1 Prior to 1948

Prior to 1948, the generation and distribution of electricity in Egypt was partially undertaken by the Government of Egypt (GOE) through its Ministry for Municipal and Village Affairs, and by private utility companies under concession agreements with the Government of Egypt.

The Lebon Company held the concession for the greater Cairo area while the suburb of Heliopolis and the electrified mass transportation systems throughout the city and its suburbs (Tramway and Metro systems) were served by The Egyptian Electricity Company, a subsidiary of the Belgian developers of Heliopolis.

Alexandria was served by the Alexandria Lebon Company. The Suez Canal area which came under the jurisdiction of the Suez Canal Company was served by that company, while the remaining requirements of the three cities of Port Said, Ismalia and Suez was supplied by diesel power plants operated by the Ministry of Municipal and Village Affairs. This Ministry also supplied the Delta with electricity purchased from the Ministry of Public Works, Mechanical and Electrical Department, which operated some generating plants in the Delta and in Upper Egypt interconnected by H.V. 33/66 kV transmission lines. The initial objective of these plants and transmission lines was to serve the pumping stations for irrigation and drainage purposes.

3.1.2 From 1948 to 1956

In 1948, upon expiration of the Lebon concession for the city of Cairo, the Egyptian Government took over the company's responsibilities and formed the Cairo Electricity and Gas Administration as a separate entity under the Ministry of Public Works.

3.1.3 From 1956 to 1976

In 1959, the Egyptian Government sequestered the Egyptian Electricity Company together with all the other Belgian assets in Egypt following the rupture of relations with Belgium over the Congo-Lumumba affair. In addition, in 1962, the government nationalized both the Lebon Company in Alexandria and the Egyptian Electricity Company in Cairo. Thus all electricity production, transmission and distribution came under government ownership.

With the promulgation of Law No. 3 in 1962, the "Electricity Committee" was created under the National Council for Economic Development to rationalize and coordinate the

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Egyptian power sector. This was the precursor to the creation of a Ministry for Electricity.

In 1964, Presidential Decree No. 1301 was issued, forming a new cabinet under the newly-adopted constitution of March 25, 1964, and establishing the Ministry of Electricity and Energy.

Pursuant to Law No. 60 of 1963, which established the system of General Authorities, Presidential Decree No. 1472 was issued on April 20, 1964, establishing the Egyptian General Authority for the Production and Transmission of Electricity under the Ministry of Electricity and Energy.

On that same date, two other Presidential Decrees were issued establishing the Egyptian General Authority for Electrical Distribution, and the Egyptian General Authority for Executing Electrical Projects, both also under the Ministry of Electricity and Energy.

3.1.3.1 The Egyptian General Authority for the Production and Transmission of Electric Energy

This Authority was established by Presidential Decree No. 1472 of 1964 to be responsible for the generation and transmission of electric energy throughout Egypt. It was set up to operate as a corporate entity with its own capital and balance sheet. It was headed by a chairman who acted as the CEO and reported on most matters to the Minister of Electricity, although some issues had to be raised at the Presidential level. (See the text of the Law in Appendix A, Section A.)

3.1.3.2 The Egyptian General Authority for Electricity

In 1965, Presidential Decree No. 3726 was issued, establishing the Egyptian General Authority for Electricity, in accordance with Law No. 60 of 1963, but reporting to the Minister of Industry, Mineral Resources and Electricity. This new Authority replaced the three Authorities established on April 20, 1964 and combined their objectives. (See Appendix A, Section D.)

3.1.4 From 1976 to Present

3.1.4.1 The Egyptian Electricity Authority

In February 1976, the GOE promulgated Law No. 12, establishing the Egyptian Electricity Authority under the jurisdiction of Ministry of Electricity and Energy.

The Authority was given the exclusive right to the generation and transmission of electricity throughout the Republic of Egypt. The management of the Authority rests with a Board of Directors whose Chairman is the Chief Executive Officer, appointed by Presidential Decree. The other Directors are appointed by

the Prime Minister upon recommendation by the Minister of Electricity and Energy. (See Appendix A, Section E.)

Law 36 of 1984 This law was passed by the Peoples Assembly in early 1976 to replace Articles 2 and 4 of Law 12 of 1976. In effect, the 1984 law removed from Article 2 the term "exclusively", i.e., Law 36 of 1984 removed EEA's exclusive right to generate and transmit electricity. This change has enabled several industrial projects to establish their own generating plants. (See Appendix A, Section F.)

3.1.4.2 The Nuclear Power Plant Authority

Established by Law 13 of 1976, this entity was charged with the design and construction of nuclear power plants to be operated by EEA. (See Appendix A, Section H.)

3.1.4.3 The Kattara Depression Project Authority

Established by Law 14 of 1976, this authority was charged with the design and execution of the Kattara Depression Generating Plant Project. Its name was later modified to the "Kattara and Hydraulic Power Plant Authority", and its charter was broadened to include any hydroelectric power project. The operation of these plants would again come under the jurisdiction of the EEA. (See Appendix A, Section I.)

3.1.4.4 The New and Renewable Energy Authority

This entity was established in 1987 to carry out research, design and construction of non-conventional power plants, including wind and solar powered plants.

3.1.5 Evolution of the Electric Power Sector in Egypt

The figures in Table 3-1 give a comparison of the status of the Electric Power Sector in Egypt between 1950 and the present. It shows that, while the installed capacity and the peak load have increased 30-fold, energy generated has increased by over 400 times. This reflects the increase in per capita consumption of electric energy from 40 KWH to 690 KWH, and the increase in population from 20 million to 60 million.

TABLE 3-1 ELECTRIC POWER SECTOR IN EGYPT 1950 AND 1992						
	Total Installed Capacity		Peak Load		Annual Gross Electricity Generated	
Geographic Areas	1950 MW	1992 MW	1950 MW	1992 MW	1950 GWh	1992 GWh
Greater Cairo	129	2,680	81	2,551	345	12,177
Greater Alexandria	92	1,280	52	995	219	5,025
Suez Canal Area	37	1,860	16	700	30	9,083
The Delta	74	2,599	41	1,882	219	7,890
Upper Egypt	40	3,105	19	1,665	58	11,307
TOTAL	**372**	**11,524**	**209**	**7,793**	**871**	**45,482**
Increase 1950-1992		**2,997%**		**3,628.71%**		**5,121.81%**

3.2 INSTITUTIONAL FRAMEWORK AND ROLES

3.2.1 Overview

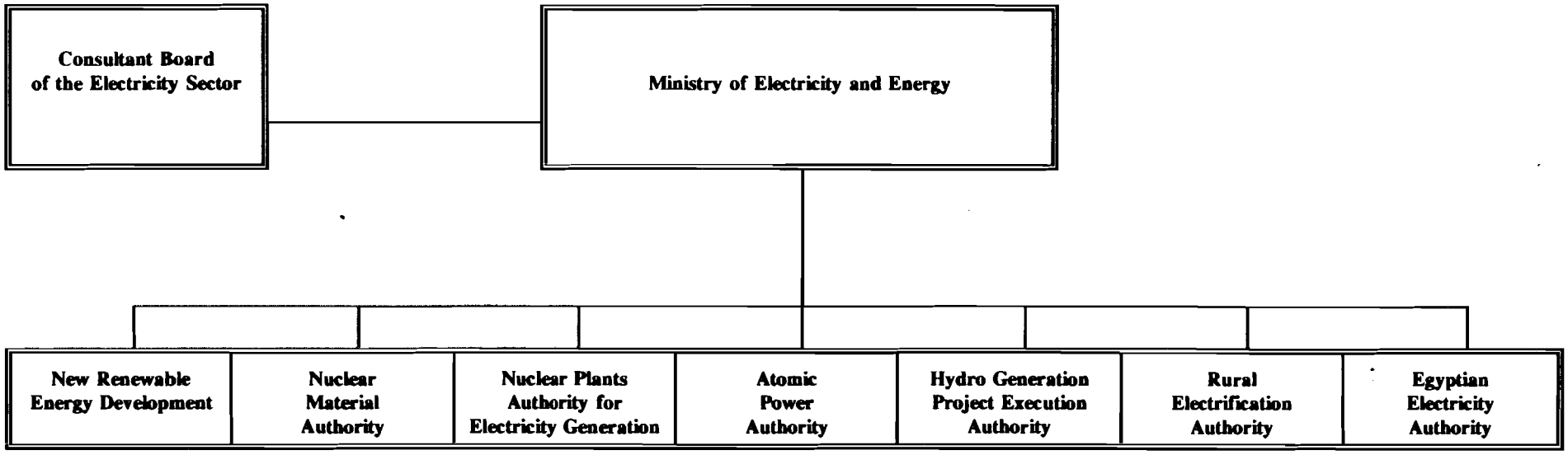
With the exception of the distribution of electricity, the Egyptian power sector is currently under the direction of the Ministry of Electricity and Energy. Electricity distribution is the responsibility of eight regional Distribution Companies (EDCOs), accountable to a Holding Company. This arrangement will be discussed more fully in Volume II of this report. Figure 3-1 shows the various authorities reporting to the Ministry of Electricity and Energy. The Minister of Electricity serves as the Chairman of the Board of the various Authorities with the exception of EEA. Coordination of the various authorities and internal affairs at the Ministry is the responsibility of the First Under Secretary, who is accountable directly to the Minister. The Ministry's own staff is relatively small, numbering approximately 300 personnel.

EEA's charter stipulates that the Chairman is appointed by the President of the Republic, whereas the Members of the Board are appointed by the Prime Minister upon recommendation by the Minister.

His Excellency Maher Abaza has been the Minister of Electricity and Energy since 1980. He is a graduate Electrical Engineer who advanced through the ranks of EEA and the Ministry and therefore, has an intimate knowledge of its organization and operations. He has played a significant role in the development of the entire electric power sector of Egypt and its growth to its present size and structure.

Figure 3-1

SCHEMATIC ORGANIZATION OF EGYPTIAN ELECTRICITY SECTOR



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The primary mission of the Ministry and EEA has been to provide a reliable source of electricity for Egypt while operating within the GOE laws and regulations. These regulations included:

- Labor Policies & Compensation
- Unified Accounting Code and supervision of the Central Auditing Authority

Profitability and adequate return on investment were not priorities spelled out in the objectives at that time. Furthermore, EEA had no control over the cost or source of the fuel it used, nor over the price of the electricity it sold. As a result, EEA has developed as a "production-oriented" entity.

Previously, the Government of Egypt (GOE) used electric power as an instrument for development within the overall context of its social, economic and political objectives. This has resulted in some confusion over subsidized (or non-economical) tariffs to both households and industries. While all governments have tended to use subsidies, price controls and other such methods in the administration of their economies, it is important that such measures be made transparent and easily quantifiable in order to maintain managerial responsibility and accountability.

With the advent of the reform process in 1991, under which the GOE adopted a series of economic reforms in order to move closer to a market economy, it has become necessary for public utilities in Egypt to generate revenue from the sale of electricity to cover a larger portion of their funding requirements, particularly those allocated to expansion. Accordingly, the Authority is now required to operate as a profitable, efficient electric utility generating real profits and cash flow.

This change will require a complete reorientation of EEA's management toward efficiency and least cost operation. It is imperative for EEA to become a least-cost producer while providing adequate, reliable service to both residential and industrial customers. As Egypt seeks to develop its export industries it must be able to produce its goods competitively. As a major component in any manufacturing process, electric energy affects production costs directly.

For the above reasons, regardless of ownership, EEA must transform itself into a commercially-oriented enterprise that pays attention to its Profit and Loss statements.

4 LEGAL ISSUES

4.1 CURRENT STATUS

Law No. 12 of 1976 established the Egyptian Electricity Authority and granted it exclusive right to the production and generation of electrical power, its transportation to different parts of Egypt, and its distribution to consumers. (Appendix A, Section E)

In 1983, Article (2) of Law 12 of 1976 (Appendix A, Section E) was amended to remove the electricity distribution function from EEA, and its distribution to consumers. It was further amended to remove the "exclusivity" for power generation granted to EEA. Private generation of electricity has therefore become legally permissible, and several industrial projects were able to establish their own generating plants. Article (4) relating to the EEA's resources has also been amended.

Distribution of electricity is currently taking place under the Holding Company for Distribution of Electrical Power whose subsidiaries, formerly public sector companies, are located to serve all parts of Egypt.

4.2 LIST OF LAWS REVIEWED

We have reviewed the following Laws:

- Law 12 of 1976 (Appendix A, Section E), establishing the Egyptian Electricity Authority.
- Law 36 of 1984 (Appendix A, Section F), amending Law 12 of 1976.
- Law 203 of 1991, organizing the Public Works Sector and its Executive Regulation.
- Law 97 of 1983, organizing the Public Sector (currently not in force).
- Law 30 of 1975, organizing the Suez Canal Authority.
- Law 116 of 1975 setting some provisions related to Egyptair.
- Presidential Decree 600 of 1975 re-organizing Egyptair.

In addition to the above Laws, we have also reviewed:

- By-laws of the Holding Company for Distribution of Electricity.
- By-laws of the affiliates of the Holding Company for Distribution of Electricity.

4.3 OPTIONS FOR LEGAL FRAMEWORK RESTRUCTURING

4.3.1 Option 1: Change Charter to allow EEA to operate on a commercial basis

Law 12 of 1976 stated in its Article 1 that:

> A public authority is to be established and to be named "Egyptian Electricity Authority". Such authority shall be subject to the control of the Ministry of Electricity.

Article 3 of the same Law provides that:

> The capital of the authority consists of:
>
> - Funds of the general establishment for electricity.
> - All funds allocated by the state.

It is apparent from the articles of the above Law that as a "Public Authority", EEA cannot be run on a commercial basis. Its employees are considered government employees subject to Law No. 47 of 1978 (although Law 12 of 1976 provided that a distinct internal work regulation is to be issued for such employees). In order to have EEA operate on a commercial basis, Law 12 of 1976 must be modified or superseded by a new Law allowing commercial operation. Such a Law would be very similar to that organizing the Suez Canal Authority (Law 30 of 1975) which states expressly in its Article 4 that:

> The authority shall use, without being bound by governmental, restriction, all appropriate systems of management and exploitation used by commercial basis.

Article 10 of the same Law states that:

> All funds of the authority are considered private funds.

Article 2 of Law 600 of 1975 organizing Egyptair states that:

> The purpose of the establishment is to enhance the national economy in the fields of air transportation pursuant to the general policy of the state.
>
> The above purpose may be achieved by performing air transportation for passengers, mail and baggage within or outside of the country in an effective, economical manner.

The new Law to be issued will of course maintain the new entity as a governmental authority, with all consequences such as the possibility to effect administrative attachment, and all exemptions normally granted to governmental bodies. Nevertheless, its funds shall be considered as private funds, and it shall operate on a commercial basis (similar to the Suez Canal Authority). Therefore, a system of merit performance for its employees must be established and not rely on the government employment regulations. Accordingly, loans and bonds may be issued.

4.3.1.1 Practical Possibility

Issuing a Law in Egypt normally takes some time. The draft Law (bill) is submitted to the parliament for discussion and amendment. The approval of the President of Egypt is also needed before the Law is passed.

4.3.1.2 Advantages of Option 1

Should EEA be reformed as discussed above, it shall remain under the supervision of the Minster of Electricity. The threat to the Ministry of not having supervision over the EEA is overcome with regulatory authority to be confined to the Ministry of Electricity.

4.3.2 Option 2: Restructure the Power Sector to Conform with Law 203 of 1991

Under this scenario, EEA would become the Holding Company for the Generation and Transmission of Electricity. This Holding Company would have several affiliates (the number of which to be determined according to a detailed research). The distribution would be the responsibility of the EDCOs, which would remain subsidiaries of the Holding Company until privatized. The Holding Company would retain the possibility of varying its portfolio of companies. Both holding companies would conform to Law 203 of 1991, i.e., would be wholly owned by GOE under the supervision of the Minister and the Central Agency for Accounting.

4.3.2.1 Practical Possibility

Resistance from the Minister of Electricity would be a potential obstacle to this option since the dissolution of EEA would remove it from ministerial supervision.

The practical possibility of this option is obscured by the fact that two interpretations of Law 203 of 1991 are viable.

Pursuant to Article 2 of Law 203, it may be argued that EEA may automatically become a holding company. The second interpretation would maintain that Article 2 of Law 203 cannot be applied as outlined because it reads as follows:

> As of the date of coming into force of this Law, holding companies are to replace the public sector authorities which are subject to Law 97 of 1983 -- affiliate companies are to replace those companies which are under the supervision of such public sector authorities without the need for any other procedures.

The second interpretation, therefore, would rest on the fact that EEA, although being a public authority, was not subject to Law 97 of 1983. This fact is clearly expressed in Law 12 of 1976 which states that EEA is subject to Law 12 of 1976 only. It may not, therefore, be legally possible for EEA to automatically become a holding company pursuant to Law 203 of 1991, without further legislative intervention. According to this interpretation, for EEA to become the Holding Company for Electricity, Article 9 of Law 203 of 1991 will apply. This article states that:

> It is possible, by virtue of a decision of the President of the Republic, and with the approval of the Council of Ministers, to change any economic authority, public establishment, or special public sector company to a holding company or an affiliated company.

We believe that pursuing the second interpretation would be more effective since, obviously, EEA has not been changed automatically since Law 203 of 1991 came into force.

4.3.2.2 Advantages of Option 2

The affiliates may be "privatized", i.e., shares thereof may be sold to private subscribers pursuant to Law 203 of 1991, and may be negotiated under the rules of the capital market.

Furthermore, the Ministry of Electricity, which shall no longer have control over EEA, shall still have supervisory authority over the Holding Company for Electricity. Its authority over the electric power sector would therefore not be substantially reduced.

In view of the above, and taking into consideration the amount of effort it would take to have a new Law passed re-organizing EEA, we feel that the second option would be less cumbersome and easier to achieve. The most it would require would be a Presidential decree.

4.4 THE REGULATORY FRAMEWORK

4.4.1 The Need for Regulation

When pursuing a plan to commercialize and eventually to privatize either all or part of its utility system, a government should institute public regulation of utilities as an integral part of that plan. The purpose of such regulation is not to exert government control over utility operations, but to act as the necessary substitute for the discipline of the competitive marketplace that will be developing over time. As competitive markets develop, regulation can and should be reduced.

THE REGULATORY FRAMEWORK

Glossary of Terms and Definitions

Cost of Service -	To the total cost that a utility incurs in providing service to its customers and it includes an allowable return on invested funds
Cost of Service Regulation -	The examination of all costs a utility incurs and the determination that such cost will or will not be included in the rates the utility is allowed to charge its customers
Indexing -	Tying the electric energy rates to a recognized index such as the "Cost of Living Index"
Performance Agreement -	Both parties to an agreement negotiate goals to be achieved within certain time frames, at certain costs i.e., establish standards of performance
Performance Regulation -	The negotiation of the Performance Agreement related to operational and services standards
User Fees -	Fees paid to the GOE by the regulated utilities (EEA, EDCO's, etc.)

The economic regulation of utilities must exist whenever the level of competition is insufficient to prevent the abuse of either "natural" or "de facto" monopoly power that utilities can exert.

"Natural" monopoly power exists whenever there is a single producer who has some key advantage and is therefore always able to produce a product at a lower cost than anyone else. In the case of electric utilities, natural monopoly power has accrued in the past primarily as a result of the huge capital investments needed to build the required facilities. Such huge capital costs act as significant barriers to entry into the business by would-be competitors. A "de facto" monopoly exists whenever end-point consumers do not have real choices because of, for example, the limitations of current technology or

the high cost of alternatives that put them beyond the means of most consumers. At the present time in Egypt, both EEA and the EDCOs are monopolies de facto.

Recently, changes in utility technologies, as well as changes in the ways economic activities can be organized in a global economy, have been creating much broader opportunities for competitive entry into the electric power business. Over time, such changes will have the cumulative effect of transforming both the structure of the power sector and the nature of its public regulation as well. Already some argue that electric power generation is no longer a true "natural" monopoly because of the increasing economic feasibility of small-scale generation facilities. There is also growing recognition that traditional utility regulation needs to be restructured in light of the increasing number of competitive opportunities for power generation and delivery through innovative power transactions which eliminate de facto monopoly.

Worldwide, many utility systems are moving either from full regulation to mixed regulation and competition (as the U.S. is now doing) or from government ownership to mixed regulation and competition (as the U.K. is doing and Egypt intends to do). Despite the fact that the starting points of these reforms are so different, the policy objectives being pursued appear to be quite similar.

The central purposes of the current evolution toward systems that mix together regulation and competition are to:

- Assure greater operating efficiency,
- Enhance the effectiveness of both public and private investment, and
- Improve the performance of the power sector as a whole in line with global economic realities and each country's specific development policies and priorities.

Economic regulation of utilities is always a balancing of consumer interests on the one hand and producer needs on the other hand. In the course of privatization, establishing a predictable and transparent regulatory framework is one of the necessary first steps in attracting private investment into the electric power sector, both initially and on a sustained basis over time. A predictable and transparent regulatory framework is one that clearly delineates its objectives and principles, its operating policies, and its decision process and criteria.

4.4.2 Traditional Utility Regulation

4.4.2.1 The Regulatory Board and its Primary Responsibilities

Utilities in a market-based economy are normally regulated by an independent, professional regulatory agency, commission, or board (the "Regulatory Board").

The Regulatory Board is composed of several members either elected or (most usually) appointed for multi-year, staggered terms. The Regulatory Board normally has independent authority to hire and fire its own professional staff as well as technical experts and advisers.

The primary responsibilities of the Regulatory Board are to:

- Protect consumers' interests by setting fair prices for "captive" customers, i.e. those end users of electric services who do not have competitive choices,
- Monitor and enforce service standards, and
- Ensure a stable business environment that will allow the utility to attract capital investment over time.

The scope of the Regulatory Board's authority is usually quite broad. Such authority is set out by the government and also mandates that the regulated utility will be required to provide service to the public. Because of the requirement to serve, the Regulatory Board has a responsibility to provide the utility a process of regulation that should allow the utility to operate efficiently and profitably. A Regulatory Board makes findings and issues decisions that, for example, limit a utility's ability to:

- Raise capital;
- Locate and construct facilities;
- Access specific consumer markets;
- Acquire or dispose of assets;
- Change its corporate structure;
- Set tariffs for different types of customers;
- Establish certain internal operating rules; and
- Earn a profit.

4.4.2.2 How Regulators Set Rates

Historically, traditional utility regulation has worked best when a boom in utility service expansion and increased per capita consumption have occurred at the same

time that significant and consistent technology-driven improvements in productivity have caused a steady decrease in the real price of electricity. In such circumstances, the key decisions of the Regulatory Board are how to redistribute the productivity gains by lowering the real prices consumers pay for electricity. When costs and prices are going up steeply and steadily, on the other hand, the flaws of after-the-fact (based on historical data) traditional utility regulation become much more apparent and more politically sensitive.

In setting the rates a utility is allowed to charge its customers, the Regulatory Board first determines the total amount of revenues a utility will need to collect in order to cover all its costs to provide service. This amount is called the "Cost of Service." This normally includes the utility's most recent actual operating expenses plus an allowable return on the invested capital that forms a utility's rate base.

The Regulatory Board next determines how much of the total required revenue each customer class should pay, based on some combination of economic and (often implicit) social criteria. Based on this and estimates of expected average consumption levels, the Regulatory Board then derives a price per kwh applicable to each customer class.

Changes in fuel costs are usually passed on to the customers as they occur and frequently appear as such on the customers bills. There are numerous theories and technical arguments about the best methods regulators can use to determine what a fair return on investment is under current conditions, how total revenue requirements should be calculated, and how rates should be designed to meet economic, social, and environmental goals.

4.4.2.3 Current Efforts to Reform Traditional Regulation

In recent years, customers, regulators and utility managers have become increasingly disillusioned with Cost of Service Regulation, but for different reasons:

- Customers argue that Cost of Service Regulation does not provide adequate incentives for a utility to keep its costs down by increasing capital and labor productivity.

- Utility managers argue that Cost of Service Regulation has become confiscatory and a disincentive for capital investment and innovation.

- Regulators argue that the system has become excessively complex, adversarial, and time consuming without commensurate benefits.

The dissatisfaction expressed by all parties has led to reforms and some noteworthy experimentation with "Indexing," an innovative variation of Cost of Service Regulation. With Indexing, the regulators' decisions shift from a primary focus on determining the amount of profit they allow the producer to earn to a primary focus on the price that the utility's customers pay.

Indexing thus represents an important change in the philosophy and focus of traditional regulation and rate-making. Indexing changes the focus of both regulators and utility managers from inputs to outcomes.

Under Cost of Service Regulation, regulators look at each expenditure after-the-fact and decide if it was "just and reasonable," "prudently incurred," and therefore "allowable." They then, in essence, sum all these allowable costs and add what they determine to be an allowable profit margin.

Under Indexing, regulators first set an allowable base revenue requirement, usually using the same process and techniques they use to determine a utility's Cost of Service, which includes a fair rate of return or profit. The indexed rates are periodically reviewed and the base is adjusted as necessary. The major innovation comes next when the regulators pick a relevant price index to which they peg future changes in rates in such a way that it creates an incentive for efficiency, productivity, and cost reduction. This is most frequently referred to as the "RPI-X" formula, now in use in the U.K., Chile, and elsewhere. (RPI stands for Retail Price Index and X stands for a deflator factor set by the regulators.)

Utility rates are thus "indexed" and allowed to rise as other consumer prices rise, but never by as much as the full amount. This creates, therefore, a built-in incentive for a utility to do better than the performance of the price index. If through productivity innovations a utility can reduce it costs below the prices it is allowed to charge, it can keep the difference as increased profit for some period of time. On the other hand, increases in cost will also have to be absorbed for some period of time until the next periodical review of the index .

Under traditional Cost of Service Regulation, in contrast, all such gain or cost would be quickly passed back to the consumers. Indexing thus creates a "win-win" opportunity -- both consumers and producers can be made better off through lower prices and higher profits than under more traditional Cost of Service Regulation.

Even under Indexing, however, after a set period of time (5 years, for example) regulators will eventually pass back such gains to consumers. This occurs when, again using traditional Cost of Service methods and current data, the regulators

"true-up" and reset the utility's allowable revenue base to which they will apply the price index when they want to set new rates.

4.4.3 Performance Regulation

4.4.3.1 How Performance Regulation Works

As the worldwide electric power sector is evolving toward greater competition and more privatization, there is increasing interest in the use of Performance Regulation. While the public policy objectives of this type of regulation are much the same as Cost of Service Regulation, the underlying philosophy of how best to achieve those objectives is different.

Traditional Cost of Service Regulation works by placing full reliance on the regulators' ability to make after-the-fact judgements on each expenditure that a utility has made. Performance Regulation, in contrast, works by placing more reliance on clear, specific, before-the-fact incentives for the utility to meet the financial, operational, and economic goals that the regulators set for it.

Indexing, described above, is just one example of placing greater reliance on the use of direct incentives to affect utility performance, although Indexing focuses on just one measured goal--the final price to the customer.

Performance Regulation spells out specific, measurable expectations for utility performance, monitors that performance, and holds the utilities accountable for results. A key to its success is an adequate management information system. The goal of this type of regulation is to drive the continual improvement in the operational and financial performance of utilities, starting from each utility's current levels of performance.

Performance Regulation encourages and rewards utility managers who shift from a "cost-plus" to a "cost-minus" style of operating, those managers who continuously search out and find more effective ways to do more at less cost. Performance Regulation seeks to reduce both short term costs through cost control measures and long term costs through innovation and cost-effective investment.

4.4.3.2 Use of Negotiated Performance Agreements

The key to Performance Regulation is a negotiated Performance Agreement that sets forth a framework for accountability including specific performance targets, rewards if targets are met, and sanctions if targets are not met.

Over time, regulators can allow greater managerial autonomy as they gain experience with the most effective ways to define and enforce accountability and as managers develop a "track record" of continually improving performance.

Performance Agreements can be established between the Regulatory Board as one party and EEA, the Holding Company, or individual EDCOs as the other party. They can also be designed and used internally by EEA, the Holding Company, or individual EDCOs with:

- Their suppliers, including future private power suppliers,
- Their own managers and employees, and
- Any of their customers who are large enough or well organized enough to exercise market power. This could include the EDCOs as customers of EEA.

One of the prime benefits of using Performance Agreements is that they clarify intentions, goals, and objectives. Confusion over these essentials has proved to be a continuing problem during transitions to commercialization and privatization. Performance Agreements also set forth the obligations of both parties, the responsibilities and authority of each, specific rewards and sanctions, and the particular physical and financial indicators that will be used to measure performance.

Performance Agreements are a systematic way for regulators and utilities to identify opportunities for performance improvement, set priorities based on cost effectiveness, to develop and implement action plans to capture the savings, and to monitor results and adjust plans and priorities accordingly.

Regulators can tailor Performance Agreements to areas that are of special interest as long as it is kept in mind that the production and delivery of electricity is an integrated system. Special focus on just one or a few performance indicators in isolation can lead to unintended consequences.

Examples of performance indicators which could be tracked include:

- Average age of accounts receivable,
- Lapsed time for meter hook-up or change out,
- The frequency and duration of service interruptions,
- Financial ratios,

- Employment targets over time,
- Scheduled and unscheduled down times,
- Reliability,
- Heat rates, etc.

The effectiveness of Performance Agreements depends on:

- The reasonableness of the target for improvement in terms of both level and schedule,
- The scope and dependability of management information systems,
- The accuracy of projected economic and financial variables, and
- Most important of all -- the enforcement of sanctions.

Performance Agreements, under a variety of names, have been used by France with the Electricité de France since the 1960's and in several Francophone countries since then. Lessons from these countries include the following:

- Performance Agreements work best at achieving the objectives if they are short, simple, and flexible.
- The process of negotiating Performance Agreements is a key benefit for both parties, especially in the area of clarifying intentions, goals, and expectations.
- Performance Agreements will be effective only if their provisions for recourse and enforcement are real.
- Any performance obligations made by the Government as part of a Performance Agreement must be tied to the Government's budget.

4.4.4 A Conceptual Framework for Utility Regulation in Egypt

4.4.4.1 The Independence of Egypt's Regulatory Board

Commercializing EEA, encouraging independent power supplies to sell into the Egyptian grid, and eventually privatizing the EDCOs will require Legislation to establish a regulatory agency.

The regulatory entity that the Government establishes should be an independent board composed of no less than three and no more than seven members who are appointed by the Prime Minister for fixed but staggered terms.

In order to prevent conflicts of interest, or even the appearance of conflicts of interest in a system evolving away from full government ownership, there should be clear separation of the different and potentially conflicting roles of the government as owner or stockholder of utility assets and the government as regulator of utilities. Therefore, the Regulatory Board should be created separate from the Ministry of Electricity and Energy.

Although independent, the Regulatory Board should be held accountable to the government through the Board's authorizing legislation, its annual budget appropriations, and review of its audited accounts. A Regulatory Board should also be held accountable to the government and the public for its specific decisions through the decision documents it issues and the process used for review and recourse.

Funded primarily through "user fees" assessed by a simple formula, the Regulatory Board should have authority to hire and fire its own professional staff of qualified economists, accountants, engineers, and lawyers. User fees are a toll or a charge to be paid by each utility to the government to be used exclusively to pay for the operation of the Regulatory Board. User Fee levels should be adjusted periodically to reflect budget requirements. The amount of these fees are a cost of the electricity service of the utility and are ultimately paid by the customer. The staff's internal expertise and experience can be augmented by external technical experts and advisors during the initial phases of transition to commercialization and eventually privatization. The Regulatory Board members and the Board's staff could be trained initially through a series of programs involving selected regulatory experts from the U.S., U.K., France, Chile, Argentina, and other countries that are successfully reforming their regulatory frameworks and processes.

As a necessary precondition of effective regulation of privately owned utilities, the Government should articulate a clear legal framework for utility regulation which sets forth the Government's obligations to investors who own or operate EDCOs or certain private power projects, for timely authorizations or approvals of financing and access to foreign exchange, for repatriation of profits when applicable, and for security against expropriation.

4.4.4.2 The Functions of Egypt's Regulatory Board

The Regulatory Board's primary functions should be to:

- Regulate those utility activities that have natural or de facto monopoly characteristics until sufficient competition evolves to assure a functioning market which can eventually substitute for full regulation;

- Ensure coordinated, adequate, and reliable electric services throughout Egypt;

- Issue service franchises and specify service obligations and standards;

- Establish initial transfer prices between EEA and the several EDCOs and a process for their periodic revision to reflect changing costs and economic conditions;

- Set rates for the various customer classes on a centralized basis;

- Monitor the quality of electric services delivered to customers on a decentralized basis;

- Design and oversee a strategy for phasing-in tariff reform to eliminate cross subsidies consistent with established fiscal, economic, and social objectives and national development goals;

- Promote and oversee the development of the wholesale market and phase-in of competition throughout the sector where feasible;

- Establish clear guidelines, rules and incentives to provide a stable regulatory environment that will attract investment capital to the Egyptian power sector.

- Centralize or coordinate key approvals a utility company would need to operate in Egypt including those for changes in corporate structure and ownership after initial privatization, access to capital and foreign exchange, and access to necessary facilities and land;

- Collect and disseminate information about the sector's performance and development of the markets for power and electric services;

- Review the level of efforts and results of utility conservation and least-cost planning, system design and maintenance practices, and financial planning;

- Design the rules for power pooling, dispatch, transmission access, and wheeling;

- Provide an effective, efficient forum for adequate public participation that reduces the need for formal litigation and adversarial proceedings.

4.4.4.3 The Principles, Policies, and Process of Egypt's Regulatory Board

To the extent feasible, the Regulatory Board should operate under the principles of Performance Regulation as the preferred method of attaining the public policy objectives of utility regulation. To do so, the Regulatory Board must be vested with sufficient authority and use effective means to enforce accountability on the part of utility managers, including rewards and sanctions.

The Regulatory Board should use direct and clear incentives that are designed whenever possible to make the economic interests of consumers and suppliers coincident and therefore reduce the need for continuous oversight or constant "second-guessing" of utility managers by utility regulators.

The Minister of Privatization should make the negotiation of an initial Performance Agreement between the purchaser of an EDCO and the newly created Regulatory Board an important factor to consider in addition to price in the Government's selection of the initial purchaser of utility assets.

Performance Agreements between the EEA and the Regulatory Board and between the EDCOs and the Regulatory Board should be based on 3-5 year strategic business plans prepared and submitted to the regulatory Board for review and approval.

These initial Performance Agreements should focus on outputs and outcomes where possible and on minimizing the cost of inputs where outputs and outcomes cannot be measured well enough yet. They should include, at a minimum, specific benchmark and performance targets for:

- Customer service indicators,
- Information systems,
- Power quality and reliability,
- Employee productivity,
- System operations (including decreasing losses and increasing load factors),
- Cost of capital,

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- Cost of power and energy,
- Price targets by customer class, and
- Profitability.

The EEA and the EDCOs should be encouraged to apply the same type of Performance Agreements with its managers and employees as well as with its suppliers, which in the case of the EDCOs would include EEA.

Performance Agreements between the EEA and the Regulatory Board and between the EDCOs and the Regulatory Board should specify the rewards for meeting the performance targets and the sanctions for not meeting the targets. Likewise, the Performance Agreements between the utility and its managers and employees and its suppliers should also specify rewards and enforceable sanctions.

4.4.5 Framing the Policy Debate

There must be extensive policy discussions preceding the structuring of the Regulatory Board. Some of the key points for discussion in the policy debates about the nature and scope of appropriate and effective utility regulation in Egypt's changing economic environment should include the following observations based on experience with various regulatory frameworks in other countries.

1. The government's public policy goals of regulation must be specified clearly at the beginning of the debate. These usually include the objectives of assuring:

   - A safe and reliable supply of electricity adequate for economic and industrial development consistent with Government policies and plans,
   - Universal service at acceptable price levels, any subsidiaries required should be clear and identified,
   - Efficiency in the absence of sufficient competition to result in market discipline,
   - Financial performance of utilities sufficient to attract investment capital,
   - Sector performance that fits with economic, social, and political realities.

2. The trend to separate and encourage competitive generation, transmission, and distribution is clear and continuing.

3. The trend away both from rigid regulatory processes and from centralized planning is also clear and continuing. Preference is turning away from direct control and after-the-fact regulation and toward more competition, greater reliance on incentives, and increased accountability through performance assessment.

4. There is no universal, optimal regulatory framework that will guarantee success in meeting all of a country's public policy objectives. While it is important to learn from various models around the world, each country's own unique combination of economic, political, cultural and social factors must be taken into account in designing the regulatory framework which best fits its internal conditions.

5. There is no such thing as a perfect market in the real world, nor is there such thing as a perfect regulatory scheme that can substitute for it. It is therefore misleading to compare outcomes expected either from theoretically perfect competition against the known flaws of imperfect regulation, or, on the other hand, outcomes expected from theoretically perfect regulation against the known flaws of a competitive marketplace.

   The challenge is to find the right balance, the right type and amount of regulation, as increasing competition and reliance on market discipline becomes more practical in each of the segments of the business, from generation to distribution. Too much regulation itself results in inefficiencies and discourages the emergence of competition; too little regulation can result in pricing abuse of captive customers.

6. Commercialization and even privatization by themselves will not necessarily result in maximum efficiency unless accompanied by an appropriate regulatory framework. Such a framework is one that does not reward cost-plus inefficiencies but does encourage the emergence and spread of competition through all parts of the system that no longer operate as "natural" monopolies.

7. Subsidies that are large, widespread, and embedded in tariffs create distortions in the marketplace and will discourage private investment.

   Subsidies that the government decides should be continued for social and political reasons -- those needed, for example, by low-income consumers (often called "life-line rates") and in rural areas -- could have fewer adverse consequences if handled in a more direct manner.

One way to make subsidies less distorting would be a direct payment by the government to compensate the utility for the services that the utility delivers below its actual costs to low-income and rural customers at the government's request. Such an attempt to eliminate the distorting effects of subsidies, but not their benefits to individual groups of customers, is being considered by the Government of Pakistan as part of its move to privatization.

4.5 SUMMARY OF RECOMMENDATIONS

4.5.1 EEA Charter

To avoid the delays and political complications potentially associated with changing EEA's Charter, it is recommended that EEA pursue its efforts to restructure its overall legal framework. Accordingly, using the provisions of Law 203, EEA should be transformed into a holding company comprised of a number of regionally or functionally segregated subsidiaries (i.e., segregation by region or by generation, transmission, etc.). This structure might be simpler to implement and more compatible with current GOE policies.

4.5.2 Regulatory Framework

It is recommended that:

- The Government of Egypt create a Regulatory Board of five members appointed from existing government entities and the private sector by the Prime Minister to serve staggered six-year terms;

- This Regulatory Board be independent and operate by majority vote.

- The Regulatory Board hire its own small technical staff of qualified engineers, economists, accountants, and lawyers. The Board and staff should participate in training programs with regulatory experts from countries that are successfully reforming their regulatory frameworks and processes.

- The Regulatory Board design its policies and procedures to use wherever possible direct, performance-based incentives and negotiated Performance Agreements to achieve its public policy objectives.

- The Egyptian Electricity Authority and the EDCOs use Performance Agreements throughout their operations, including with their own managers, employees, and suppliers.

- In view of the ultimate objectives of the current economic reform efforts, the Regulatory Board should be designed to accommodate the privatization of generation and transmission of electricity should the Government decide to pursue this objective at a later date.

The Chairman of the Electro-Technical Commission (MOEE)
The Under Secretary for West European Affairs, Ministry of International Cooperation

This composition might change at the next annual meeting.

The Board of Directors consists entirely of EEA executives and other GOE officials. No businessmen or representatives of financial institutions (government or private) are appointed. EEA's Charter does not appear to preclude such appointments.

It is recommended that EEA appoint to its Directors private sector businessmen and bankers and lawyers who could contribute to the management and financial decisions of the Board.

5.1.2 Management Structure (The chain of command at EEA is represented by the shaded boxes in Fig. 5-1)

The following functional positions report to the Chairman:

- The 5 Deputy Chairmen
    - The Deputy Chairman for Administration, Manpower and Training
    - The Deputy Chairman for Operations
    - The Deputy Chairman for Projects
    - The Deputy Chairman for Studies, Research and Planning
    - The Deputy Chairman for Finance and Accounting

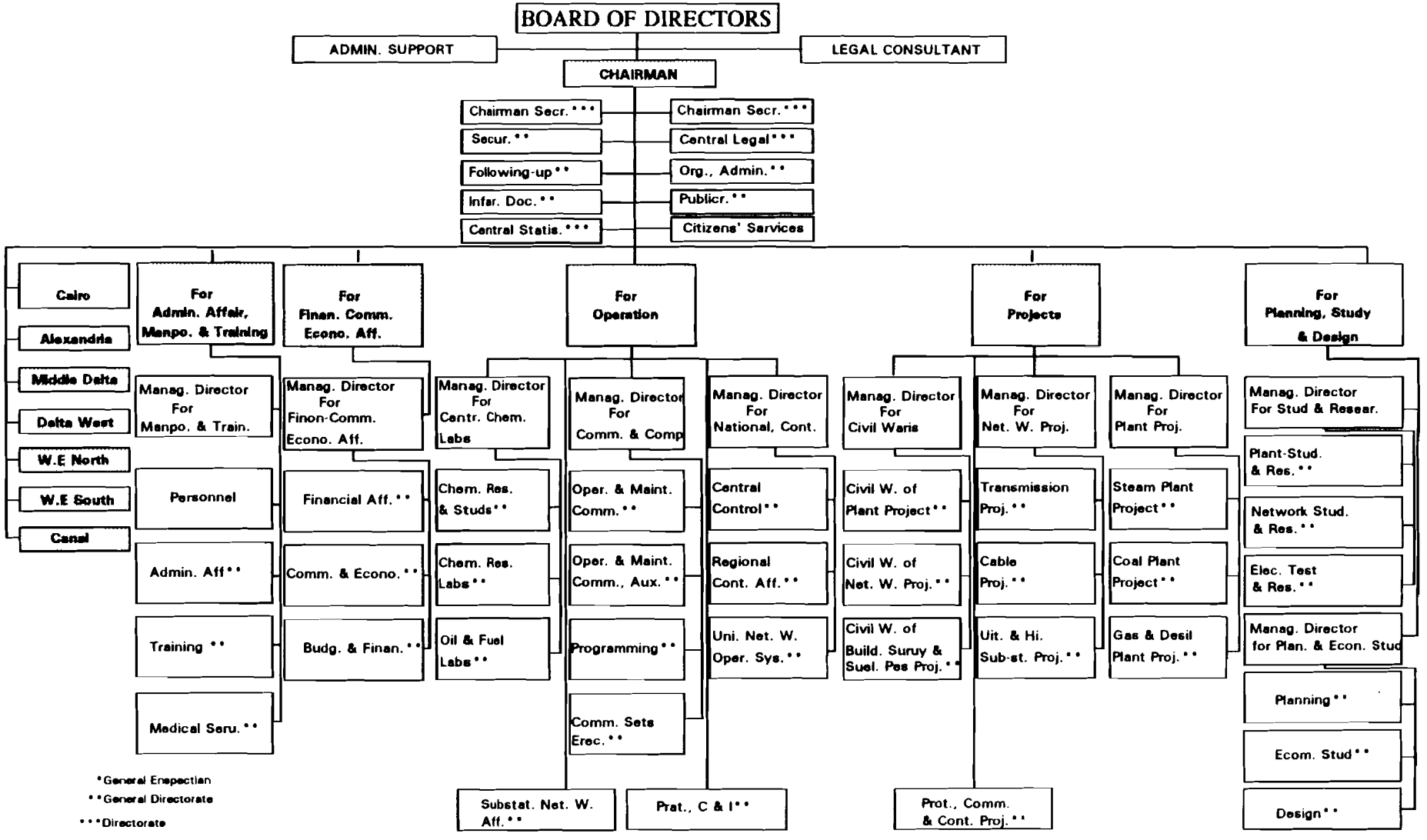
- The 7 Presidents of the Regional Zones:
    - President of Cairo Zone
    - President of Alexandria Zone
    - President of West Delta Zone
    - President of Middle Delta Zone
    - President of South Upper Egypt Zone
    - President of North Upper Egypt Zone
    - President of the Canal Zone

The Chairman and all of the Deputy Chairmen, except for the Deputy Chairman of Finance, are engineers. This is true for the zone presidents and most local managers.

While a large number of technical oriented staff is not unusual in electric utilities, there is still the need for skilled administrators, accountants, economists, etc. as in every business enterprise. It is therefore recommended that in the future a more varied mix of professional backgrounds be represented among EEA's top management personnel.

EGYPTIAN ELECTRICITY AUTHORITY

Revised Figure 5-1 (11/8/93)



Staff functions reporting to the Chairman also include:

- The Legal Department
- The Security Department
- Organizations and Administration Department
- Central Statistics
- Information and Documents
- Public Relations
- Follow-Up
- Secretaries
- Citizens Services

Managing Directors are responsible for one or more individual departments within a division. Each department is headed by a General Manager who is accountable to the Managing Director. (See Figure 5-1)

Each of the Deputy Chairmen have from one to three Main Divisions reporting to them. The head of the Division is referred to sometimes as Authorized Member of Management, or, Managing Director. The duality in the title is mainly due to the difficulty in translating from Arabic, i.e., literal translation or using terms that are more familiar to English-speaking persons.

The seven Zone Presidents are Presidents of regional profit centers, which can be considered equivalent to regional utilities. Each is autonomous and accountable for:

- O&M of plant and equipment;
- administration and manpower within their operational region;
- construction of new plants; and
- accounting and collection of revenues.

5.2 MANAGEMENT STYLE AND REPORTING PROCEDURES

EEA is currently subject to various GOE regulations inappropriate to the commercial operation of a utility. Most notably, on the managerial level, there is a clear lack of delegation of authority. The Chairman and Deputy Chairmen must approve and sign a tremendous number of documents daily, many concerning relatively minor issues. This overloads management and slows down the decision process considerably. "Management by Objectives" is not currently practiced at EEA which, combined with insufficient delegation of authority, contributes to significant delays and detracts management's attention from more pressing problems.

Areas where delegation of authority is recommended are:

- Procurement
- Recruiting of Personnel

The Vice Chairmen, Zone Presidents and Plant Managers should be given specific authorities with guidelines and ceilings. Such authorities should be consistent with policies formulated and the amounts budgeted in EEA's Annual Business Plan with accountability for costs.

Generally, reporting follows the lines of responsibility. It should be noticed, however, that just as the emphasis to date has been on "production", i.e., generation and transmission of energy without consideration of profitability, reporting procedures are also geared toward technical production management only. The Presidents of the Zones are primarily concerned with the technical aspects of their responsibilities, i.e., O&M and construction in progress. Financial reports flow directly to the central financial and accounting departments without too much attention from the Zone Presidents, despite the fact that they are responsible for the profitability of their regional profit centers. For example, as will be discussed under Chapter 11 of this report, the energy transferred from one zone to another is not reflected in the accounts books. This practice presents a distorted picture of the profitability of the individual zones. With the advent of the new emphasis on profitability, and IBRD requirements that EEA generate at least 40% of funds required for new investments internally, it is hoped that financial aspects including income and expenditure issues both at the Zones level and at the headquarters level will receive more attention from top management. In order for this to take place, a major reorientation of the top staff of EEA will be required.

In particular, technically-oriented departments such as Operations and Projects do not seem to coordinate in any formal manner with the Finance and Accounting Department. The engineers in these two departments do not provide feedback or report on financial issues. This problem stems from the engineers' lack of focus on financial profitability and lack of training in non-technical areas. In addition, the Finance Department does not appear to have a great influence in matters of expansion planning or in major investment decisions; their function appears to be solely that of maintaining financial records. Furthermore, more coordination between the Studies, Research & Planning, Projects, Operations and Finance and Accounting Departments is required.

Commercial operation at EEA will require that all current procedures be reviewed and significantly modified to establish a clear pattern of delegation and accountability. Above and beyond procedural changes, it is essential that managerial philosophy and style be adjusted. This will require meaningful changes to EEA's Charter in order to allow managers at all levels the authority and flexibility they need to meet the new objectives.

Following presentation of our draft report, EEA Human Resources Department gave us on November 8, 1993, the new manpower plan up to the year 2007, according to EEA, is based

on increasing productivity index that EEA uses (person/MW installed) by 60%. This is calculated as follows:

- The plant considers 1992 as a base with productivity index calculated as 3.6 person/MW installed.

- The stated objective of the plan is to reach approximately 2 person/MW installed by the year 2007 as per the attached Table 5-2.2.

EEA also claims that the 1 person/MW installed cannot apply to its organization which carries out many duties usually contracted out by other utilities (Example: maintenance, transportation, cleaning, etc.)

It is apparent from the above statements by the management of EEA, and the manpower plan shown on Table 5-3 that EEA intends to increase its overall employment from the 1992 level of 40,427 employees to 44,690 by 2007 i.e. a net increase of over 4,000 employees. Therefore, it is quite clear that EEA has not yet come to terms with the fact that overemployment exists in its organization.

In view of this situation it is recommended that, as a first step, EEA impose a freeze on new hiring until it can fully and objectively assess its human resources requirements. This would be probably better achieved with the assistance of a Human Resources specialist. A scientific analysis of positions required to operate the entire system should be performed to arrive to an optimum manpower plan to be gradually implemented over a period of approximately 5 years. Priority should always be given to retraining existing employees to meet the new requirements of EEA.

5.3 HUMAN RESOURCES MANAGEMENT

5.3.1 Overview

Overemployment is a significant problem at EEA. While the total cost of labor is only about 3% of the total operating cost at one of the newer EEA generating plants (including interest on loans and depreciation), or 9% of the out-of-pocket cost of generating electricity, it does result in major inefficiencies, constraints, and distortion in the operation of the system. For example, partially in response to employment considerations, inefficient plants are not retired and are being operated on a regular basis, while other more efficient plants are idle or under-utilized. With the change in direction of the Egyptian economy and the new emphasis of the GOE towards productivity and efficiency in the public sector, it is imperative that EEA face this situation with imagination and determination, but still within the nation's social constraints. Included in this chapter are a few recommendations that, after further refinement and customization, could help reduce over-employment over time. The Human Resources

function at EEA reports to the Deputy Chairman for Administrative Affairs, Manpower and Training (Figure 5-3, as revised by EEA, 11/8/93).

5.3.2 Personnel Policies

Since the 1960's, EEA (or its predecessors) hired a certain quota of college graduates assigned annually to them by the GOE Ministry of Labor. Personnel policies at that time did not take into consideration such factors as profitability, or even productivity. Table 5-1 gives the history of total employment of EEA during the last 10 years.

Table 5-2 gives the details and classification of the EEA employees. It should be noted that while total female employment is 5,202, or about 12% of the total; in the professional categories including engineers, females constitute about 25% of the total. That figure is high relative to female representation in electric utilities in the US.

In 1992, EEA has appointed about 3,000 new employees, reflecting a net increase after attrition of about 3.5%. Approximately 10% of the new appointees are employed on a temporary basis. Out of seven hundred engineers that applied for jobs 80 were selected. It is important to note that EEA's management is aware of the problem of over-employment. In fact, top management has mentioned several times that a good general ratio for such a utility is one employee per installed kW. However, due to social considerations, there is no present plan to reduce overemployment at EEA.

TABLE 5-1
EEA TOTAL EMPLOYMENT HISTORY
1983-1992

Year	Total Employees	Annual Increase
1983	25,612	
1984	27,862	8.8%
1985	28,666	2.9%
1986	29,650	3.43%
1987	30,762	3.75%
1988	33,032	7.4%
1989	34,633	4.85%
1990	37,429	8.1%
1991	40,427	8.0%
1992	41,844	3.5%
INCREASE 1983-1992	16,232	63.4%

It has been observed that there is an overwhelming emphasis on appointing engineers to most management positions, despite the fact that some of the positions require expertise in such areas as economics or human resources management. However, notwithstanding the university degree background of the employees, it is important that they be given proper training in fields directly relevant to their activities.

TABLE 5-2
DETAIL OF TOTAL EEA PERSONNEL AS OF DECEMBER 1992

Employment Classification	Engineers Univ. Graduate		Science & Math Univ. Graduate		Medical Univ. Graduate		Legal Univ. Graduate		Finance & Comm. Univ. Graduate		Personnel Dev. Univ. Graduate		Clerical		Technicians School		Crafts		Services		TOTAL	
Location	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Headquarters	464	324	52	55	18	20	37	32	178	256	90	166	391	1,073	414	60	897	6	316	8	2,857	2,000
Cairo Zone	730	93	95	27	15	6	18	8	126	88	74	24	698	312	2,505	40	2,277	7	508	-	7,046	605
Alexandria Zone	434	125	55	41	4	-	13	6	80	70	43	47	250	353	1,234	122	1,546	3	200	3	3,859	770
West Delta Zone	340	15	36	9	3	1	4	1	68	26	45	16	182	166	12,66	76	1,668	11	52	1	3,664	322
Middle Delta Zone	555	147	51	34	9	2	8	3	130	63	67	25	339	386	1,541	76	1,603	44	19	-	4,322	780
Canal Zone	568	23	53	3	8	-	7	-	97	20	52	6	322	113	1,940	21	1,404	1	595	-	5,046	187
North Upper Egypt Zone	322	18	16	10	2	2	10	1	53	33	33	10	172	175	1,273	14	1,279	1	186	3	3,346	267
South Upper Egypt Zone	367	18	9	7	4	1	15	1	77	13	42	9	395	186	1,850	25	3,505	5	238	6	6,502	271
Total	3,780	763	367	186	63	32	112	52	809	569	446	303	2,749	2,764	12,023	434	14,179	78	2,114	21	36,642	5,202
Grand Total	4,543		553		95		164		1,378		749		5,513		12,457		14,257		2,135		41,844	

Table 5-3

The Proposed E.E.A. Plan For Manpower (From Year 1992-2007)

Years of Plan (Y.P.)	No. of Staff at End of (Y.P.)	Installed Capacity at the End of (Y.P.) (MW)	Total Productivity Index Persons/(MW)	Increase in Installed Capacity During (Y.P.)	Productivity Index for New Recruitment New Person/MW Addition	Required No. of Newly Recruited Staff	No. of Retiring Staff During (Y.P.)
92 (as a base)	40427	11200	3.6:1	----------	----------	----------	----------
92-97	43056	13800	3.12:1	2600	1.68:1	4366 (in 5 years)	1737
97-2002	44550	16500	2.7:1	2700	1.42:1	3850 (in 5 years)	2356
2002-2007	44690	20500	2.18:1	4000	0.8:1	3240 (in 5 years)	3100
						11856	7193

The plan indicates that E.E.A. will recruit 10550 employees during the next 15 years (about 700 per year).PAGE

From time to time, EEA loans personnel to other Arab countries at their request. In such cases, the policy is as follows:

- Period of Loan: 6 years, though sometimes this has been extended by another 6 years if the spouse is also employed.

- Compensation and Other Conditions: EEA maintains pension benefits and the seniority of loaned personnel for a period of 4 years. The personnel contribute a percentage of their salary to EEA to compensate for the pension benefits and for the maintenance of their positions.

Such loans of personnel should be investigated in depth as a means to reduce excess personnel at EEA. However, it is recommended that EEA encourage and perhaps participate in the establishment of private Egyptian firms staffed by EEA-trained personnel which could bid for O&M contracts in the Gulf countries. This is potentially a more effective way of reducing excess personnel than loaning individual staff members, and it is also more lucrative for Egypt as a whole.

5.3.2.1 Appointment to Senior Positions

The Chairman of the Board of EEA as well as the Deputy Chairman and the Zone Presidents are appointed by a decree of the Prime Minister upon recommendation of the Minister of Electricity and Energy.

The other senior positions (Managing Director, General Inspector and General Manager) are appointed by the Minister of Electricity.

5.3.2.2 Promotion

Promotion for most positions is by seniority, with some consideration given to merit. For the senior positions such as Zone President and Deputy Chairmen, Managing Directors, General Inspectors, General Manager, promotion relies on merit. According to Law No. 5 of 1991 concerning selection of management. All such appointments are made by the Board of Directors and confirmed by the Minister of Electricity and Energy.

Under commercial operation, efficiency, cost-control, budget improvement and business planning are of paramount importance. Accordingly, employees' contribution to these tasks should be a key consideration in both promotion and compensation.

It is therefore recommended that the entire promotion system be reviewed, and that more weight be given to merit.

5.3.3 Compensation

Compensation at EEA follows the overall GOE pattern, but is generally higher than most other GOE entities. This level of compensation is the result of management's use of all the flexibility in the Charter to increase compensation of its employees through a complex system of benefits and incentives.

In general, compensation should be commensurate with results. Furthermore, some link to the "bottom line" is necessary at all levels.

The whole compensation structure should be overhauled and an effective system of incentives developed. This incentive system should be transparent and designed to reward productivity, initiative, and overall contribution to profitability at both the departmental and divisional levels. Individual initiatives which result in quantifiable cost savings should be adequately rewarded.

EEA's approximate salary scale is shown in Table 5-4. While EEA's 1976 Charter stipulates that the total salary to EEA personnel, including bonus and incentives, should not exceed three times the base GOE salary scale, EEA has been able to exceed this limit through overtime pay, fees for attending meetings, and non-pecuniary compensation.

TABLE 5-4 APPROXIMATE SALARY SCALE			
Classification	**Promotion Expected After**	**Base Salary L.E./Y**	**Total/Compensation L.E./Y**
Engineer 3rd Class or Researcher or Specialist	3 Years	576/1608	1728/4824
Engineer 2nd Class, Chief of Unit	5 Years	660/1608	1980/4824
Engineer 1st Class, Chief of Section	5 Years	840/1908	2520/5724
Senior Engineer	2 Years	1140/2088	3420/6264
General Manager Under Secretary of Staff Managing Director Inspector General	2 Years	1500/2304 1680/2433	4500/6912 5040/7299
First Under Secretary Chairman Deputy Chairman Zone President	1 Year	2603 and above	7809 and above up to 40000

All permanent employees of EEA contribute 7.5% of their base salary to a special retirement fund, while EEA contributes 10%. The employee, upon retirement, permanent disability, or death, receives a lump sum equivalent to 42 months of his/her last base salary. This amount has been gradually increased in recent years from the original equivalent of 25 months of the employee's base salary. The normal Egyptian government pension system applies to EEA employees (in addition to the retirement fund). However, the amounts are presently quite low -- on the order of L.E. 100 to 200 per month, although this is presently being increased for all GOE employees.

Despite EEA's efforts, the level of compensation remains low in comparison with that in the private sector in Egypt. This situation persists because EEA is obligated to comply with the general compensation levels for GOE employees. EEA, however, has not had a great problem in recruiting personnel and, in general, in retaining them, due to the relatively high unemployment rates among university graduates in Egypt and due to the fact that EEA salaries are probably among the highest in the government, following the Suez Canal Authority and the petroleum sector.

5.3.4 Training

EEA has a special department in charge of training programs which reports directly to the Deputy Chairman for Administration, Manpower and Training. The organization of this department is shown in Figure 5-2. (Updated 11/8/93 as per EEA)

Since 1965, EEA has established training centers for its personnel and those of the Distribution Companies (EDCOs). As of 1992, there were training centers for engineers and technicians at:

- Cairo North Shoubrah El-Kheima
- Cairo South Abu Sultan
- Abu Kir Talkha

Other training centers are in the process of being established in Aswan, Talkha and Fayed, as well as an additional training center for administrative and financial personnel. As of fiscal year 1991, 8,701 trainees representing 24% of the total EEA personnel received training in technical, financial, administrative, and managerial subjects.

5.3.4.1 Cairo-North Training Center for Electrical and Mechanical Power

The Cairo North center (the oldest at EEA) was established in 1965 with the help of the Soviet Union. Its main function is to train engineers and technicians needed by EEA through a joint venture between the Ministry of Electricity and Energy and the Ministry of Education. The center was expanded in 1987 with the assistance of the German Agency for Technical Cooperation of the Government of the Federal Republic of Germany. The training center, located next to the Cairo-North Power Station on the Ismailia Canal, has training classrooms, mechanical and electrical workshops, sport and recreational facilities, and housing for up to 100 trainees. The training programs available -- including electric, mechanics, control and instrumentation, and technical secondary schools -- are shown in Figures 5-3 through 5-6.

5.3.4.2 The Cairo-South Training Institute

This institute, located 25 km south of Cairo close to the Cairo-South Power Station, was established in 1967 with the assistance of the U.N. and the ILO. Further technical assistance was provided by countries such as England, France and Sweden. EEA continued to develop and modernize this center with the help of the World Bank and the British Council.

In 1987, the Canadian International Development Agency (CIDA) and the British Council supplied the Center with new equipment and training material. The Center has classrooms, mechanical, electrical, and communications workshops, as well as a hostel for up to 96 trainees. Figure 5-7 shows the training programs available at the Cairo-South Training Institute.

5.3.4.3 The Abu Quir Training Center

The Abu Quir training center is a new training center located on the Mediterranean, next to the Abu Quir Power Plant, 40 km east of Alexandria. This center was established with the assistance of the British Government specifically for EEA personnel for power plant O&M training. The instructors assigned to this training center have been trained in the United Kingdom and will be starting the courses in 1993. The center will carry out theoretical and practical training related to power station O&M as follows:

1- Operation and maintenance for power station mechanical equipment.
2- Operation and maintenance for power station electrical equipment.
3- Operation and maintenance for Control and Instrumentation.
4- Electronics and electronic devices.
5- Power plant training simulator.

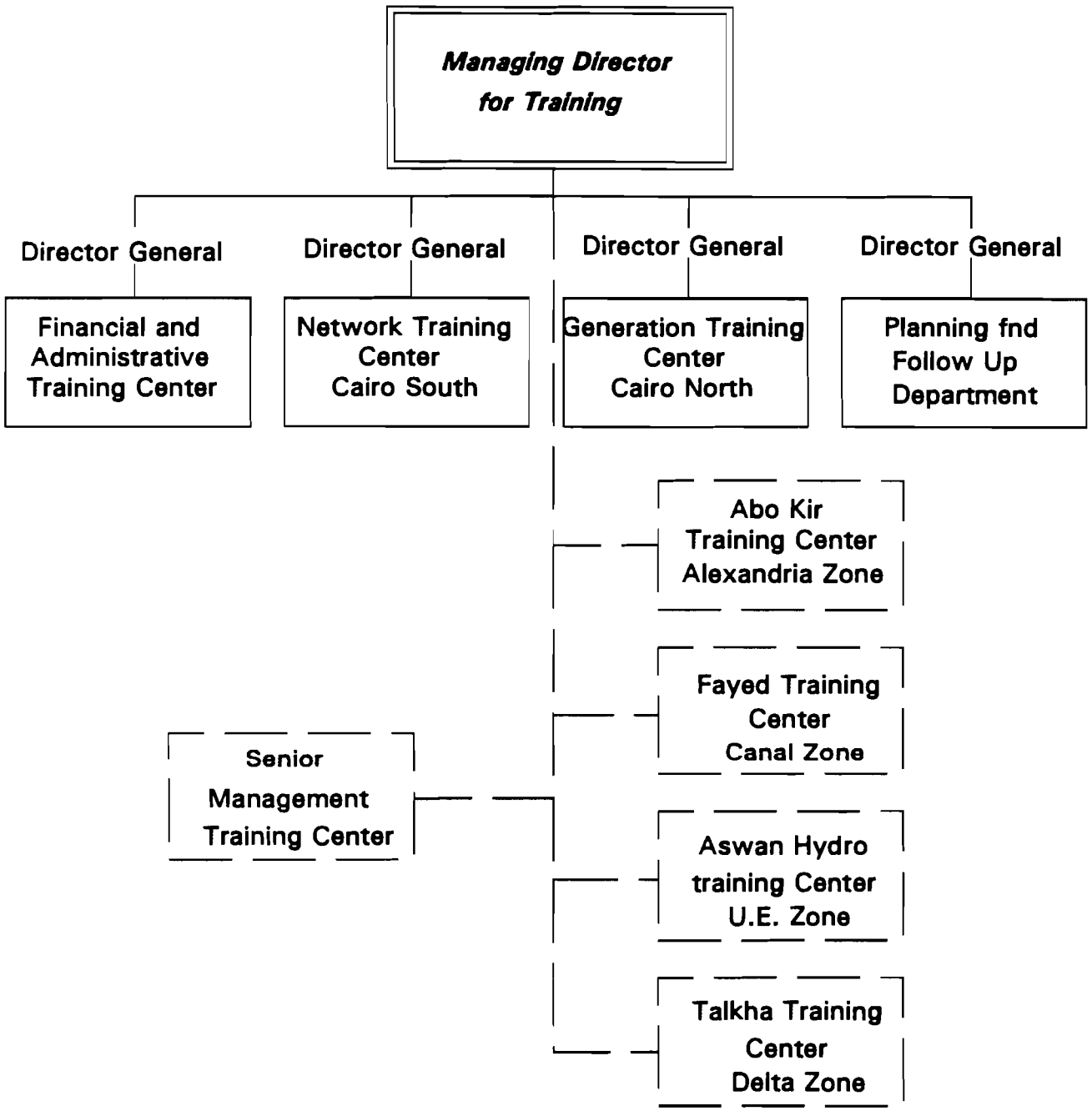
EGYPTIAN ELECTRICITY AUTHORITY

Figure 5-2

New Organization

for

Training Department



Instead of Fig. 5-2 Section 5

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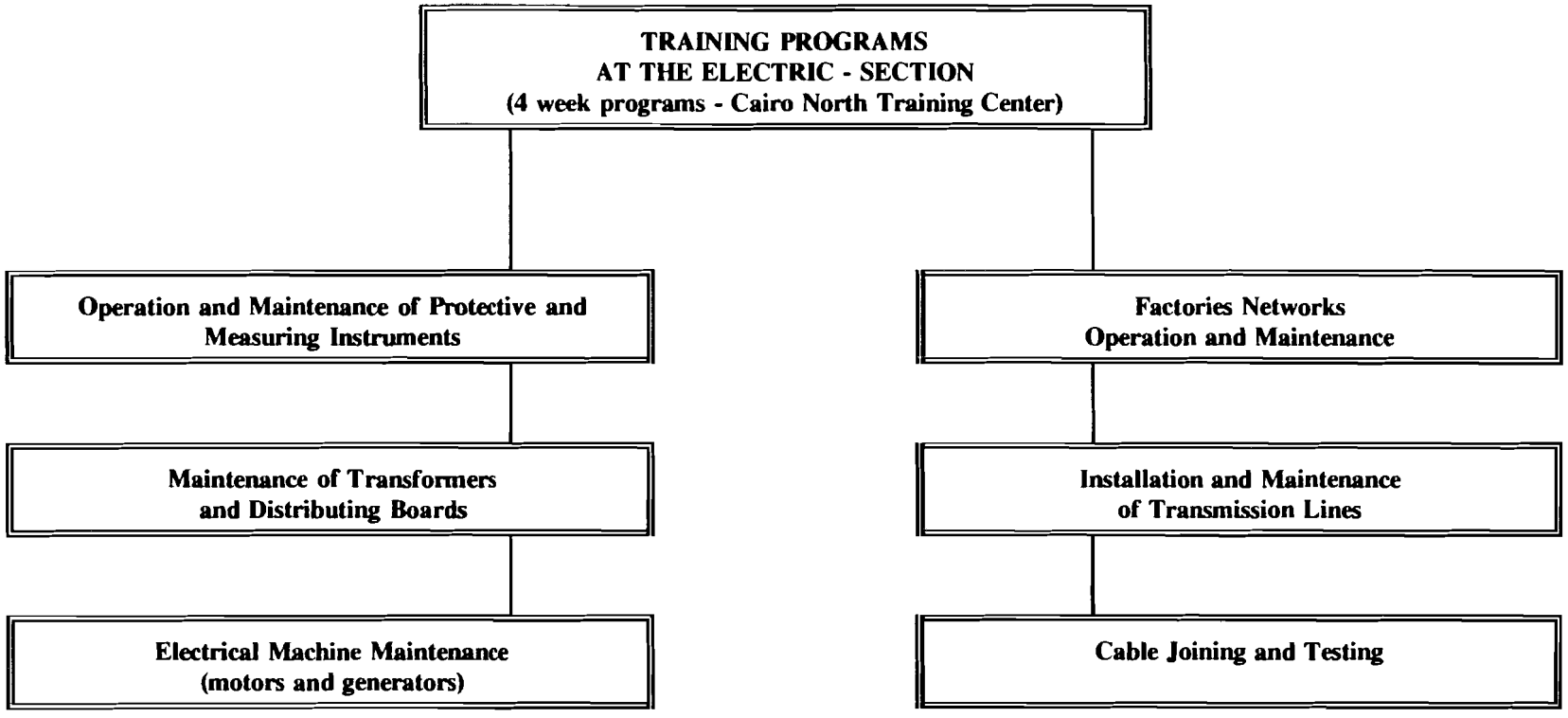
86

EGYPTIAN ELECTRICITY AUTHORITY

Figure 5-3



EGYPTIAN ELECTRICITY AUTHORITY

Figure 5-4

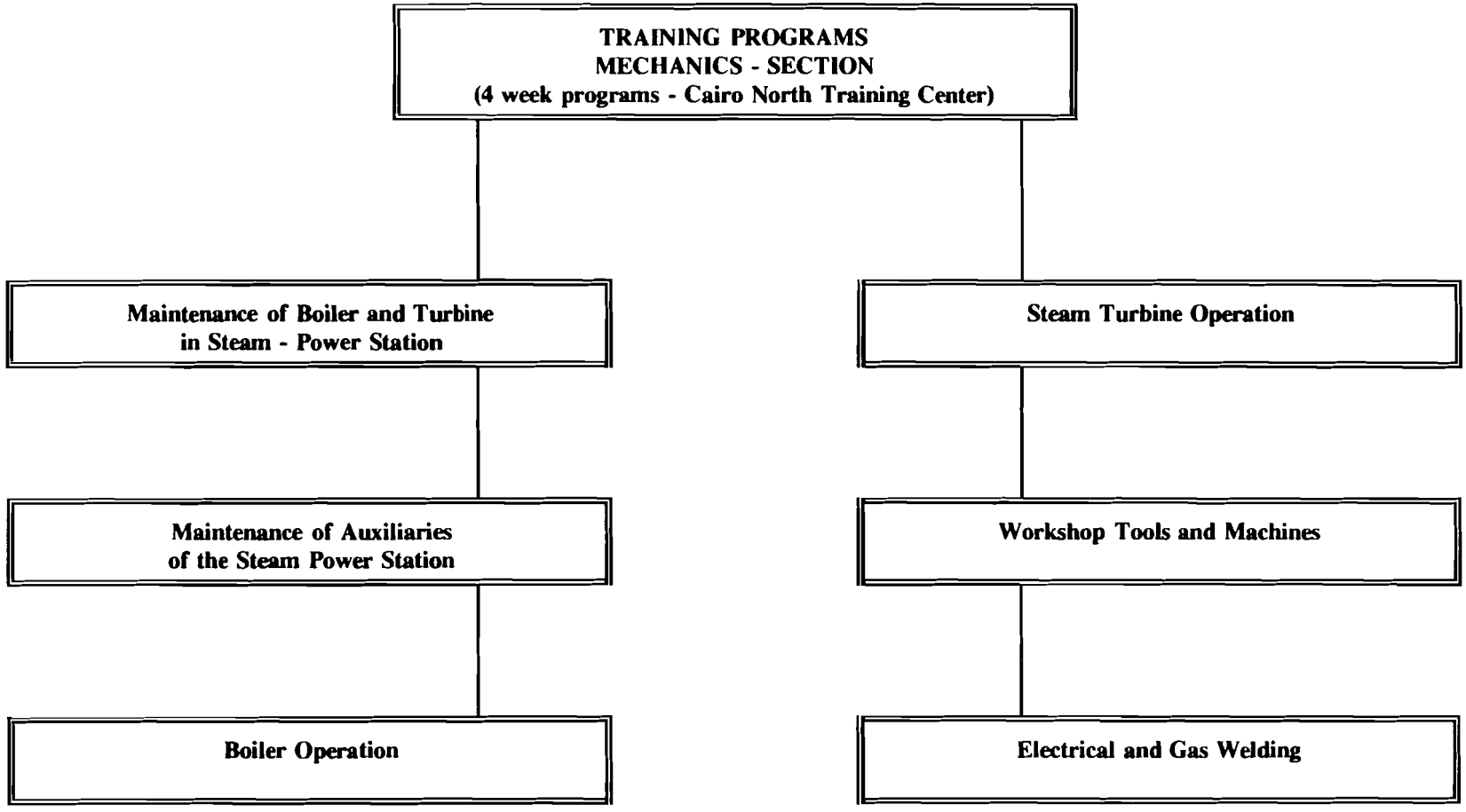


Figure 5-5

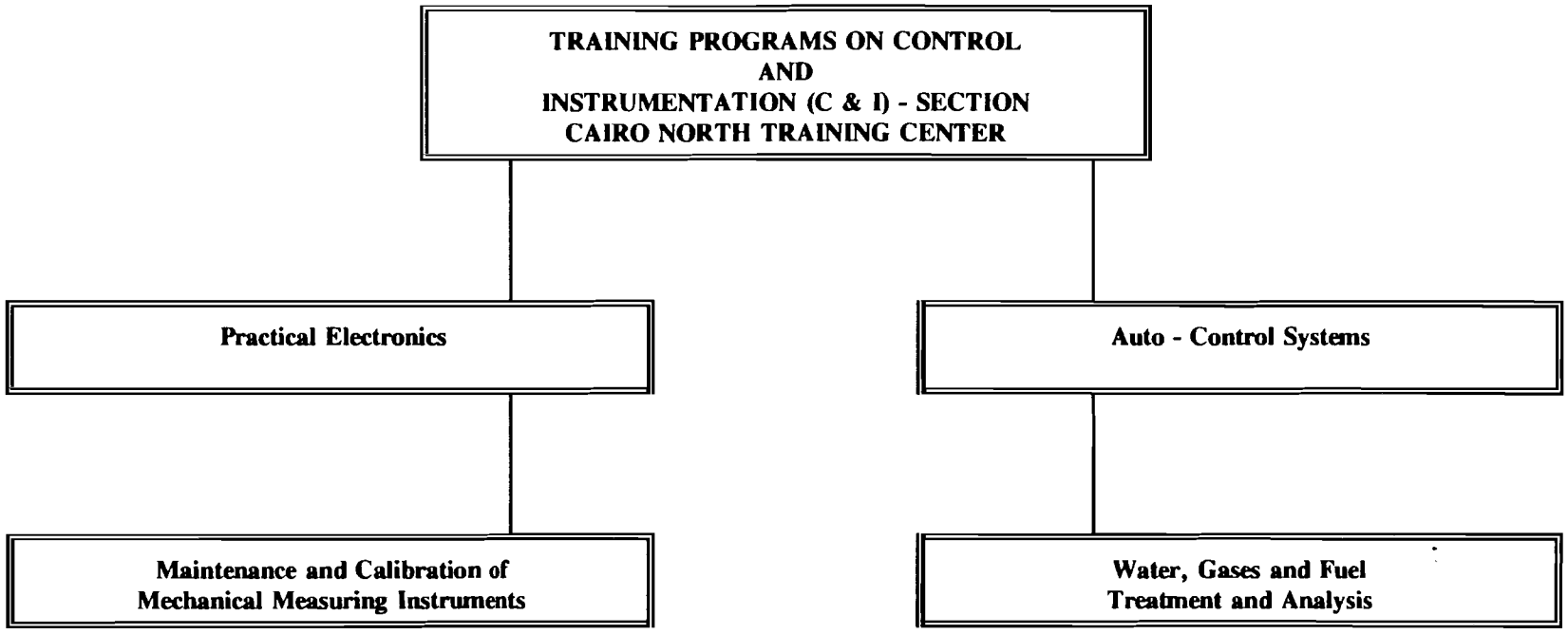

TRAINING PROGRAMS ON CONTROL
AND
INSTRUMENTATION (C & I) - SECTION
CAIRO NORTH TRAINING CENTER
Practical Electronics
Auto - Control Systems
Maintenance and Calibration of
Mechanical Measuring Instruments
Water, Gases and Fuel
Treatment and Analysis

Figure 5-6

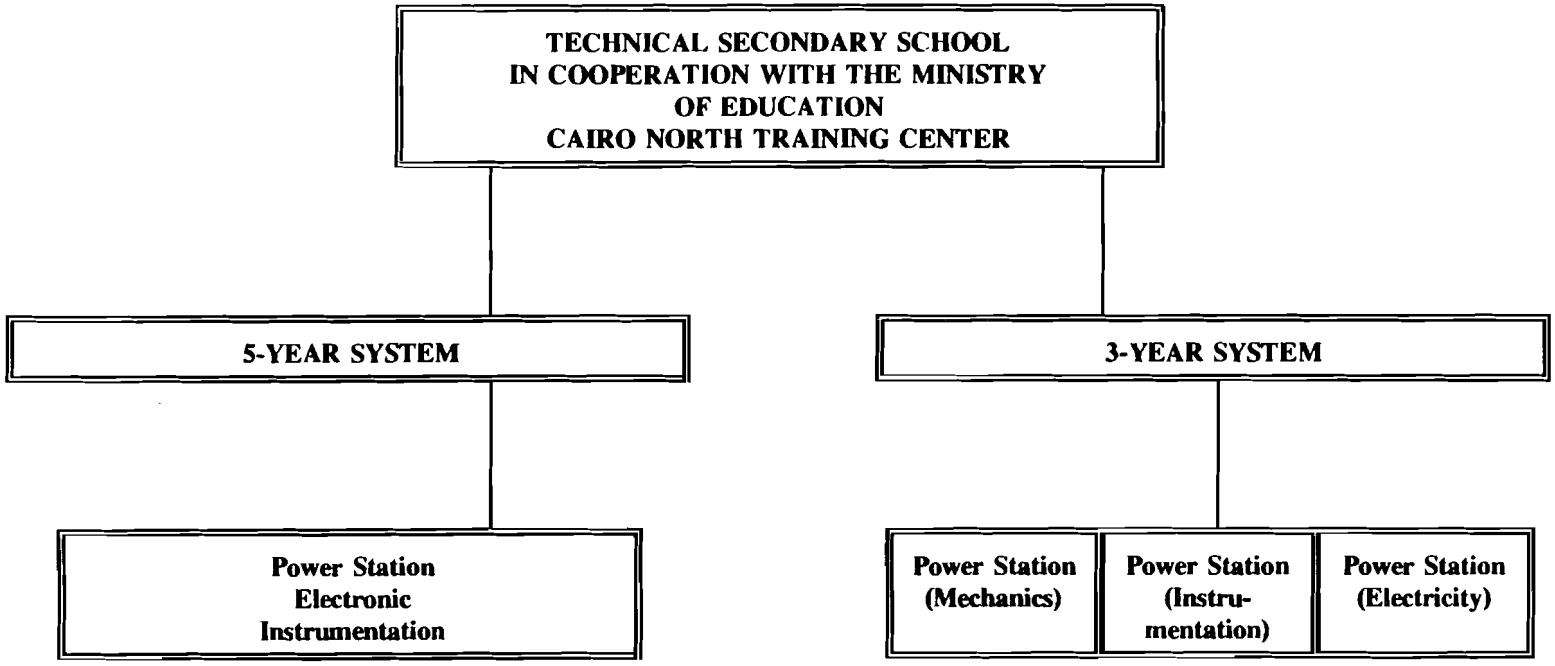

TECHNICAL SECONDARY SCHOOL
IN COOPERATION WITH THE MINISTRY
OF EDUCATION
CAIRO NORTH TRAINING CENTER
5-YEAR SYSTEM
3-YEAR SYSTEM
Power Station
Electronic
Instrumentation
Power Station
(Mechanics)
Power Station
(Instru-
mentation)
Power Station
(Electricity)

Figure 5-7

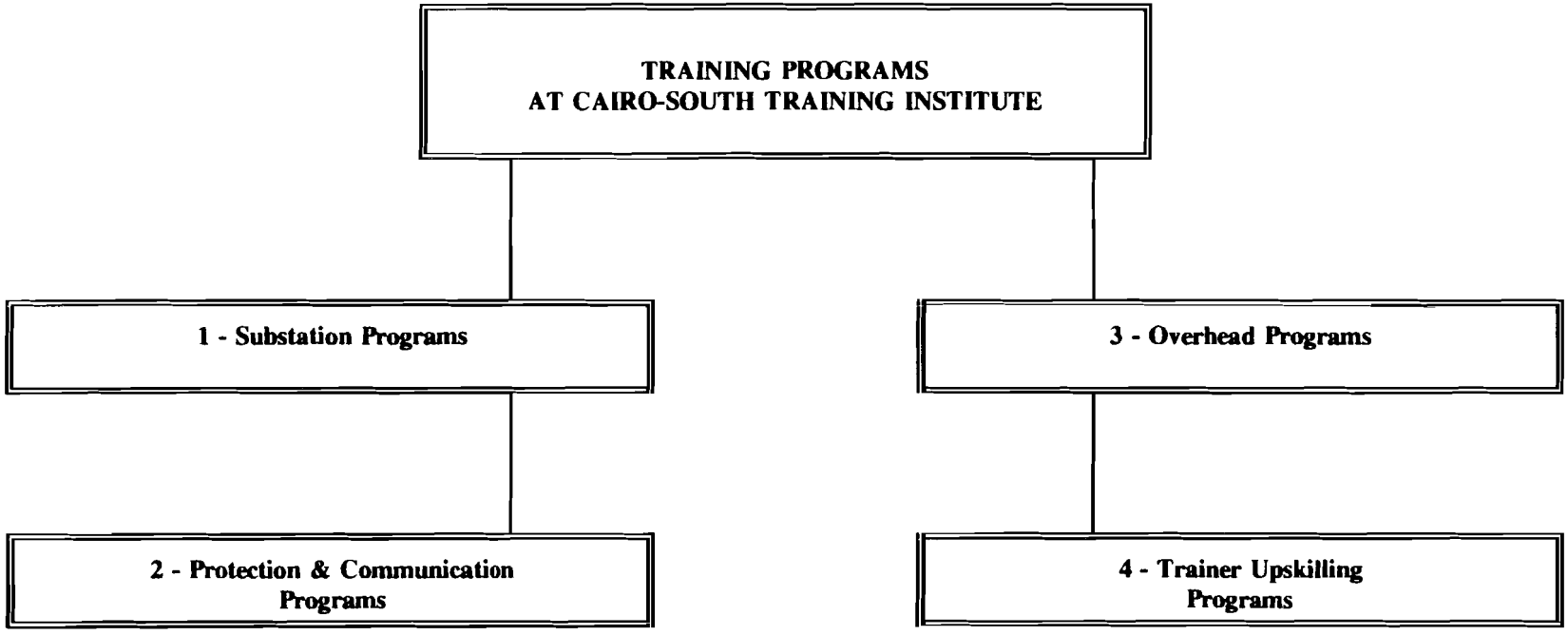
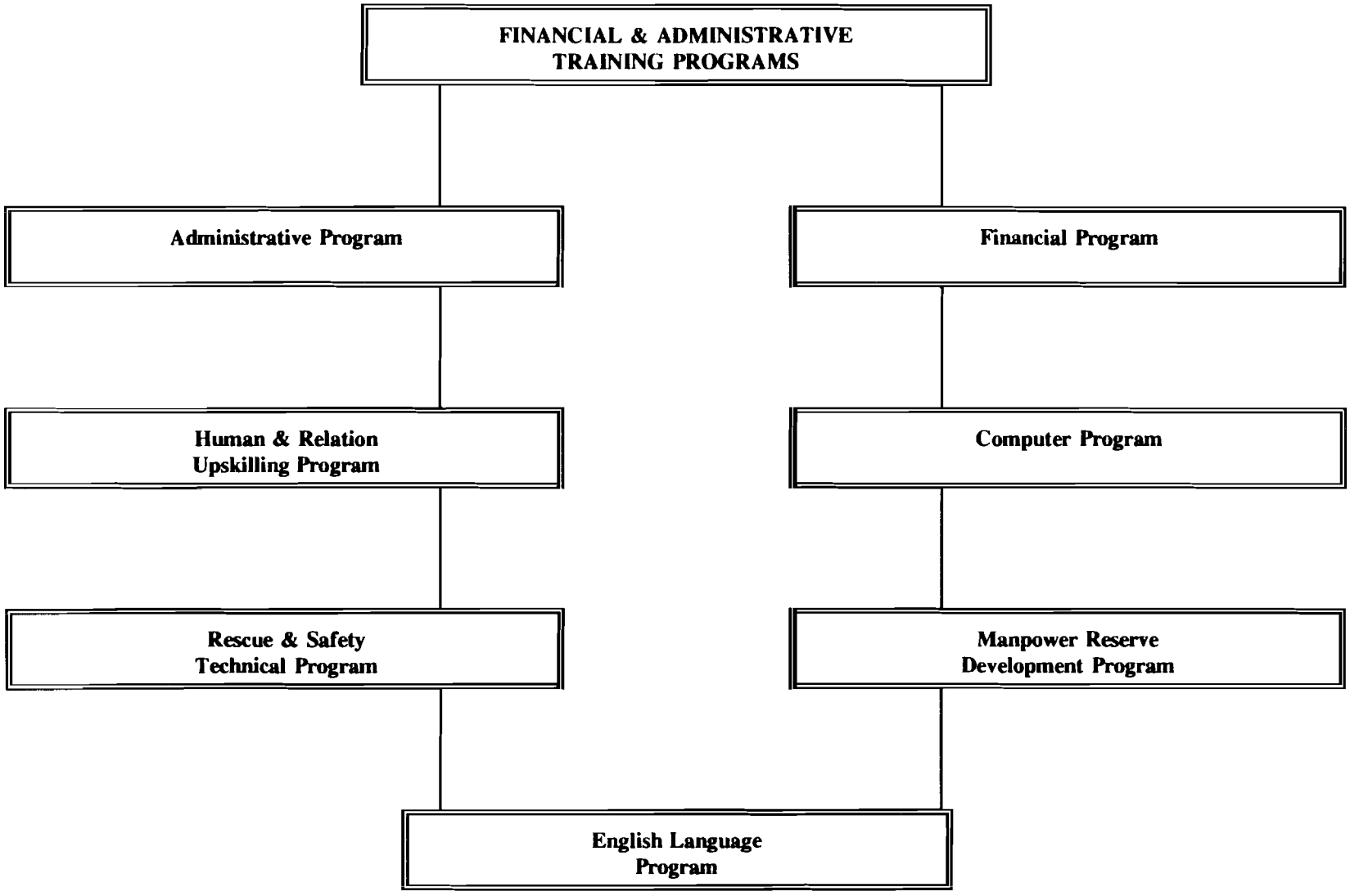

TRAINING PROGRAMS
AT CAIRO-SOUTH TRAINING INSTITUTE
1 - Substation Programs
3 - Overhead Programs
2 - Protection & Communication Programs
4 - Trainer Upskilling Programs

Figure 5-8


FINANCIAL & ADMINISTRATIVE TRAINING PROGRAMS
Administrative Program
Financial Program
Human & Relation Upskilling Program
Computer Program
Rescue & Safety Technical Program
Manpower Reserve Development Program
English Language Program

5.3.4.4 The Financial and Administrative Training Center (FATC)

The FATC is presently located at Cairo-North, next to the Cairo-North Training Center described above.

The FATC was established partly with funds from USAID for both hardware and training specialists. The programs currently offered are shown in Figure 5-8, and include an English language program.

It is clear from the preceding discussion that great emphasis is given to training engineers and technicians. Most training appears to be technically oriented, with no significant effort to train the personnel in management skills. The recent establishment of the Financial and Administrative Training Center offers an opportunity not only to increase the training of non-engineering personnel, but more importantly, to train staff of all disciplines in the management skills relevant to the various aspects of EEA's operations. It appears that in 1992 EEA offered external management training courses to Senior Managers which covered about 90% of the Senior Managers. This program is called the Top Management Development Plan (TMDP) and it was sponsored by the MOEE, EEA and the Government of Canada through the Canadian International Development Agency (CIDA).

In future, a new Management Training Center will be located in the new building in construction soon to become the EEA headquarters. This center will be exclusively devoted to management training for the entire EEA power sector. USAID is presently in the process of selecting a US contractor to train EEA personnel. Part of the assignment will be to design a new management training program.

5.4 MANAGEMENT INFORMATION SYSTEMS

In 1986, EEA began a UNDP-funded project to computerize its operations. Phase I, completed in 1987, involved the installation of a VAX 8200 mainframe to improve efficiency at EEA's Studies, Planning and Research division. The system was subsequently updated to a VAX mainframe computer 8350 in 1989, and a VAX 6310 in 1992. Its software capabilities included:

- Energy Demand Forecasting
- Generation Expansion Planning
- WASP III, and Least-cost Generation Expansion Software (EGEAS)
- Integrated Resource Planning
- Electricity Price Elasticity Models
- Power Plants Performance Evaluation
- Average Selling Prices to EDCOs & End-Use per Year
- Average Rate of fuel consumption

- Average Rate of fuel consumption
- Energy Sales by Sector
- Load Statistics
- Net Generation and Sales per Zone
- Losses in the Egyptian UPS by year

Data for entry into these programs was provided by various EEA departments, or by Research and Planning engineers. No other division had access to these computer facilities, software, or even on-line data.

Phase II of the project sought to extend the system installed in Phase I, bringing it closer to a management information system, covering all of EEA's operations. Phase II was designed to improve the flow of information throughout EEA by developing on-line programs for the VAX system customized to fit the individual divisions' requirements. These programs provided basic data-entry capability and the possibility of producing management reports on demand. A department was created and staffed to operate the computer facility (henceforth, "Data Bank"). Taken together, these changes created the tools necessary to monitor and evaluate the individual division's operations as required by EEA's MIS objectives. By 1990, the Data Bank staff had developed programs capable of producing a variety of management reports for the various divisions based on data entry performed by a special three-member department at each division. The following reports can now be produced for the Financial Affairs and Accounting division:

- Long-term external and internal loans
- Capital Expenditure for HQ and each Zone
- Uses and Applications of External loans and grants
- Operating expenses for HQ and per Zone
- Income Statements for HQ and per Zone
- General ledger
- Energy Sales by Supply Voltage
- Energy Sales by Zone
- Sales Revenue per Supply Voltage
- Sales Revenue per Zone

Unfortunately, the division does not use the installed system as intended. Raw data is not entered on a regular basis. The VAX systems are used mostly as word processing facilities to provide printed information when required by external agencies such as USAID or the World Bank. Financial and accounting operations are still largely manual.

The current procedures have serious drawbacks. For example, when account information is loaded from hard copies into the system, it must be verified after it is entered. The staff currently responsible for such a review is both numerically and technically inadequate (there are three to five staff members, none of whom have adequate accounting training). Often, despite the fact that the computer generated reports are sent

to the responsible individual department, they are not given appropriate attention because the responsible department is not accountable for the quality or content of the reports it receives. In reviewing financial records for this study, we discovered a number of major errors. These errors were comprised primarily of inconsistencies between the manual reports and those subsequently generated by the computer system.

It is strongly recommended that the Financial Affairs and Accounting division re-evaluate and revise its policy concerning integration of its manually-recorded and computer-generated records, and the organizational structure which it supports.

It is further recommended that the data entry staff be integrated within each department in each division. This would entail allowing each department to enter its own data into the system and be accordingly accountable for the verification of the data entered.

The implementation of these recommendations would involve assigning one or more persons, or charged specifically with data-entry, to each department. Making data entry and verification simultaneous and on-going processes at each department would increase both the availability, timeliness, and accuracy of information at the Data Bank.

The Projects, Operations, and Training and Personnel Affairs divisions also began integrating Data Bank Systems into their daily tasks. The integration process, however, is slow and involves a myriad of problems ranging from telephone lines for data transmission to the apparent lack of focus of individual departments on providing accurate data on a timely basis. The Data Bank can currently provide the following reports to the divisions:

PROJECTS DIVISIONS

- Project Implementation Status
- Transmission Line Project Details
- Cables Project Details
- Individual Project Cost, including breakdowns of parts and installation into local and foreign future financing

TRAINING AND PERSONNEL AFFAIRS

- Training Donor Agencies, listing Training Centers, type of funding and source of funding
- Training Centers Activities
- Training Center Staff
- Trainees hostel information
- Training center facilities and equipment
- Training expenditures and budget

- Permanent and Temporary employment
- Medical, dental and hospital, by zone and department

No sample reports to the Operations division were available for review.

A further problem lies in the production of technical and economic forecasts. Under current procedures, the Studies, Planning, and Research division relies on other EEA divisions and the EDCOs to provide data required for forecasting. Ideally, this data should already be present in the Data Bank as the various divisions input it directly. This would allow the Studies, Planning, and Research division to produce reports and forecasts automatically as needed. Instead, the division requests much of the information related to the distribution sector needed for forecasting and planning from the EDCOs or the Holding Company. Under current procedures, the EDCOs or Holding Company, in turn, relay the request to the Al-Ahram computer facility, where customer bills are prepared. Al-Ahram prints the requested information and sends it by hard copy back to the EDCO or Holding Company. It is then relayed to the Studies, Planning, and Research division which originally requested the information. Once back at EEA, the information must be entered into the computer for processing. Thus, a request for information must go through a number of divisions and be downloaded and uploaded a number of times. This procedure is not only time-consuming, but also increases the possibility of inaccuracy during the data-entry process.

It is, therefore, strongly recommended that the Data Bank be linked directly to the Al-Ahram computer facilities, even if access is restricted to statistical information only. Such a data link will facilitate EEA's access to up-to-date statistical information on the distribution sector.

Under-utilization of the existing VAX system is a serious problem, not just at the Financial Affairs and Accounting division, but throughout EEA's divisions. The system possesses capabilities which are left completely untapped. The result of this under-utilization is reduced operational efficiency and adaptability in response to changing current and future conditions. This problem is largely due to the staff's general lack of familiarity with the operation and function of computers.

It is essential that a significant proportion of EEA's divisional staff receive training in the benefits of an MIS and how one is created. This training will provide them with the familiarity with the system necessary to encourage them to maximize its use in their own daily tasks. Furthermore, it is equally important that this training be provided to managerial staff first, in order to allow them to incorporate automation into their planning decisions.

Increased familiarity with the system will enhance staff's awareness of the fact that computers are not a burden, but rather a tool to expedite processing and increase overall efficiency and productivity. Furthermore, it would decrease the number of inconsistencies between manual and computer-generated documents by fostering better understanding of what the computer programs do and how they work. This would inherently smooth the process of integrating manual and computer-based data until such time as full computerization is achieved.

The implementation of the MIS recommendations in this section will increase divisional exploitation of the capabilities of the Data Bank. Accordingly, we envisage increased efficiency and ease in the working environment.

It is evident that EEA's computer facilities are quite extensive. They are capable of supporting data flow and providing access to all existing divisions. Accordingly, EEA's computer facilities are capable of providing reasonable and comprehensive Management Information Reports to the offices of the Chairman and Deputy Chairmen. It is also evident that the Data Bank staff are capable of creating and customizing programs to produce management reports from existing stored data in cooperation with individual EEA divisions. These programs have in the past been designed with extensive help screens and good editing functions.

The main problem with Data Bank is that the need for it has not been clearly established and recognized in the day-to-day activities at EEA. It is important to realize that however abundant the available data is, if the need for it is not identified, it will not be used effectively. Therefore, it is vital that the need for accurate, timely, and comprehensive data is established and accepted by each department in each division. It is clear that the solution to this problem must come through changes in EEA's operational policies and through active participation by divisional staff the computer's potential is recognized. Strong direction from the Chairman and Deputy Chairmen will be necessary to implement such changes and support to these efforts.

Operational policies should allow for a phased transition of the manual system into an automated system according to a specific timetable. The transition should include a period of overlap during which manual and automated systems are used in parallel in order to ensure accuracy during the system's readjustment. The period of overlap should be specifically set to avoid prolonging the conversion process and dragging it for an unnecessarily long period of time.

In addition to procedural changes, changes in divisional and departmental policy should be made part of improving MIS at EEA. Each department in each division must be made accountable for the quality and accuracy of its data. The inclusion of data-entry personnel in each division would allow simultaneous processing and data-entry as well as cross-pollination of data.

As a corollary to increased departmental accountability, the Data Bank department's responsibilities should be shifted slightly to include support of, and assistance to, other departments during the transition period. It is important that departments feel that the MIS is something that they helped create to fulfill their own particular need. Departmental managers should be part of the system design team to perpetuate ownership in the final product. All of these changes must be complemented by scheduled training to prepare personnel for the automation of the system.

5.5 SUMMARY OF RECOMMENDATIONS

Present Organization

a) EEA should appoint some outside directors with business and financial expertise who can be of assistance to EEA management in important commercial decisions.

b) Commercial operation at EEA will require that all current procedures be reviewed and significantly modified to establish a clear pattern of delegation and accountability. Areas such as procurement and recruiting of personnel The Vice Chairman, Zone Presidents, and Plant Managers should be given specific authorities with guidelines and ceilings. Such authorities should be consistent with policies formulated and amounts budgeted in the Business Plan with accountability for costs.

c) While a large number of technical oriented staff is not unusual in electric utilities, there is still the need for skilled administrators, accountants, economists, etc. as in every business enterprise. It is therefore recommended that in the future a more varied mix of professional backgrounds be represented among EEA's top management personnel.

Human Resource Management - Personnel Policies

d) Gradually reduce personnel by several measures including:

- Performing a study to determine the number of employees needed for each function;

- Freezing hiring for a set period of time, and thereby reducing total employment through attrition. New plants can be manned by transferring employees from existing facilities.

- Offering early retirement with full benefits;

- Making a special effort to train personnel in skills which are in demand in Arab countries. Training should include English, which is sought by most foreign firms operating in those countries;

- Encouraging or participating in Egyptian private companies that will bid for Operations and Maintenance contracts in the Gulf. Most of the government plants in Arab countries are operated by private firms for periods of 3 to 5 years. Egyptian companies with a qualified and well-trained personnel should have an advantage over foreign companies employing largely Asian labor;

Whatever cost of the above recommendations to EEA, it will be much less expensive than operating inefficient plants with high fuel consumption.

e) Such loans of personnel should be investigated in depth as a means to reducing excess personnel at EEA. However, it is recommended that EEA encourage and perhaps participate in the establishment of private Egyptian firms staffed by EEA-trained personnel which could bid for O&M contracts in the Gulf countries. This is potentially a more effective way of reducing excess personnel than loaning individual staff members, and it is also more lucrative for Egypt as a whole.

Training Programs

f) In view of the new policy of independence and financial profitability, it will be of prime importance to re-orient the management of EEA towards commercialization. This will require executive training geared toward the operation of a profit driven utility. Such training should also include fostering:

- electric utility management;
- a more customer-oriented attitude;
- a better understanding of the cost structure of EEA's operations; and
- the training of accounting and financial personnel should be given special attention. It should include the operation of modern accounting systems, computerization, and international financial issues such as foreign exchange, risks, foreign and international lenders' requirements, etc.

Compensation

g) Incentives and profit sharing should be increased at all levels in order to motivate personnel. These incentives, however, should be made commensurate with results and not distributed across the board.

h) The whole compensation structure should be overhauled and an effective system of incentives developed. This incentive system should be transparent and designed to reward productivity, initiative and overall contribution to profitability at both the departmental and overall utility levels. Individual initiatives which result in quantifiable cost savings should be adequately rewarded.

Management Information Systems

i) Increase divisional dependence on Computer-based operation by designing a phased transition plan to automate operations. This plan should be given a high priority and treated as a project with a responsible project manager to supervise its design and implementation. This plan should include extensive training especially to the department managers and supervisors.

j) Re-evaluate and revise divisional operational policies on the integration of manual and automated systems. Support and direction for this change should come from Deputy Chairmen through clear and unequivocal mandates to all departments within their respective divisions.

k) The data-entry and data-verification process should be incorporated into each department. Each department will then increase its staff by one or two or use one or two of its existing staff for data entry and verification. The departments should then be made accountable for the availability of accurate data on a timely basis.

l) Departmental Staff should receive specialized training on the benefits of an MIS system and how one is created. This training should be carried out by the Data Bank staff.

m) Linkage between Al-Ahram historical statistical consumption information and the Data Bank should be established to facilitate data flow between EEA and the distribution sector.

n) The proposed linkage of the Zones to the Data Bank is highly recommended to allow data flow from its source. It will allow EEA divisions to conduct their operations efficiently without delays caused by manual transfer of data or data discrepancy. Furthermore, it is also vital to allow cross-pollination of new data in the system to ensure consistency and accuracy.

o) The Financial Affairs and Accounting division should re-evaluate and revise its policy concerning integration of its manually-recorded and computer-generated records, and the organizational structure which it supports.

6 THERMAL AND HYDROELECTRIC GENERATION

This chapter discusses operational issues across the Egyptian Unified Power System (UPS), including aspects of both fossil-fueled and hydroelectric power generation. These operational issues include not only the actual running of the system, but also system inputs such as the characteristics and management of fuel and system constraints such as environmental regulation and the impact of irrigation water requirements on hydroelectric generation.

6.1 THERMAL GENERATION

6.1.1 Operational Parameters

The fossil-fueled power generation system of the Egyptian Electric Authority consists of 36 stations, including steam plants, simple cycle gas turbine plants and combined cycle plants, with nominal installed capacity of 8 821 MW. Thermal stations accounted for

GLOSSARY OF TERMS

Efficiency
The ratio of the energy produced by a unit (or station) and the energy contained in the medium (fuel, water, wind, etc) that propels the unit (or station). The calculations herein are based on net energy output. The higher the efficiency figure, the better the utilization of the input energy.

Heat Rate
The amount of thermal energy required to produce a unit of electrical energy (kWh). The calculations herein are based on net energy output. The lower the heat rate figure, the better the utilization of the input energy. It is a different way of expressing efficiency.

Nameplate Capacity
The capacity shown on the nameplate of each machine. The units used to express this capacity may vary, depending on the type of machine.

Nominal Capacity
The actual net capacity of a generating unit, when operating under specified conditions. It is the capacity shown in the EEA books. Usually it is the capacity as measured during the acceptance tests.

Capacity Factor
The ratio of the energy (MWh) produced by a unit in a given period, divided by the nominal capacity of a unit, multiplied by the number of hours in the given period.

Peak Load Factor
The ratio of the energy (MWh) produced by a unit (or station) in a given period, divided by the maximum load (MW) produced by the unit (or station) during the given period, multiplied by the number of hours in the given period.

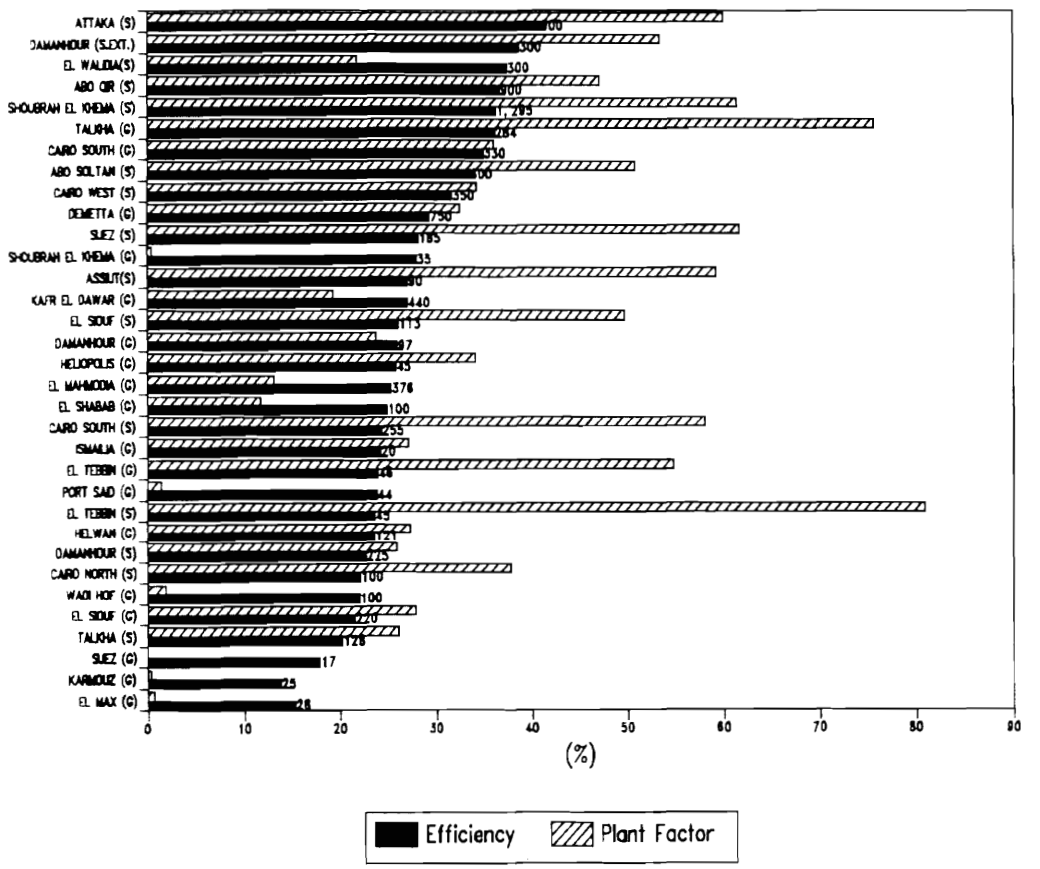
Plant Factor
The ratio of the energy (MWh) produced by a unit (or station) in a given period, divided by the unit (or station) nominal capacity (MW) multiplied by the number of hours in the given period. When the station has only one unit, it is equal to the capacity factor.

35 278 GWh out of a total 43 704 GWh of electricity generated in fiscal 91/92, representing 81% of the total electric energy generated and a 4.5% increase over fiscal 90/91.

Station sizes range from 17 MW (Suez gas turbine plant) to 1 260 MW (Shoubra El Khema), and commissioning dates range from the early 50's (Cairo North) to 1991 (El Walideia)[1].

Figure 6-1 shows station efficiencies in descending order and their corresponding plant factors (Please note that generation statistics were not available for the Talkha combined cycle plant for the 1991/1992 time period).

Figure 6-1 COMPARISON OF EFFICIENCIES AND PLANT FACTORS (91/92)
Rated capacity Shown for Each Station



[1] Arab Republic of Egypt, Ministry of Electricity, Egyptian Electricity Authority, "Annual Report of Electric Statistics 1991/1992".

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TABLE 6-1
RELIABILITY STATISTICS
1991/1992

	Nominal Plant Capacity MW	Station Average				Forced Outage Rate	Incapability Factor %	Avail-ability %
		Operating Time-h	Maintenance Outage Time-h	Number of Forced Outages	Forced Outage Time-h			
CAIRO WEST	350	11 555	1 755	19	788	6.4	17.2	82.0
CAIRO SOUTH (S)	255	15 035	1 728	10	781	4.9	21.4	85.7
CAIRO SOUTH (G)	330	9 192	1 641	17	1 641	15.1	18.3	81.7
CAIRO NORTH (S)	100	9 466	4 202	9	589	5.9	33.8	71.6
HELIOPOLIS (G)	45	12 119	321	26	389	3.1	39.1	95.2
EL TEBEEN (S)	45	16 055	708	23	390	2.4	6.3	93.7
EL TEBEEN (G)	46	13 056	1 482	21	2 055	13.6	30.6	79.8
HELWAN (G)	121	5 638	2 054	12	258	4.4	28.2	86.8
SHOUBRA EL KHEMA (S)	1295	15 086	1 907	16	551	3.5	14	86
WADI HOF (G)	100	2 593	0	1	49	1.8	9.3	99.7
TALKHA (S)	128	10 871	702	23	1 196	9.9	12.5	87.5
TALKHA (G)	284	15 429	492	12	206	1.3	4.3	95.7
DAMANHOUR (S)	225	13 601	1 100	45	2 337	14.7	25.2	79.8
DAMANHOUR (G)	300	4 827	510	3	61	1.3	3.3	96.7
DAMANHOUR (EXT)	97							
KAFR EL DAWAR	440	10 132	1 417	50	2 344	18.8	39.3	72.9
EL MAHMODIA (G)	376	3 429	369	2	114	3.2	6.6	97.2
DOMIAT (G)	750	6 081	1 634	5	656	9.7	17.2	82.8
KARMOUZ (S)								
KARMOUZ (G)	25	2 115	240	4	186	8.1	2.4	97.6

TABLE 6-1
RELIABILITY STATISTICS
1991/1992

	Nominal Plant Capacity MW	Station Average				Forced Outage Rate	Incapability Factor %	Avail-ability %
		Operating Time-h	Maintenance Outage Time-h	Number of Forced Outages	Forced Outage Time-h			
SUIF (S)	113	16 319	277	7	618	3.7	5.1	94.9
SUIF (G)	220	10 597	321	7	1 151	9.8	9.5	90.5
EL MAX	28	209	4 872	0	0	0	39.7	60.3
ABU QIR (S)	900	12 933	1 908	46	2 449	15.9	24.8	75.2
ABU QIR (G)								
ISMALIA (G)	20	6 918	1 634	5	656	2.9	1.4	98.6
SUEZ (S)	185	10 893	815	28	634	5.5	15.8	89.1
SUEZ (G)	17							
ATTAKA	900	15 680	1 152	28	590	3.6	9.9	90.1
EL SHABAB (G)	100	3 920	48	3	18	0.4	0.4	99.6
ABU SULTAN (S)	600	14 741	2 079	20	724	4.7	16	84
PORT SAID	44	1 795	7 139	3	95	5	41.2	58.8
ASSUIT (S)	90	15 123	1 088	23	1333	8.1	13.8	86.2
EL WALIDEIA	300	5 916	648	11	578	8.9	16.7	83.3

The nominal capacity of each station is also shown. It should be kept in mind that the plant factor takes into account also the normal degradation of the stations' output due to the gradual wear and tear that should be expected between overhauls. Statistics were not yet available for the Talkha combined cycle unit.

Ideally, under conditions of an ideal load curve, the most efficient machines should have the highest plant factor. However, conditions may be such that it is necessary to put other machines on line, even though this solution is not the least-cost one. For example, transmission network constraints lead to inefficient plant utilization by necessitating operation of the Tebeen, Siouf, Assiut, and Suez power stations. Should these constraints be eliminated, older units could be retired and newly rehabilitated ones could be kept in non-operating reserve status.

Figure 6-2 compares the peak load factors with the corresponding plant factors for each station, according to the EEA's "Annual Report of Electric Statistics 1991/1992". The nominal capacity of each station is also shown. As a rule, it would be expected that the larger units, which are usually the most efficient, should have the highest factors. If the peak load factor is higher than the plant factor, it means that the units have been operated above their nominal rating.

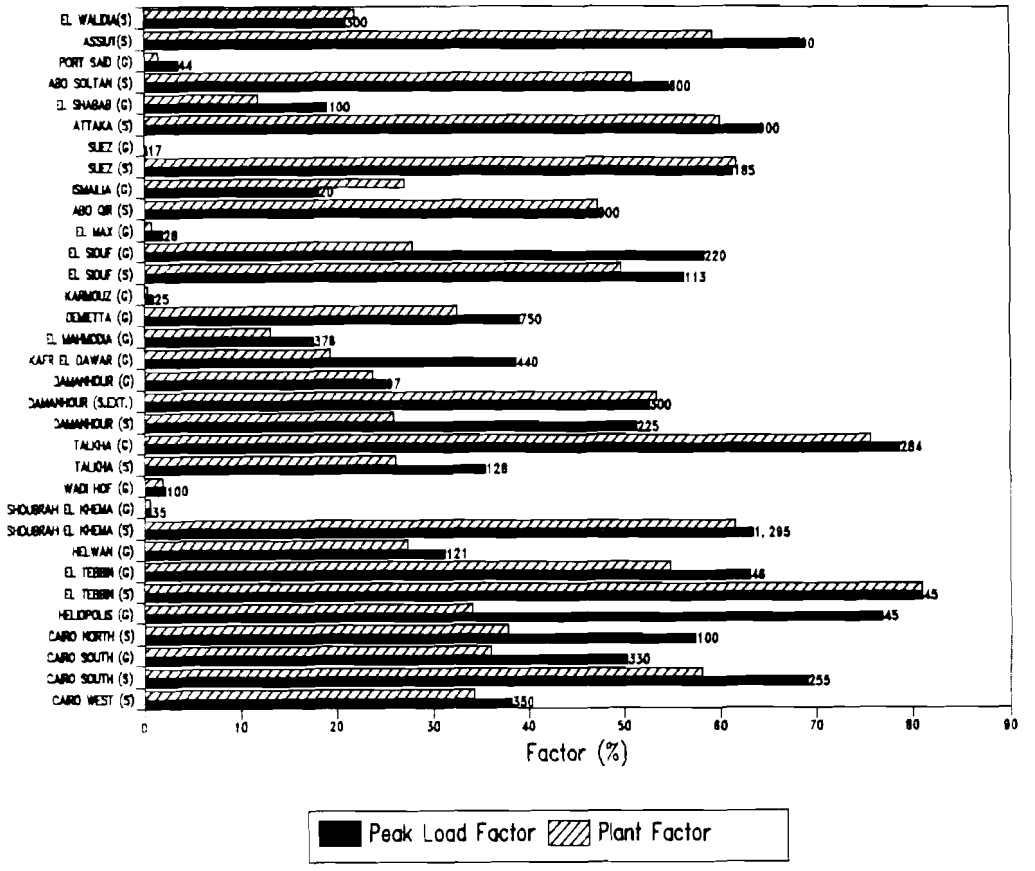
It should be pointed out that the efficiencies were calculated using the lowest of the fuel heat contents shown in Tables 6-2 and 6-3 (Section 6.1.9). Efficiency (figures) may therefore differ from similar published data computed using different calorific values.

6.1.2 Reliability

Table 6-1 presents reliability statistics for each of the units during the two-year period January 1991 through December 1992 (provided by EEA). Included are plant capacity, average station operating time, average station maintenance outage times and number of outages, average station forced outage times and number of outages, the forced outage rate, and incapability and availability factors.

The total time during the period was 17 544 hours. Average time of operation varied from 209 hours (El Max) to 16 054 (El Tebeen). The duration of maintenance outages ranged from 0 hours to 4 202 hours for Cairo North (commissioned in the 1950s). The number of forced outages varied widely from 0 to a high of 50 for Kafr El Dawar (1979, 1986 commissioning), with average duration of outages varying from 0 to a high of 2 448 hours for Abu Qir (1983, 1984 and 1991). In summary, the percentage of operating time displaced by forced outage time ranges from 0 for El max (no forced outages, but minimal operating time), to a high of 18.8 for Kafr El Dawar.

Figure 6-2 COMPARISON OF PLANT AND LOAD FACTORS (91/92)
Rated capacity Shown for Each Station



The incapability factor, the sum of the forced outage factor, the maintenance outage factor and the derating-adjusted outage factor, ranges from 0.4 (El Shebab) to 41.2 (Port Said). Conversely, the availability factor, the sum of the operating factor and the stand-by factor, ranged from a low of 58.8 (Port Said) to several units with highs over 97%: Wadi Hof, El Mahmodia, Karmouz gas station, Ismalia, and El Shebab.

6.1.3 Plant Efficiencies and Fuel Consumption

Figures 6-1 and 6-2 reflect the wide variation in plant factors and plant efficiencies. Fuel represents by far the largest portion of the cost of generating electricity and EEA in the past few years has undertaken a large effort to reduce fuel consumption, thus increasing plant efficiency, in various plants. Since the draft version of this report was issued in August, 1993, EEA has initiated measures to improve the fuel consumption and performance which include:

- changing the status of units (where possible) that have unreasonably higher average fuel consumption than the overall system average to from operating to non-operating reserve for emergency use;

- operating only one unit at Cairo North power station during staff relocation/retraining;

- taking action to alleviate network constraints;

- preparation of monthly performance indices and revising operation strategies accordingly.

As shown in the table in Supplement A at the end of this chapter, there have been recent (1992/1993) improvements in fuel consumption compared to 1991/1992, primarily due to increasing consumption by the more efficient units such as Demietta, Damanhour (ext), El Walidia and Talka combined cycle, and decreasing consumption by the less efficient plants such as the older units at Damanhour and Talkha, El Mahmodia and Helwan. However, none of these older units have been taken out of service. This effort should be pursued rigorously, especially as fuel prices charged to EEA are creeping up closer to the international price level.

Any reduction in fuel consumption and improvement in overall plant efficiencies achieved through effective integrated planning, heat rate improvement programs and load levelling would immediately translate into savings of millions of Egyptian pounds to EEA. This underscores the need for more consistent and accurate fuel metering and on-line monitoring of heat rates on fuel efficiency at all stations. Heat rate testing is not periodically performed at all of the thermal units. In many cases, only acceptance testing is performed without subsequent periodic follow-up performance testing over the remaining life of the unit. The Central Control center may not always have updated heat rate curves for all the thermal units. The methodology and consistency of testing on the units which are tested is also of concern. As units age and as parts or equipment wear, heat rates will decay. Only through frequent heat rate testing and performance testing on equipment and systems can plant management determine the true condition of their equipment. Furthermore, there cannot be effective economic dispatch without updated heat rate and incremental heat rate curves from each thermal plant. Heat rate testing should have the following characteristics:

- Consistency in testing criteria across the system as a whole

- Periodic performance at steady state conditions for at least 4 to 5 generation capacity levels, and for at least one to two hours

- Frequent and periodic fuel quality sampling should take place during testing to ensure the accuracy in the fuel heating value used

- All auxiliary power should be accounted for

- Twice yearly testing

- Testing should provide average heat rate curves, input/output curves, and incremental heat rate curves (In developing incremental curves, careful statistical curve fitting is required). Economic dispatching and marginal cost wholesale pricing are based on incremental heat rate curves.

- Testing results and data should be compatible with any system planning or integrated planning software required format. There should be coordination between the Central system planner and the plant engineer providing the data. The system planner must be fully aware of the meaning of the data, how the data was calculated, and its limitations. For example, if the heat rate data does not take into account auxiliary power, this is something that the system planner must know.

On-line monitoring should not in most cases depend on assumptions of fuel heating value. Because heating value varies directly with sulphur content, moisture, and other values, it must be accurately calculated to account for potentially wide variations. The Damietta power plant has an on-line heat rate monitoring which could set the standard for the rest of the system. It is only when plant efficiencies are known and can be compared unit to unit that proper capacity utilization can take place with the data also being integrated into the integrated planning process.

On-line heat rate monitoring can give instantaneous feedback on the fuel efficiency effect of any maintenance job. It can also provide trend analysis under which any degradation in heat rate can be dealt with through measures up to and including off line maintenance. On-line heat rate monitoring is a key component of any preventative maintenance program.

The on-line monitoring system employed at the Damietta Power Station exemplifies the type of monitoring which could be applied across the system. At this combined cycle facility, main-screen and sub-screen displays show graphical representations of key subsystems. Temperature, pressure, flow rates, and module efficiency are provided on a real-time basis. Additional analysis would be required to fully comment on this system and to isolate its limitations. However, it could be a starting point for implementing a consistent heat rate monitoring system for each of the thermal facilities. As indicated earlier, due to variability of fuel heating value, no heat rate monitoring system should be dependent on this variable as an assumption. Many U.S. monitoring systems have utilized a boiler efficiency assumption in lieu of a fuel heating value assumption. It is felt that boiler efficiency is a more reliable assumption than fuel heating value.

It is recommended that an on-line heat rate monitoring system similar to the one installed at the Damietta Power Station be applied across the system.

6.1.4 Maintenance/Preventive Maintenance/Spare Parts

Maintenance is the responsibility of each station superintendent. Accordingly, maintenance procedures vary from plant to plant. EEA faces dilemmas with regard to the procurement and inventory of spare parts which are exacerbated by certain characteristic local conditions such as: i) the large variety of equipment suppliers, many of which are from countries that are no longer active in the supply of the equipment or parts; ii) the lack of standardization of components (valves, motors, controls,etc.) or even of dimensional standards; iii) frequent restraints to the quick acquisition or importation of parts, which add to the time required to receive parts, and have a direct influence on the inventory levels which must be maintained; and iv) the absence of a tradition of financial evaluations of the feasibility of procuring costly spare parts to be kept as stand-by.

a) Maintenance and Preventive Maintenance

Operation and maintenance of the plants in the EEA systems varies significantly. Maintenance procedures and policies are not uniform from plant to plant. While such plants as Shoubra El Kheima and Attaka input all maintenance operations into the computer and have preventive maintenance programs, other plants such as Cairo South have just recently started to input maintenance data.

Regional centralization of maintenance crews, possibly stationed at a specific plant in a region, could improve both off-line and on-line maintenance for all plants within the region. Such an arrangement would reduce maintenance costs and shorten outage durations. This approach requires skilled personnel with updated training. Furthermore, the experience accumulated by a centralized maintenance group will greatly reduce maintenance costs and contribute significantly to any preventative maintenance program.

Even though numerous computer packages for maintenance have been available on the market for several years, the computerization of maintenance has been slow at EEA. For example: at the Shoubra El Khema plant, maintenance operations (including preventive maintenance) and spare parts control have been computerized since plant start-up; the South Cairo station computerized the maintenance procedures only (approximately) one year ago and is now in the process of computerizing spare parts control.

One of the current maintenance programs and its system classification format should be adopted and applied consistently throughout the system. The program at the Attaka Plant is a primary candidate for uniform application. This program is now in the early stages of implementation at the Abu Quir, High Dam and Damietta plants. While different manufacturers have supplied equipment to the various plants, a consistent system and subsystem classification methodology should be utilized regardless of the various

suppliers. For example, although the feedwater systems at various plants may have different pump suppliers, the feedwater system can be consistently classified for maintenance data input into the computer. This would be of great aid to any regional maintenance crew, to the overall preventive maintenance program, and to statistical comparisons between plants.

b) Spare parts

The process of determining the ideal inventory level of spare parts to be kept, considering the constraints mentioned above, is more a matter of subjective judgement than of precise technical considerations. Furthermore, there may be only a limited supply of people that are knowledgeable and experienced in the matter.

The current procedure for ordering spare parts is as follows:

- The power plant requiring the spare part(s) prepares a list identifying the quantities of the parts needed for maintenance, overhauling and/or repair.

- The request is then submitted to the zone head office, which in turn contacts qualified suppliers to obtain offers.

- After the offers have been received, the zone head office will review each request and when found satisfactory, will submit same to the High Purchase Committee in the EEA headquarters for review and approval. Once this approval has been obtained, the parts are ordered. This approval is principally a determination of the availability of funds. The Zone head office is responsible for the follow-up of the order.

- Upon arrival of the parts, they are stored in the warehouse of the power plant which requested them.

It appears that this process does not require the exchange of information with other zones that may be procuring similar parts for the same type of equipment. Coordination of this kind could lead to a wider selection of possible suppliers and to better utilization of available inventories.

It is recommended that a work group, including people from each Zone and Headquarters, be formed to: i) exchange experiences for the solution of maintenance and procurement problems; ii) establish criteria and medium term plans for the implementation of a process to standardize components of the stations; iii) identify those individuals who can contribute positively to the determination of inventory levels; iv) establish a program of computerization of maintenance and spare parts control for those plants that will ***not*** *be retired shortly; and v) establish mechanisms that will enable the plants to consult each others' (computerized) inventory records to bring about reductions in stocking levels and duplication.*

It is further recommended that a local manufacturing facility (or facilities) be encouraged to produce some of the required spare parts, possibly in association with the current suppliers, in order to support the overhaul process.

No evidence was found of a formal procedure to budget the procurement of spare parts to be used for routine maintenance or for overhauls as a recurring operating and maintenance cost. Also, we could not identify guidelines or policies, based on a comparison of acquisition and storage costs vs. cost of lost production, to determine when it would be economical to stock major and costly components.

It is highly recommended that EEA develop a budgeting and procurement system to anticipate the needs for spare parts and to expedite the procurement of the parts included in the budget.

Spare parts procurement should always be on a competitive bid basis, unless some incentive is provided by the supplier to be the sole source of parts.A competitive bid process, applied consistently across the system is essential for low-cost power production. The competitive bid approach could provide the incentive for suppliers to offer additional services such as the building of manufacturing facilities in Egypt and/or storing of spare parts at their facilities with no carrying charge applied to the cost of the part.

Experience in the U.S. has shown that the development of a spare parts program should always include input from plant maintenance personnel and planning personnel. This requires not just input from supervisory personnel but from mechanics, electricians, foremen, etc. In the final analysis these are the people that are the "customers" of the spare parts program.

6.1.5 Current Maintenance Management Systems at EEA

As mentioned above, a well planned maintenance management system has been developed and implemented at the Attaka and Shoubrah El-Kheima power stations. The computerized maintenance management system at Attaka currently performs the following functions:

- Computer support for all maintenance activities
- Processing all information required to support staff members in the performance of maintenance work (again, in the development of any such program, input from all personnel is required)
- Ensuring that all preventative maintenance is carried out in time sequence by the relevant personnel
- Keeping spare parts inventory in good order

- Evaluating the performance of different departments
- Predicting failures and minimizing forced outages
- Keeping and updating equipment histories

The system consists of the following subsystems of modules:

- Preventative Maintenance Module
- Spare Inventory Module
- Work Order and Procedure
- Documentation Module
- Corrective Maintenance Module

It appears the system at Attaka is a good starting point for the implementation of a uniform maintenance management system throughout EEA. The spare parts inventory module, in particular, should have the same coding and classification system as any regionally centralized spare parts manufacturing facility or warehouse when such centralized facilities come into existence.

One of the primary objectives of a maintenance management and preventative maintenance program is to ensure that optimization of low costs and performance and availability occurs. A key approach in achieving this objective is to extend the time between major outages while not compromising plant or equipment integrity. In order to accomplish this it is necessary to accumulate data on past/historical equipment failure rates and on-line sub-system fuel efficiencies to determine if degradation is occurring. Reliance on an artificial cap of operating hours prior to replacement of specific equipment may cause unnecessary expenditures. If such data as the following is kept and trended, the time between equipment replacement may be extended, or a major failure prevented, thus realizing significant savings on O&M expenditures:

- Boiler tube mapping
- Vibration monitoring of key components
- Oil temperatures
- Condenser backpressures

- Feedwater and turbine performance (efficiencies, temperatures, pressures, fouling, corrosion, scaling, etc.)

- Auxiliary power usage

- Cooling water consumption

- Boiler efficiency testing

- Mean time between failures for all key components

In addition, any equipment tracking program should be designed to assist plant personnel with maintenance information and inventory control. An ideal system should be on-line and menu-driven and include the following functional areas:

(a) Equipment Information System

The equipment system would use on-line processing to add, update, modify, and delete any information associated with the tracking of equipment maintenance. Each piece of equipment throughout the plant would be assigned an equipment specification tied to an account number. When a maintenance order is written against a piece of equipment and written to the file, the associated account number is pulled automatically from the equipment specifications.

(b) Downtime/Availability System

In this system records of unit downtime and availability would be collected and entered into the system. This information is then available for inquiry and analysis.

(c) Preventative Maintenance Program System

The preventative maintenance program would provide the user with information about the preventative maintenance activities against each piece of equipment. Preventative maintenance requirements such as frequencies and scheduling would be established depending on criticality of equipment. The program system would allow access according to:

- Preventive Maintenance (PM) Requirements

- PM Schedules

- PM man-hour summaries

- Delinquent/Outstanding PM's
- PM Backlog

(d) Maintenance Order Information System

Such a system would help manage the maintenance order backlog. The system would require adding maintenance orders along with estimated man/hours. In adding a maintenance order, the required input fields are unit and equipment number, priority, classification, crew code, request, require and schedule dates, and a description of work to be performed.

(e) Cost Information System

The system should provide the user with the ability to store, update, sort, and display maintenance cost information. This information would then be used to create cost summaries for equipment, systems, units, etc. This kind of cost information can be invaluable for marginal cost studies, power pricing, and integrated planning.

In view of the advantages associated with maintenance programming, we recommend that EEA consider selecting and installing a standardized Classification System and utilize the same nomenclature for plant systems and subsystems. Unless standardized classification systems are utilized, collected data is only of limited use since the data (and therefore experience) cannot be fully utilized by other plants for benchmarking, preventive maintenance and other purposes.

6.1.6 Plant Staffing/Personnel

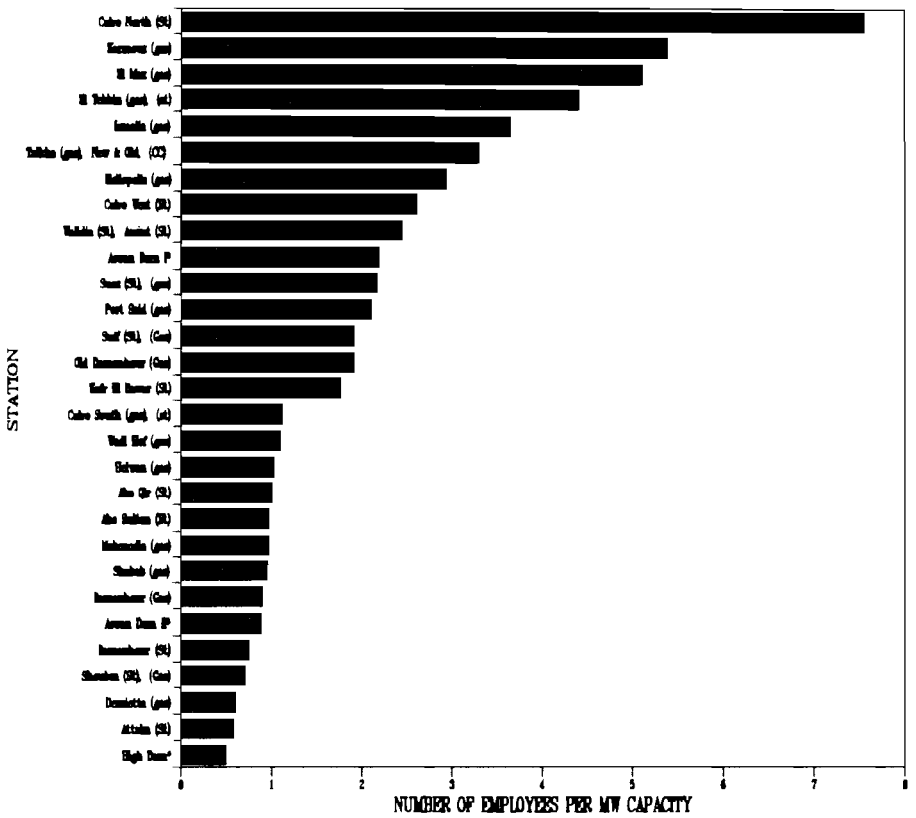
The number of employees on an employee/MW capacity basis varies considerably throughout the EEA system. This is true even for plants of similar design. The range is from 0.5 to 19.1 for the thermal units (Hydro units are shown with an asterisk on the figure). Figure 6-3 lists the plants and the employee per MW ratios. It is quite clear that for the types of plants under consideration, ratios on the high end of the range discussed above are perhaps needlessly high. A review was made of organization at the Attaka plant; the employee to MW ratio at Attaka is approximately one or less. Attaka's organization appears to be suitable and adequate, consisting of the classical support structures such as a separate operational, maintenance, planning and project engineering groups. A review should be conducted of all thermal plants to determine the reasonable ratio for the various facility designs. Comparisons of plant personnel numbers should include the following considerations: i) Plant design (e.g. simple cycle vs. combined cycle, etc.) and location, ii) Energy (MWh) generated; the more the generation the more maintenance and engineering required, iii) Number of units within a given plant, iv) Fuel type, v) Type of operation, (e.g., peaking vs. baseload); although a peaking facility may

have less hours of generation, if not properly designed for peaking, additional maintenance and engineering may be required, vi) Environmental controls, and vii) Centralized support facilities.

The objectives of any structural organization study should include: i) reducing costs, ii) the promotion of individual effectiveness,iii) wider communication between management and workers, iv) allowing worker input in policy development and procedural issues, v) the encouragement of worker leadership, vi) the encouragement of self-managed work teams, vii) facilitating operational/maintenance efficiency, viii) integrating maintenance, operations, engineering within individual units, thereby developing common and consistent goals, ix) the elimination of unnecessary management levels, thereby streamlining communication between management and workers, x) allowing operators to perform some minor maintenance jobs, thereby giving them more control over their systems and increasing their productivity, xi) allowing operational personnel to become more involved with preventative maintenance, xii) allowing operational personnel to become more involved with the heat rate testing of equipment and/or having heat rate engineers or fuel efficiency engineers be organizationally integrated into the operations group. Under such an arrangement the heat rate engineer becomes part of the operational "team" and is no longer perceived as some sort of "policeman", xiii) preventive maintenance is a proactive effort and therefore incentives for good performance are essential.

Promotion or rewards based on merit as opposed to seniority is an essential to solicit creative ideas and extra effort.

Figure 6-3 NUMBER OF EMPLOYEES/GENERATION CAPACITY RATIOS
Per Plant or Station Basis



6.1.7 Plant Personnel Training

EEA currently has a special department in charge of training programs that reports directly to the Vice Chairman of administration, Manpower and Training. As of 1992, EEA had established three training centers for engineers and technicians at Cairo North, Cairo South and Abu Quir. (Please see Appendix E)

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The Abu Quir Center is located on the Mediterranean, next to the Abu Quir Power Plant, 40 km East of Alexandria. This Center was established with the assistance of the British Government specifically for the training of EEA personnel for the O&M of power plants.

The training center carries out the theoretical and practical training in the field of power stations as follows:

- Operation and maintenance for power station mechanical equipment
- Operation and maintenance for power station electrical equipment
- Operation and maintenance for Control and Instrumentation
- Electronics and electronic devices
- Power plant training simulations

Apparently, the instructors at this training center have been trained in the United Kingdom and will be starting sometime in 1993. It was not clear at the time of this writing if the courses have begun.

It is recommended that in addition to the classical instructions to be provided at the Center future emphasis in the training of O&M personnel include the following: i) more emphasis on operational personnel performing small or routine maintenance items. This will provide additional "ownership" of systems and subsystems and reduction of maintenance costs, ii) more emphasis on operational personnel participating is preventive maintenance activities, iii) a closer coordination between operation and maintenance with regards to preventive maintenance and heat rate, and iv) operational training specifically oriented toward the type of plant (e.g. baseload vs. peaking).

Operational/maintenance personnel training for load following or peaking facilities would be more involved in such issues as: i) start up, load change, and shut-down frequency, ii) Target start up time, iii) Required minimum load, iv) Desired load change rate, and v) Temperatures [2].

[2] Each plant will be different. Instead of relying on a generic list, the operator/maintenance personnel training needs to emphasize what is going to happen to equipment at low load or start-up. Where are the highest thermal transients going to occur and will they be accompanied by high stresses and lower service lives? Water induction is major concern in the turbine. Concerns about overheating of tubes without sufficient flow, etc. Again, these are just a few of the issues that need to be emphasized in training plant workers.

6.1.8 Fuel Procurement

It should be kept in mind that fuel is EEA's largest single expense item, amounting to L.E. 801 million in 1991/92. Thus it is of utmost importance that the administrative systems used to determine fuel prices and the basis be as accurate as possible.

The issues to be resolved in the procurement of fuel are:

- Is the measurement of the fuel quantities correct?
- Does the payment for fuel include adjustments for heat content?
- Is the quality of the fuel received according to specifications?
- Are there administrative procedures to keep adequate accounting costs for the purchased fuel (these being very important if the heat content of different batches of fuel varies over wide margins)?

6.1.9 Characteristics of Fuels

Fuel sources for the thermal power stations in Egypt include mazout (heavy fuel oil), natural gas, solar and naphtha. In July 1991 through June 1992, natural gas represented 53.5% of the total amount of fuel used in electricity generation, mazout represented 46.3%, and other fuels totaled 0.2%. Current EEA policy is to maximize natural gas utilization by the thermal units in order to improve environmental performance and to save oil for export; recently, the natural gas percentage consumption has increase relative to the other fuels.

Typical analyses of natural gas are shown in Table 6-2 and of mazout in Table 6-3. The data for these tables were supplied by EEA testing laboratories.

(a) Liquid Fuel

Because the quantities of the other liquid fuels involved are relatively small, this discussion will be limited to mazout, the price of which is stated in terms of weight (L.E./tonne) {metric ton}. Recommendations are based on the assumption that the methods used at the Cairo South plant are typical, bearing in mind possible procedural differences in other plants. The procedure may be outlined as follows:

- The mazout is delivered to the power plant's 250-ton day-tanks through a pipeline 2-3 times daily. The volume of liquid delivered is measured before and after filling. Depth is measured by dipstick and graduated tape and the quantity read from tank calibration tables.

TABLE 6-2
TYPICAL ANALYSES FOR NATURAL GAS

Description	Sample 1		Sample 2	
	Volume %	Weight %	Volume %	Weight %
Propane	1.663	4.007	1.211	3.030
I-Butane	0.587	1.865	0.529	1.740
I-Pentane	0.203	0.800	0.165	0.680
Hexane +	0.000	0.000	0.138	0.670
CO_2	2.149	5.168	0.688	1.720
Ethane	5.908	9.708	4.117	7.030
Nitrogen	0.004	0.005	0.385	0.620
Methane	89.486	78.447	92.776	84.490
Molecular weight		18.301		17.570
Gross Heat Content		9 982 kcal/m³		9 545 kcal/m³
Net Heat Content		9 011 kcal/m³		8 677 kcal/m³
Density @ 60°F		0.774		0.742

TABLE 6-3
TYPICAL ANALYSES OF MAZOUT

Description	Sample 1	Sample 2
Specific Gravity at 15.5 °C	0.9333	0.9442
Flash Point °C	140	140
Fire Point °C	155	160
Viscosity Red 1 Sec at 100 °C	83	97
Sediments %	none	none
Water %	none	none
Ash %	0.06	0.05
Corrosion of Copper Tape	none	none
Residual Carbon	none	none
Heat Content - High kcal/kg	10 370	10 400
Heat Content - Low kcal/kg	9 851	9 842
Sodium (ppm)	10.19	3.4
Vanadium (ppm)	33.1	42.7
Calcium (ppm)	none	0.01
Lead (ppm)	0.01	33.6
Sulphur (ppm)	2.1	2.5
Asphalt	-	5.38

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- The specific consumption of the plant is calculated daily through the tank readings (329≈g/kWh).

Since the tanks are filled several times a day, there is not enough time for the fuel to settle and to attain a uniform specific density. In addition, impurities (especially water and sludge) are not allowed sufficient time to settle in the bottom of the tank and are fed to the boilers, reducing their efficiency.

The specifications EEA uses for mazout (see Supplement B at the end of this chapter) allow a density variation of 5%. Under this arrangement, depending upon the density-value used in weight calculations, the amounts paid to the mazout supplier are potentially incorrect by up to 5%. Revisions of EEA mazout purchasing guidelines could amount to saving of L.E. millions per year.

Whereas spot measurements of densities can be carried out using inexpensive equipment and relatively untrained personnel, there does not appear to be any simple and inexpensive equipment to monitor density continuously. Therefore, if the density of mazout delivered varies considerably it is necessary to implement a density sampling program (more frequently than the current periodic lab analysis). Since delivery of mazout to the largest users is via pipeline, it may be assumed that its flow is constant. Accordingly, a density sampling program based on taking samples at equal time intervals would be sufficient to ascertain the density weighted average.

Table 6-3 shows the heat content of two samples of mazout. It will be noticed that the heat content difference between these two samples is small. However, we have no means of knowing whether these samples are representative or not.

It is recommended that EEA investigate a large number of past mazout sample analyses in order to determine the uniformity of heat content.

The results of this investigation will show whether it will be necessary to increase the frequency of testing heat content.

The issue of heat content of mazout does not appear to be significant. Judging from the analyses of samples of mazout made available to us, the specific heat content does not vary over a wide enough range to merit corrections.

Based on the above observations it is recommended that a study be performed to determine whether the methods used to purchase mazout for power generation should be refined to reflect more accurately the characteristics and pricing of the fuel and to determines potential impact on all stations.

(b) Natural Gas

EEA purchases gas by volume. From analyses of samples of natural gas we have seen we can state that its heat content may vary considerably, which would affect plant efficiency and consequently the cost of operation.

Determining the heat content of natural gas using relatively inexpensive chromatographic equipment is relatively simple. Equipment that will take on-line samples automatically, analyze them, calculate their heat content, and compute the 24-hour average energy content is available. Alternatively, portable chromatographic equipment can be used to analyze samples. The frequency of testing should be determined based on the expected changes in the characteristics of the gas stream over time.

It is recommended that EEA survey its present natural gas heat content testing capabilities in order to determine what changes are required to allow comprehensive control of natural gas purchasing. This survey would also ascertain whether or not permanent testing facilities should be installed at the larger power plants.

It is recommended that an immediate investigation be started to determine the expected differences in the heat content of the natural gas purchased by EEA in order to determine if the initiation of negotiation to adjust natural gas prices according to heat content is justifiable.

Indications are that EEA accepts that the measurements of the volume of gas delivered by the gas supplier's meters are correct. Generally there is no check metering - an exception to this being the Cairo South plant, where each of the three gas turbines has its own meter, as well as the quantity for total consumption. An agreement exists between the EEA and the Gas company that states that i) EEA does have the right to witness gas meter calibration by the Gas company, and ii) EEA has the right to review and approve the gas quantities billed; however, this is not sufficient to ensure accurate measurement.

An accepted wide-spread utility practice is that duplicate metering should exist at all delivery points of large blocks of energy (gas, liquid fuel or electricity itself) and that the contracts for these supplies should include a thorough description of how the energy is going to be measured and of how to treat possible discrepancies between the indications of the two metering systems (see Supplement C at the endo of this chapter, a sample fuel sales agreement for a private power project).

It is recommended that a study be carried out to determine if the methods used to measure gas are adequate and to establish what improvements, if any, are required.

6.1.10 Automatic Generation Control for Generation Plants

The EEA National Energy Control Center (NECC) has system control and data acquisition (SCADA) facilities which would permit it to remotely operate some of the equipment in the system. Provision has also been made to add these functions to most of the remaining equipment. However, most of the operations are performed by local operators, in accordance with instructions received from the NECC. Not all major units are equipped with Automatic Generation Control (AGC).

In order to maximize unit efficiency and therefore system efficiency, AGC should be installed/operated on all high load factor units.

The installation of AGC at all units would provide the following benefits:

- AGC contributes to least cost dispatching of units to assure the system is operating at minimum cost.
- AGC contributes to leveling of load throughout the system generation units
- AGC is invaluable in marketing wholesale power to other countries or systems
- AGC can set ramp rates for units such that the units which are designed for higher ramp rates can be utilized for peaking duty.
- The AGC system can prevent units from ramping too quickly which could cause thermal/mechanical damage to units over a period of time.
- AGC aids in quick and rapid response to emergency conditions, for example, by maintaining control of non-affected units while the problem is being addressed.

6.1.11 Demand Side Management

A demand side management (DSM) project is underway at EEA and is receiving continued support. The project centers around improving energy conservation and efficiency at industrial sites and large institutional buildings. However, additional equipment, such as load records, is required. The benefits of DSM are:

- Improvement of efficiency among energy customers
- The reduction of loads, or the shifting of loads to off-peak hours.
- Significant aid to the development of least-cost planning approaches.

Furthermore, from a power plant point of view, DSM has the following additional advantages:

- Through load shifting power plants are loaded in the off peak hours thereby reducing "cycling" of peaking or intermediate facilities. Cycling can cause above normal thermal and mechanical wear and tear costs. Thus DSM can save on maintenance expenditures through proper load shifting.

- Through load shifting to off-peak hours plants which normally run at low capacity during off-peak hours are now run at higher loads, and therefore higher fuel efficiencies.

- DSM can help postpone the building of new generation facilities thus saving or postponing capital expenditures.

Most of the above discussion applies to thermal units but is also applicable to hydroelectric facilities.

6.1.12 Environmental Issues

Egypt's environmental protection laws are currently being strengthened. Furthermore, GOE has developed a new environmental action plan.

EEA has been obligated to comply with the various GOE environmental regulations issued by various ministries. However, as in the last 15 years most of the new power plants as well as the upgrading and rehabilitation of the older ones has been financed by foreign bilateral or multilateral financing agencies, EEA has been required to build its plants to meet the environmental regulations followed or adapted by foreign organizations such as the USAID, U.S. Environmental Protection Agency (EPA), and the World Bank (IBRD). In general, the plants were designed to meet whichever regulation is most stringent.

(a) Water Quality

As most of the plants are cooled by water supplied by the Nile river directly or indirectly (through canals) EEA is required to conform to the regulations of the Ministry of Health as to water quality. Therefore, all wastewater has to be segregated by quality and processed through a wastewater system.

(b) Air Quality

Here again, EEA has been required to conform to GOE regulations or those followed or adapted by foreign organizations, for example, the USAID, EPA and IBRD, whichever is more stringent. The following

Table 6-4 compares the various environmental requirements applicable to EEA.

TABLE 6-4 AMBIENT AIR QUALITY STANDARDS mg/m^3 (mg/ft^3)				
Pollutant	Period	Quality EPA	Criteria World Bank	Ambient Air Egypt
Sulfur Dioxide	Max. Annual.	80 (2.3)	100 (2.8)	60 (1.7)
	Max. 24 Hrs.	365 (10.3)	500 (14.2)	200 (5.7)
Suspended Particulates	Max. Annual.	75 (2.1)	100 (2.8)	-
	Max. 24 Hrs.	260 (7.4)	500 (14.2)	150 (4.2)
Nitrogen Oxide	Max. Annual	100 (2.8)	100 (2.8)	-

Recently built plants are equipped with air quality monitoring stations. Compliance with air quality standards have been easier to achieve as EEA increases its use of natural gas as a fuel source.

(c) Noise Levels

The most recent plants are designed so that individual pieces of equipment produce a maximum sound level of 90 dB(A) at a distance of 1.5 m from the equipment outline. This sound level has been further reduced to 85 dB(A) at the Kureimat power plant.

It is recommended that EEA continue its conformity to environmental protection regulations, and upgrade its older plants to bring them in line with these regulations. Should the cost of improving some of the older plants prove to be uneconomical, further consideration should be given to accelerating their retirement.

6.2 HYDROELECTRIC GENERATION

The hydroelectric generation capacity of the Egyptian Electricity Authority consists of three stations: Aswan I, Aswan II, and the High Dam. The Public Works and Water Resources Ministry (Ministry) determines the daily amount of water that can be released from the High Dam. EEA is allowed to determine the dispatch schedule of the hydro stations in order to obtain the best mix of hydro and thermal generation while meeting the water release guidelines established by the Ministry. EEA's operation policy in this regard is as follows:

"The system is operated in the most economical manner to meet the system load and reserve requirements within the constraints imposed on the system by utilizing the hydro resources to the maximum extent to level the thermal generation and consequently minimizing the thermal production cost."

All authority and responsibility for the two dams and reservoirs resides with the Irrigation Ministry and includes the operation and regulation of the reservoirs, and monitoring the hydrology of the watershed. The Ministry is also responsible for dam safety, including authority over the civil works of the powerhouses, intakes, tunnels, and outlet works. Any required repair to a concrete structure, such as the piers at the intake structure, must be coordinated through the Ministry.

6.2.1 Operational Parameters

Table 6-5 shows the principal characteristics of the three existing hydroelectric stations.

TABLE 6-5
CHARACTERISTICS OF ASWAN STATIONS

Station	Years Built	Unit Number	Total MW	Plant Factor - %	Peak Load Factor -%
Aswan I	1960	1-2 3-9	23 322	39	52
Aswan II	1985-86	1-4	270	65	67
High Dam	1967-70	1-12	2100	40	48

In additional, the Esna project, a run-of-the-river low head hydroelectric station, is currently under construction at the Esna Barrage, approximately 140 km north of Aswan. The plant capacity will be approximately 96 MW, and is scheduled to be commissioned by the end of 1993.

Generally, the daily operation of the three Aswan generating stations is as follows:

(a) Each day the Ministry notifies the High Dam station of the required total water release for the next 24 hour period. Releases range from a high of 230×10^6 m^3/day (equivalent to a total daily generation of ≈ 42.3 GWh, of which ≈ 31.5 GWh are produced by High Dam and ≈ 10.8 GWh by Aswan I+II) during the irrigation season to a low of 80×10^6 m^3/day during the winter (equivalent to a total daily generation of ≈ 14.8 GWh, of which ≈ 11.0 GWh are produced by High

Dam and ≈ 3.8 GWh by Aswan I+II). Annual average daily release is 155×10^6 m^3/day (equivalent to a total daily generation of ≈ 28.5 GWh, of which ≈ 21.2 GWh are produced by High Dam and ≈ 7.3 GWh by Aswan I+II).

(b) The High Dam calls the central Load Dispatch Center in Cairo and informs them of the water available that day for generation. The Dispatch Center then determines a generation schedule for the day.

(c) Typically, four or five units at the High Dam run as base load units for 24 hours. For the evening peak load, as many as 10 units will be put on line for up to 8 hours. For 340 m^3/sec flow through each turbine, the release from the station varies from 118×10^6 m^3/day (four units, producing 700-MW) to 294×10^6 m^3/day (10 units, producing 1750 MW). These flows do not include cooling water release and leakage.

(d) The High Dam turbines release into a re-regulating lake formed by the Aswan Dam. The re-regulating lake has approximately 3 meters of depth for storage, containing about 30×10^6 m^3.

(e) The Aswan I and II stations operate as base load stations, discharging a constant release each day from the re-regulating lake. About 40% of the available water is allocated to Aswan I, which has a hydraulic capacity of 113×10^6 m^3/day (345 MW). The remaining 60% is allocated to Aswan II which has hydraulic capacity of 100×10^6 m^3/day (270 MW). Hydraulic capacity out of the re-regulating lake, therefore, is 213×10^6-m^3/day (615 MW).

(f) For peaking operation, utilizing 10 units at the High Dam, approximately 9 hours of storage exists in the re-regulating pond. Pond volume is therefore not a constraint if the necessary peak generation period is less than the stated time period. For operation at full capacity with 12 units, the amount of storage time available drops to approximately 5 hours. However, there are normally only 10 units available, with 2 units out of service for repair or maintenance.

(g) The total annual water yield from the Nile watershed is approximately 85 billion cubic meters per year, of which it is reported that 18 billion cubic meters is allocated to Sudan, leaving 67 billion cubic meters of water. Egypt currently uses about 55 billion cubic meters for irrigation, all of which is available to pass through the turbines at the High Dam and either Aswan I or II.

From 1982 to 1989, a severe drought occurred in the Nile watershed and stored water in Lake Nasser was used to supply irrigation and power demands. Consequently, the lake dropped more than 20 meters. This drop adversely affected power production from 1986 to 1989 due to the reduced head available, and loss in production of almost 30% took place. However, the water throughput

at the generating stations remained constant as the reservoir was drawn down, and the generation at Aswan I & II was not affected.

6.2.2 Operational Constraints

The constraints that the Dispatch Center must adhere to for the daily regulation of the hydroelectric stations are:

(a) The total daily discharge from Aswan I and II covers the irrigation requirements; High Dam discharge is dependent upon the level of the lake between the two dams. Such discharge has to be fixed on a per-hour basis.

(b) The re-regulating pond above Aswan I and II must be kept within a 3-meter operating range to avoid under-loading the turbines or spilling water.

(c) Hydro and thermal units availabilities.

(d) The maximum number of units that can be on-line at the same time must comply with the transfer capability of the 500 kV transmission system and stability considerations. Previously this requirement limited the number units that could be on-line in High Dam to 10, but improvements in the relaying and speeding-up of the corresponding circuit breakers has obviated this need and now the full output of the plants can be transmitted.

The assigned transfer capability and determination of stability conditions of the 500 kV lines falls under the jurisdiction of the NECC. No stability study was found to indicate that the plant statistical analyses have been modified accordingly; the Plants continue to consider that the maximum transfer capacity limit is the output of 10 units (instead of the existing 12) and, consequently, their statistics, including plant factors, are still stated in terms of the transfer capability available prior to the modifications performed to the 500 kV circuit breakers and protective relaying.

6.2.3 Reliability and Rehabilitations

Hydroelectric plants can usually operate within their rated water throughput even if some of their units are not in service due to maintenance or rehabilitation work. Furthermore, hydro units can be shut down for minor maintenance and be restarted in a matter of minutes - this not being the case with thermal units which require several hours, and even days, to be shut down or restarted, in order to avoid thermal shock to the equipment or to build up steam pressure. It is not unusual, for example, for two of the units at the High Dam to be out of service for maintenance or major repairs.

The following is a summary of the major rehabilitation work performed in the Aswan area over the past ten years:

(a) Aswan I - Units 3 and 4 received new turbine runners and governors in 1980. A contract has been let to rehabilitate units 3 to 9 by 1995 (rewinding and insulating the stators and rotors, replacing the mechanical governors with electronic governors, installing new motor control panels for the intake gate actuators; new generator bearings; surfacing and general maintenance of the turbines; and cleaning and resurfacing of the wicket gates and shafts).

(b) Aswan II - The only major work undertaken was the replacement of the thrust bearing of unit 4.

(c) High Dam - All the turbine runners and governors have been replaced within the past five years, due to deterioration of the runners. Electrical replacement work has been or is being performed to the excitation systems, and the circuit breakers at generator voltage and 500 KV. A contract has been let to rehabilitate the intake and tailrace gates, guides and seals.

Upgrades are planned, but not yet funded, for the control room, SCADA and the communication system.

6.2.4 Maintenance and Preventive Maintenance for Hydroelectric Plants

Maintenance scheduling is determined each December for the coming year by the Plant Manager in conjunction with the Load Dispatch center. The scheduling is responsive to the irrigation season flows when generating capacity must be highest. Scheduled maintenance is also sensitive to the outage and event history of the previous year.

6.2.5 Spare Parts for Hydroelectric Plants

The spare parts needs of hydroelectric plants differ considerably from thermal plants. Because wear and tear is not usually as pronounced as in thermal plants, hydro plants require comparatively few spare parts and consumable. However, when components do need to be replaced, their cost can be extremely high. Civil structures generally constitute the major maintenance item in hydro plants. However, their maintenance is currently the responsibility of the Ministry.

Because of the age of Egypt's hydro plants and the source of their component parts (the former Soviet Union) {High Dam Only}, spare parts may not be widely available. This has resulted in the need to replace equipment (such as the full governor systems) rather than repair it. In some cases, it is more expedient to build the spare part locally.

6.3 SUMMARY OF RECOMMENDATIONS

a) Consistent monitoring of fuel consumption and periodic testing of heat rate at all plants.

b) Adoption of a uniform preventive maintenance program for all plants. The system presently introduced at the Attaka plant is the primary candidate.

c) Training of personnel should be expanded to emphasize preventive maintenance programs.

d) Continue enforcement of environmental protection regulations and upgrade older plants to bring them in line with those regulations. Should the cost of improving some of the older plants prove to be uneconomical then further consideration should be given to accelerating the phasing out of such plants.

e) A work group including people from each Zone and Headquarters should be formed to:
   i) exchange experiences concerning solutions to maintenance and procurement problems;
   ii) establish criteria and medium term plans to standardize station components wherever possible;
   iii) identify individuals that can contribute positively to the determination of inventory levels;
   iv) establish a program to computerize maintenance and spare parts control for plants that will **not** be retired shortly; and
   v) establish mechanisms that will enable plants to consult each others' (computerized) inventory records in order to reduce stocking levels and duplication.

f) A budgeting and procurement system should be established to anticipate the need for spare parts and speed-up the procurement of parts that have been included in the budget. Local manufacturing facilities should be encouraged to produce some of the required spare parts, possibly in association with the current suppliers, in order to support the overhaul process.

g) The methods used to purchase mazout for power generation should be refined to more accurately reflect the characteristics and price of the fuel.

h) An immediate investigation be initiated to determine expected variations in the heat content of the natural gas purchased by EEA. So that negotiations to adjust the price of this gas according to its heat content can be pursued.

i) A study should be carried out to determine if the methods used to measure gas are adequate, and to ascertain what improvements are required.

j) EEA should survey its present natural gas heat content testing capabilities in order to determine what changes are required to allow comprehensive control of natural gas

purchasing. This survey would also ascertain whether or not permanent testing facilities should be installed at the larger power plants.

k) It is recommended that EEA investigate a large number of past mazout sample analyses in order to determine the uniformity of heat content.

l) To maximize unit efficiency and therefore system efficiency Automatic Generation Control should be installed and operated on all units.

Chapter 6, Supplement A
COMPARISON OF GENERATION AND TOTAL FUEL CONSUMPTION

NAME OF PLANT/STATION	GROSS GENERATED ENERGY (M.K.W.H)		FUEL CONSUMPTION (EQ. MAZOUT 1000 TON)	
	91/92	92/93	91/92	92/93
Cairo West	1114.6	1119.690	289.5	297.154
Cairo South (S)	1376.6	1114.398	467.0	376.287
Cairo South (G)	1943.4	1370.933	286.6	414.874
Cairo North (S)	349.2	337.925	131.1	116.147
Heliopolis (G)	137.4	15.399	45.3	7.162
El Tebeen (S)	340.0	280.140	117.9	97.411
El Tebeen (G)	221.0	210.177	80.0	82.769
Helwan (G)	296.8	40.751	103.2	17.430
Shoubra El Khema (S)	7278.7	7078.670	1671.4	1784.7
Wadi Hof	17.1	46.109	6.7	19.452
Talkha (S)	330.8	205.746	125.2	72.033
Talkha (G)	1905.7	1774.013	450.7	493.114
Talkha Expansion	-	125.983	-	35.036
Damanhour (S)	562.7	351.359	117.1	112.341
Damanhour (G)	206.7	33.375	68.5	12.510
Damanhour (EXT)	1455.9	1617.810	332.8	390.266
Kafr El Dawar	820.6	951.890	240.8	270.482
El Mahmodia (G)	433.9	85.546	147.7	34.305
Domiat (G)	2173.8	5085.320	632.7	1175.343
Karmouz (G)	1.3	2.189	0.5	.789
Suif (S)	532.5	496.565	164.6	159.298
Suif (G)	540.0	442.826	219.8	177.638
El Max	2.0	1.357	1.2	1.021
ABU QIR (S)	3949.4	3735.346	873.8	906.482

NAME OF PLANT/STATION	GROSS GENERATED ENERGY (M.K.W.H)		FUEL CONSUMPTION (EQ. MAZOUT 1000 TON)	
	91/92	92/93	91/92	92/93
Ismalia (G)	47.5	15.894	19.6	7.626
Suez (S)	1061.3	834.277	310.8	253.474
Attaka	4975.6	4655.549	1127.2	1040.235
El Shabab (G)	104.6	9.447	36.9	3.711
ABU Soltan (S)	2887.8	2878.910	728.8	729.585
Port Said	5.9	6.607	2.3	2.518
Assiut (S)	511.4	485.504	150.9	143.194
El Walidia	591.6	1200.837	134.1	270.193

Chapter 6, Supplement B
DESIGN AND OPERATING CONDITIONS
MAZOUT ANALYSES

Specific Weight (15 C)	t/m^{3o}	0.945 0.990 max
Viscosity Ri 37.8°C	Secs	1500 * (winter) max. 2000 ** (summer) max.
Freezing temp.	°C	13 max.
Flash Point PMC	°C	65 max
Ignition temp.	°C	70 min.
Moisture	%	1.0
Ash	%	0.1
Sulphur	%	2.5 max.
Sediment	% Wt	0.25 MAX.
C (carbon)	%	85.9
H (Hydrogen)	%	10.8
Oxygen	%	not present
Nitrogen	%	not present
Vanadium	ppm	50-150
Sodium	ppm	5-40
Cross Calorific Value - Calculated	KJ/kg (Btu/lb)	43,500 (18,700)
Gross Calorific Value - minimum	KJ/kg (Btu/lb)	41,875 (18,000)
Net Heating Value	KJ/kg (Btu/lb)	39,776 (17,100)

(*) Winter from 1st of November to end of March
(**) Summer from 1st of April to end of October

Note: The fuel oil Ultimate Analysis heating value shall be taken as 43,500 KJ/kg (18,700 Btu/lb). The minimum value of 41,875 KJ/kg (18,000 Btu/lb) shall be the value used in sizing all related equipment and systems associated with the fuel oil systems. The steam generator shall be capable of generating full capacity when burning the minimum heating value oil.

Chapter 6, Supplement C
BROAD ELEMENTS OF A FUEL SUPPLY AGREEMENT

The Fuel Supply Agreement (FSA) constitutes one of the key contractual documents of the Security Package. This agreement provides assurance for the reliable supply of a specific quantity and quality of fuel at an agreed upon price.

The price of the fuel is usually passed through into the tariff representing approximately forty to fifty percent (40% -50%) of the tariff. If the fuel is imported, the fuel supplier may be a private company or a consortium of private companies that may be part of the Sponsor Group and may also participate as shareholders upon the foundation of the Project Company. Pricing is usually negotiated between the Government as power purchaser and the fuel supplier. In most instances a "Supply-or-Pay" basis backs the Fuel Supply agreement with performance guarantee incentives.

The principal issues typically addressed in Fuel Supply Agreements include:

1. Conditions Precedent;

   Once the Implementation Agreement has been executed the FSA usually becomes effective.

2. Purchase & Supply of Fuel;

   The Supplier and Purchaser agree upon the amount of fuel to be purchased subject to the invoicing procedure, the delivery schedule subject to available transportation capacity and expected future demand, and the ordering procedures and responsibility for cancellations or shortfalls.

3. Related Facilities Necessary to Implement Delivery and Receipt of Fuel;

   The Fuel Purchaser Company must guarantee storage facilities for efficient receipt of fuel delivered. The nature of the project environment may also necessitate transportation infrastructure development to reliably deliver fuel. In this instance either the Fuel Supplier or the Project Company may undertake the development of such facilities.

4. Pricing;

   Fuel price increases are usually indexed and passed through the Energy Component of the tariff. Additional charges may reflect the cost of maintaining delivery systems as well as duties and taxes on fuel particular to the project country.

5. Invoicing and Payment;

Procedures for invoicing and receiving payment are outlined and in many instances an escrow is used to facilitate transfer of funds.

6. Quality of Fuel;

The quality of fuel is of particular concern as heat rate guarantees imply penalties for the Fuel Purchaser for failure to generate guaranteed net outputs of electrical energy. It is therefore in the interest of the Fuel Purchaser to require stringent testing to insure adequate fuel quality and establish a transference of the risk associated with failure to deliver acceptable fuel by penalizing the Fuel Supplier.

7. Measurement of Quantity Delivered;

Duplicate metering from "Point of Supply" to "Point of Delivery" is required. The cost of installing and maintaining meters (depending upon type of fuel) must be delineated and procedures for ascertaining the accuracy of meters rigorously defined. Records of both point of supply and delivery amounts must agree within acceptable "discrepancy bands". If a discrepancy exists and the matter cannot be reasonably resolved it may be referred to expert adjudication. The procedure for maintaining records, installing and removing seals, as well as inspecting and testing meters must be divided between Supplier and Purchaser.

8. Consents;

The Purchaser will be required to obtain all licenses, authorizations, and permits necessary to take receipt of the fuel as will the Supplier for delivery of the fuel.

9. Maintenance & Repair;

Scheduled and unscheduled maintenance programs must be agreed upon and allowances made for the upkeep of the delivery systems as well as storage facilities.

ADDITIONAL CLAUSES ARE AS FOLLOWS AND ARE STANDARD TO ANY CONTRACT

10. Force Majeure
11. Liquidated Damages & Indemnity
12. Term & Termination
13. Adjudication Procedures
14. Governing Law & Arbitration

7 TRANSMISSION SYSTEM

7.1 DESCRIPTION

The transmission system of the Egyptian Electricity Authority (EEA) consists of all the lines, substations, power transformers, circuit breakers, relays and associated equipment in operation in the voltage classes of 500, 220, 132 and 66 kV. Included in these are step-up transformers with a low voltage to match the generators', and step-down transformers whose low voltage is 12 kV.

GLOSSARY OF TERMS

Active Power
The component of power that produces measurable work. It is measured in watts. It is absorbed by the resistive component of the load.

Load Flow
The flow of active and reactive power in an electrical system, at any one given time.

Reactive Power
The component of power that, vectorially, is at right angles to the active power. It is absorbed by the capacitative or inductive component of the load.

Transient
An unusual, short duration, circumstance in a power system that affects any of the operating parameters.

Stability
The ability of a power system to react to transient conditions without any of the generators pulling out of synchronism.

At the time of preparation of this report data were available for the fiscal year 1991/1992. At that time, the descriptions and approximate lengths of the transmission lines were:

(a) 1 617 kilometers of double circuit 500 kV lines extending from the Aswan High Dam substation to the Cairo 500 kV substation by way of the Nag Hamadi, Asyut and Samalut substations.

(b) 5 560 kilometers of 220 kV lines mostly in the Cairo, Alexandria, Middle Delta, West Delta and Canal Zones.

(c) 2 231 kilometers of 132 kV lines, located in the Northern Upper Egypt and Southern Upper Egypt zones.

(d) 6 106 kilometers of 66 kV lines located in all zones except Cairo.

Each zone is responsible for the operation and maintenance of equipment installed within it.

7.2 TRANSMISSION PLANNING

Transmission planning is a centralized function carried out by the Directorate of General Network Planning Studies, Research and Development Sector.

Transmission planning studies are performed by the Directorate's staff and outside consultants. The studies carried out by EEA use digital computer simulations of load flows, transients, state stability conditions and short circuits. Least cost comparisons are made of technically acceptable alternative plans in order to select the lowest cost plan.

Transmission system planning additions are heavily dependent on the location and sizing of new generating stations. Special needs such as high voltage interconnections to neighboring countries also influence future transmission plans.

The operative criteria for transmission planning reliability are shown in Table 7-1. It should be noted that these criteria can be expected to result in very high reliability, since in Egypt the incidence of electric discharges (lightning) is nearly nil (except in the Cairo/Delta area where the isokeraunic level is a very low 5 -- in other areas, at similar latitudes, this level can reach 50-70). Thus lightning, one of the largest contributors to transmission systems' faults, is not a significant factor in Egypt. The other important contributor to transmission systems' faults is contamination of the insulators. In Egypt, the main manifestation of this difficulty is dust build-up on insulators strings, encouraged by early morning moisture that leads to tracking and insulation flashover.

TABLE 7-1
CONTINGENCIES AT DIFFERENT VOLTAGES

Voltage kV	Description
550	One element out of service and a single phase fault on another element followed by a successful breaker reclosing
220	Any two elements out of service at the same time
66	

The requirement is that under the stated reliability criteria, the whole electric system must remain stable, with no component of the system loaded more than 110% of its nameplate rating for more than 2 hours, and with no voltage below 90% of normal.

Similarly, there are requirements that the short circuit ratings of the circuit breakers not to be exceeded, and that sufficient reactive power be available at strategic locations, so as to insure that active power can be transmitted within acceptable voltages.

System stability is studied and modifications to the protection (relaying) systems and circuit breakers are specified, if needed, as a component of the planning process. It is interesting to note that several years ago there was a general outage of the whole system due to unstable conditions originating near Aswan. These conditions were corrected by installing adequate relaying and increasing the operating speed of some circuit breakers.

No evidence of insulation coordination studies having been carried out was detected.

7.3 EXPANSION OF THE 500 kV SYSTEM

The decision to construct the 500 kV loop around Cairo was made in order to ensure that:

- The output of the latest large generating plants (Shoubra El Kheima (4x315 MW) and El Kureimat (2x600) MW) could be transmitted to the 220 kV network through several 500/220 kV substations, without overloading the 220 kV system.

- The short circuit level was decreased, and exceeding the rating of many circuit breakers was avoided be sectionalizing the Cairo 220 kV system.

Plans are underway to extend the 500 kV system East of Cairo, from the Abu Zaabal substation to a new Suez substation by 1995, and from this new Suez substation to Taba substation, in 1996.

Steps are also being taken to build an interconnection from the Taba substation with Aqaba, Jordan through an underwater 400 kV transmission link across the Gulf of Aqaba. This interconnection will eventually permit power transfers of from 500 to 600 MW between Egypt and Jordan. It is scheduled for completion in 1998.

Expansion of the 500 kV system by around the year 2000 is also planned North and West of Cairo to the new Sidi Krir generation station. This line extension is part of the proposed expansion of the Sidi Krir generation station by the addition of two new 300 MW generators. A June 1992 study entitled "Techno-Economic Feasibility Study" recommended interconnecting the new Sidi Krir units to a new 500 kV substation tied to a 220 kV substation through two new 500 MVA transformers.

It is recommended that EEA reconsider its decision to build 500 kV lines and substations between Cairo and Alexandria as part of the planned expansion of Sidi Krir power plant, with the addition of two 300 MW units (Numbers 3 and 4). It appears from the network studies that the existing 220 kV facilities will deliver this additional power with only a small short time limitation on the maximum generation possible at Sidi Krir under a double line outage condition. This decision would postpone a very large capital expenditure for several years. This matter is discussed in more detail in Chapter 9.

7.4 EXPANSION OF THE 220 kV SYSTEM

EEA is planning considerable additions to the 220 kV transmission in the next 5-10 years. These lines are primarily to deliver new generation capacity to the load centers, but also to accommodate increasing loads, especially in the Cairo, Delta and Canal zones. These additions are related to the potential system generation expansion plans.

7.5 EXPANSION OF THE 132 kV SYSTEM

The 132 kV system between Upper Egypt and Aswan is unable to carry the increasing load in the region. To solve this problem EEA plans to construct several new 220 kV line segments in the area, and tie them to the 220 kV Cairo system. They will also be tied to the 500 kV system, if required.

7.6 EXPANSION OF THE 66 kV SYSTEM

The 66 kV transmission lines are planned and constructed for new loads as needed. They are operated radially with switches available between circuits for transferring loads when necessary.

7.7 DESIGN CHARACTERISTICS OF THE 500 kV SYSTEM

The 500 kV transmission lines are constructed on double circuit steel towers. They consist of 3 - 500 kcmil Aluminum Conduct Steel Reinforce ACSR conductor bundles per phase, with two ground wires on the tower top for shielding. The right-of-way is 25 meters on each side of the tower center line.

The present design of the 500 kV transmission substations consists of a double bus, double breaker scheme with transformer capacity installed to provide 110% loading on peak with one transformer out of service. The 220 kV side of these substations uses a double bus single breaker design, or a double bus one and one half breaker. This design provides for great flexibility in switching and is one of the schemes which results in maximum service reliability and continuity.

It is recommended that EEA study the use of less expensive substation designs, such as ring bus configurations, for its 500 kV substations, and continue investigating insulator cleaning methods with the equipment energized. This would reduce the need for SF_6 gas-enclosed substations.

The transfer capacity of the lines from Aswan was increased recently to 1600 MW by speeding up the reclosing of the 500 kV breakers after faults. This measure also increased system stability.

7.8 DESIGN CHARACTERISTICS OF THE 220 kV SYSTEM

The 220 kV transmission lines generally consist of two 400 kcmil ACSR conductors per phase with two three phase circuits per steel tower. The thermal rating of these conductors is 480 MVA per circuit. The right-of-way of these circuits is 25 meters to each side of the tower center line.

The 220/66 kV substations use double bus single breaker or one and one half breaker schemes on the 220 kV side, and double bus single breaker schemes on the low tension (66 kV) side. Where pollution is very heavy or space is limited, Sulfur SF_6 gas enclosed busses and switchgear are used. Older breakers which are inadequate to withstand the fault currents presently obtainable have been identified and are being replaced.

It is recommended that EEA change its policy and initially reduce the quantity of transformers installed in each substation until such time (probably many years) as the 66 kV transmission system is not able to carry the load from adjoining substations.

7.9 DESIGN CHARACTERISTICS OF THE 66 kV SYSTEM

Several designs of 66 kV lines are used, depending upon local requirements and the age of the lines. One design specifies 66/11 kV substations with double bus, single breaker schemes on high tension (66 kV) side of the transformer, and single bus, single breaker schemes on the low tension (12 kV) side of the transformer.

The substation transformers are standardized at 25 MVA. Table 7-2 shows the relationship between the load and the quantity of transformers used. It should be noted that the smallest substation installation must have at least two 25 MVA transformers. This provides 100% backup for any transformer in any substation, but results in most transformers being underloaded (which increases losses and does not provide for a good return on the investment).

TABLE 7-2
QUANTITY OF TRANSFORMERS USED IN 66/12 kV SUBSTATIONS

Load Range - MW	Quantity
< 25	2
26-50	3
51-75	4

It is recommended that EEA change its policy and initially install only one 25 MVA transformer in each substation until such time (probably many years) as the 11 kV distribution system is not able to carry the load from adjoining substations. The same logic should apply when considering the addition of the third and fourth transformers in these substations. There are

about 30 projects which would be affected by this change in the next seven years, representing 750 MVA of indefinitely delayed transformer installations.

It is also recommended that EEA consider developing a program to identify under-loaded transformer capacity on its system with the objective of moving such excess transformer capacity to areas of higher loads in order to better utilize the existing capacity and reduce the need for purchasing new transformers.

7.10 FORCED OUTAGES

The forced outage performance of the EEA transmission system during 1991/1992 was very good. The following outage rates were observed:

- One 500 kV system line segment was forced out for 0.30% of the total time, or 26.3 hours.
- One 220 kV system line segment was forced out 0.82% of the time, or 71.8 hours.
- One 132 kV system line segment was forced out 0.003% of the time, or 2.6 hours.

7.11 RIGHT-OF-WAY OF TRANSMISSION LINES

While the transmission lines have been granted a right-of-way, there may be legal questions as to their validity when they cross arable land. This matter cannot be pursued until the legal structure of EEA is clear.

The main implication of this issue is that in many areas EEA's mechanized equipment cannot gain access to the area below the transmission towers, preventing the insulators from being washed from ground level.

7.12 MAINTENANCE OF THE TRANSMISSION SYSTEM

Maintenance of the transmission system is the responsibility of each zone where the corresponding equipment is installed.

7.12.1 Transmission Line Maintenance

The main activities to be carried out with transmission lines are: i) insulator cleaning; ii) the elimination of right-of-way encroachment; iii) tower painting and repair; and iv) the repair of structural damage produced by accidents and other causes outside the control of the utility.

(a) Insulator cleaning - EEA currently cleans the transmission line insulators by de-energizing the segment of the line to be washed and having workers climb the tower to wipe the insulators. In some areas with high contamination or dusty conditions this process has to be carried out as often as several times monthly. The problem of insulator flashovers is especially acute when the rains come in November.

In the past, attempts were made to mechanize insulator cleaning (by using trucks which can throw a jet of water from ground level). However, this type of cleaning has not been performed lately due to: i) the right-of-way problems mentioned above, and ii) EEA has had difficulties in specifying line-washing equipment and vehicles that would fulfill the requirements of all Zones.

It is recommended that EEA encourage the development among Zones of common specifications for equipment, tools and construction materials.

The drawbacks of de-energizing lines are that: i) reliability concepts consider that de-energization of a line segment is equivalent to a fault in the line; if another fault occurs in the system at the same time, reliability criteria may have been exceeded and an outage may occur; ii) while a segment of a line is out of service, it may be necessary to increase the loading of other segments, thereby increasing system losses; and iii) if lines are de-energized some segments of lines can no longer carry the output of the most efficient generators, and the load might have to be supplied from less efficient machines.

It is understood that EEA and Electricité de France (EdF) are working together to implement mechanized insulator washing programs and that a training center has been set up in the Delta region.

(b) Encroachments on Rights-of-Way - Often people will build unauthorized structures below the transmission lines, necessitating eviction proceedings to have these structures removed. We noticed several instances of encroachments in the Delta region.[1]

It is recommended that EEA implement a patrolling system in order to identify obstructions to the right-of-way and remove them before they become very difficult to overcome.

(c) Bad contacts or broken strands in the conductors can cause hot spots or radio interference. These situations can be detected by patrolling the lines and using equipment that can recognize the existence of undesirable conditions.

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[1] A patrolling system is being implemented to identify obstructions in the right-of-way.

It is recommended that EEA initiate procedures to detect not-spots or production of radio interference by patrolling the lines with infrared and radio-frequency detection equipment.

(d) Tower painting and repair - Due to the climate in Egypt and with the exception of areas near the sea, corrosion is not a problem. Accordingly, tower painting and repair need not be frequent.

(e) Structural damage produced by accidents - the two main causes of this damage are: vehicles hitting the structures and terrorism. The first cause is not prevalent in Egypt because most transmission lines run perpendicular to the highways. The second source may be a possibility, but is beyond the scope of our work.

7.12.2 Other Transmission Equipment

The only obvious problem our inspections showed was very audible corona losses at the 500 kV substation at the Aswan High Dam. We were informed that the source of these losses can be identified by infrared test equipment which has already been ordered but that there were delays in establishing the financing for it.

No problems were reported concerning the maintenance of transformers, circuit breakers, switchgear, switches, structures, and other components of the transmission system.

7.13 SUMMARY OF RECOMMENDATIONS

a) EEA should reconsider its decision to build 500 kV lines and substations between Cairo and Alexandria as part of the planned expansion of Sidi Krir power plant, by the addition of two 300 MW units (Numbers 3 and 4). Based on network studies it appears that the existing 220 kV facilities will deliver this additional power with only a small short time limitation on the maximum generation possible at Sidi Krir under a double line outage condition. This decision would postpone a very large capital expenditure for several years.

b) EEA should study the use of less expensive substation designs, such as ring bus configurations for its 500 kV substations, and continue investigating methods for cleaning insulators while the equipment is energized.

c) EEA should reduce the number of transformers installed in each substation until such time (probably many years) as the 66 kV transmission system is <u>not</u> able to carry the load from adjoining substations.

d) EEA should initially install only one 25 MVA transformer in each substation until such time (probably many years) as the 11 kV distribution system is <u>not</u> able to carry the load from adjoining substations. The same logic applies when considering the addition of third and fourth transformers to these substations.

e) EEA should consider developing a program to identify under-loaded transformer capacity on its system with the objective of moving such excess transformer capacity to areas of higher loads.

f) EEA should encourage the development of common specifications for equipment, tools, and construction materials across Zones.

g) EEA should implement a patrolling system to identify obstructions to the right-of-way and remove them before they become very difficult to overcome.

h) EEA should initiate procedures to detect hot-spots or production of radio interference by patrolling the lines with infrared and radio-frequency detection equipment.

8 CUSTOMER SERVICE OPERATIONS

8.1 DESCRIPTION OF CUSTOMERS

EEA does not have retail customers, Its output is purchased by several large industries and the eight Distribution Companies (EDCOs). Table 8-1 (next page) shows the grouping of these customers and their relative consumption of energy in the 1991/92 fiscal year. Only the customers having consumptions equivalent to those of the smallest EDCOs have been shown individually in the tabulation.

It should be noted that the Cairo EDCO represents one third of the energy load and that the Aluminum Company's load approximates that of Alexandria.

The tariffs applicable to thirty five (35) out of the forty one (41) EEA customers are based on a flat energy charge. Thus metering and invoicing are relatively simple because they can be based on the addition of readings from normal kWh meters, despite the fact that there may be several points of delivery for each user.

The six (6) customers in the Medium Voltage range are served under tariffs which have a demand (kW) component and an energy (kWh) component. If any of these customers were to have more than one delivery point, and if accurate demand billings were to be obtained, it would be necessary to use totalizing metering equipment, which is relatively more expensive and requires more maintenance than energy meters.

GLOSSARY OF TERMS

Corona Losses
Losses due to the ionization of the air surrounding conductors with a high electrical field. These losses are dependent on weather, atmospheric pressure, conductor configuration, etc.

Remote Terminal Unit (RTU)
A device that converts analogue or digital signals produced by the equipment of an electrical system, in a format compatible with communication facilities, that can be transmitted to (or received by) equipment at a remote location. Usually RTUs are needed at both ends of the communication lines.

Shunt Losses
Losses due to the impedance to ground of the components of an electric system. The main contributors to these losses are the insulation impedance of the transmission lines and the magnetizing currents in transformers. Shunt losses vary with the applied voltage but are independent of load

System Control and Data Acquisition (SCADA)
The software and hardware to control an electric system remotely and to acquire data on its status

Transmission System
The aggregate of the transmission lines, substations and other ancillary installations. The definition of the boundaries of the transmission system may vary from utility to utility.

Voltage Categories
Are general groupings showing ranges of voltages. These groupings may vary from utility to utility. In transmission and distribution, EEA uses the following categories: i) Very High Voltage (VHV) = 500 kV, ii) High Voltage (HV) = 220, 132 and 66 kV, iii) Medium Voltage (MV) = 11 kV, and iv) Low Voltage (LV) = less than 550 V (mainly 380 and 220 V)

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TABLE 8-1
EEA CUSTOMERS AND THEIR RELATIVE ENERGY CONSUMPTION

Category of Customer	Quantity	Percentage of Total Energy
Very High Voltage	9	16.5
Aluminum	1	7.5
Kima Fertilizer	1	4.1
Other Industries in Group	7	4.9
High Voltage	18	5.6
Industry	16	3.9
Agriculture & Government	2	1.8
Medium Voltage	6	0.6
Distribution Companies	8	77.2
Cairo	1	33.3
Alexandria	1	8.2
North Delta	1	6.2
South Delta	1	6.3
El Behera	1	3.9
El Canal	1	8.4
North Upper Egypt	1	5.4
South Upper Egypt	1	5.5
TOTAL	41	100.0

8.2 LOSSES

Table 8-2 (next page) shows the energy produced, sold and lost in the EEA system during fiscal year 1991/92. The percentages of each energy component are stated in terms of both net generation and total sales.

The data in the table differ somewhat from the equivalent information contained in the 1991/92 EEA annual report. This is because we used audited figures which were published after said report was prepared.

TABLE 8-2
SALES AND LOSSES

		Percentages In Terms of	
Description	Energy	Net Generation	Total Sales
Generation	GWh	%	%
Gross Generation	45 482	104.07	111.49
Generation Losses	1 777	4.07	4.36
Net Generation	43 704	100.00	107.14
Sales			
Very High Voltage	6 741	15.42	16.52
High Voltage	2 304	5.27	5.65
Medium Voltage	236	0.54	0.58
Distribution Companies	31 512	72.10	77.25
Total Sales	40 793	93.34	100.00
System Losses	2 911	6.66	7.14
Sales + Losses	43 704	100.00	107.14

EEA's system losses are experienced mainly in the transmission system (and its associated transformers). In transmission, the determination of losses is subject to relatively large errors because the loss in a line is often considerably less than the precision tolerance of the meters used. It should be noted that an error of 1% in the calculation of the losses corresponds to the output of a 60 MW generator! Thus, it is prudent to devise other means to check independently if the recorded data are acceptable. A common method of carrying out this check is by means of load flow studies which calculate the losses during system load levels that simulate the actual loading during the daily load cycle. When performing such simulations, it is very important to take into account two categories of "shunt" losses: i) the transformers's no-load losses (which usually account for a significant proportion of the total losses), and ii) corona losses, especially in the very high voltage lines. Traditionally, "shunt" losses are not included in load flow studies.

EEA's Planning and Economic Studies group has performed several simulations which showed that the most pessimistic loss level should be approximately 5.2% of net generation (5.5% of sales), as compared with the 6.7% obtained from statistical data. Since the difference between

the results is appreciable, it is prudent to analyze the weaknesses of either method and pin-point areas where corrections can be introduced to reduce the existing discrepancies. It cannot be claimed that either set of results is free of fundamental imperfections, thus the limitations of each system are analyzed below.

8.2.1 Load Flow - Simulation

The Load Flow simulation is only as good as the assumptions of the variations of each individual load in the various scenarios that are synthesized. Whereas it is recognized that the typical loadings that are selected should be representative, there will be times when these assumptions are not correct. However, the ensuing discrepancies should be very minor because each of these loads is only a small part of the total.

8.2.2 Load Flow - Transmission Lines Disconnected

In the Load Flow simulation it is quite difficult to represent the conditions under which some transmission lines may be out of service for relatively short periods of time (as occurs when a transmission line is de-energized to clean its insulators), and during which the losses may be slightly larger than usual.

On the other hand, there are many potential sources of errors in the determination of the consumptions and losses statistics. Among them are:

8.2.3 Metering Errors

These may be caused by:

- Inaccurate meters - It is reported that EEA uses meters with a great variety of accuracies, ranging from 0.5% to 2.0%. Since each meter measures a considerable amount of revenue each year (many times the cost of a meter), *it is recommended that EEA establish a program to replace most of its existing electromechanical meters with high precision (less than 0.5% error) multifunctional electronic meters.* It should be stressed that the readings from transducers used in System Control and Data Acquisition (SCADA) systems are not usually accurate enough for billing purposes. One advantage of multifunctional electronic meters is that they are adequate for revenue billing and simultaneously can be used as transducers or Remote Terminal Units (RTU) for SCADA systems.

- Errors in the metering installations - Some causes of these errors may be: i) meters out of calibration (usually because of infrequent, or insufficient periodical calibration programs), ii) slow reading meters (this is caused by wear and tear or dirt entering the meter bearings), iii) wiring mistakes (very frequent, especially if a wide variety of meters are likely to be used),

iv) partial equipment failures, such as burnt-out meter coils or short-circuited turns in current transformers, that are not readily apparent because they affect only a part of the devices' output, v) worn out or misoperating calibration standards (this is more apparent with electromechanical standards, which are incapable of withstanding rough usage while being transported from site to site), and vi) inability to replace inoperative equipment due to budget limitations.

It is strongly recommended that EEA appraise the adequacy of the existing meter installation testing programs and initiate, if needed, procedures to inspect and revamp all of them. A paramount consideration of this reappraisal should be whether the responsibility of inspecting the metering installations should be centralized or not (bearing in mind that it is a very specialized process, requiring very well trained specialists and sophisticated equipment).

8.2.4 Administrative Errors

Administrative errors can be caused by:

- Inaccurate meter readings - This should not be a significant problem, because it should be assumed that only well trained technicians are assigned to these duties.

- Meter readings taken at the wrong time - An important feature of the meter reading program is that all meters, including those used to record generation, are read at approximately the same time (many utilities insist that <u>all</u> meters be read within 5 minutes of midnight of the last day of the month). It should be stressed that variations of a few days in the reading cycle will have a significant effect on monthly losses calculations (for example, a three day variation represents 10% of the month), but will not influence the yearly figures as much (for example, 3 days are less than 1% of a year).

8.2.5 Point of Measurement

Even though the contractual documents for a customer may state that the delivery point is on the High Tension (HT) side of the respective transformer(s), practical considerations may dictate that it would be less costly to install the instrument transformers on the secondary (Low Tension (LT)) side of the transformer(s). Thus the measurement of energy delivered to the customer will include the transformer losses, but these data do not appear in the corresponding statistics.

It is recommended that EEA survey the location of the instrument transformers used to measure the delivery to its customers, and determine if it coincides with the respective contractual documents.

8.3 APPLICABLE TARIFFS

The tariffs applicable to the EEA direct customers were modified on July 1, 1992. The modifications were carried out to increase the tariffs in accordance with the steps agreed upon with the World Bank. Simultaneously with the increase, the structure of the tariffs was simplified and unified, reducing the differences of prices between customers within the same category.

TABLE 8-3
TARIFFS APPLICABLE TO EEA DIRECT CUSTOMERS

Old Structure		New Structure		Increase
Description	P/Kwh	Description	P/Kwh	%
1 Very High Voltage		1 Very High Voltage		
Kima	1.70	Kima	4.70	176.5
Aluminum	4.60	Other Consumers	6.80	47.8
Ferrosilicon	5.27			17.9
Other Customers	6.32			7.6
2 High Voltage		2 High Voltage		
All Consumers	8.07	All Consumers	11.34	40.5

Table 8-3 shows the old and new tariffs corresponding to the Very High Voltage and High Voltage EEA customers.

EEA and the Holding Company for Construction and Distribution of Electric Power (HCCDEP) periodically negotiate the price per kWh that HCCDEP will pay EEA for the total energy delivered to the EDCOs. This price is not necessarily tied to the actual costs incurred by EEA to produce the energy. HCCDEP and the EDCOs, in turn, agree on the tariff that will be applied to each EDCO, in accordance with the ability of each of the companies to obtain revenue from the particular mix of customers they serve. At the end of the period of applicability of the tariffs, adjustments are made to take into account any differences between the forecasted and actual sales, and revenues for each EDCO.

The above process of assigning different purchased energy prices to each EDCO amounts to having the customers of some individual companies subsidize other companies. The implications of these subsidies will be discussed in detail in the report pertaining to the EDCOs.

8.4 SUMMARY OF RECOMMENDATIONS

a) EEA should consider replacing most of the existing electromechanical meters with more precise multifunctional electronic meters.

b) EEA should appraise the adequacy of the existing meter installation testing program and initiate procedures to inspect and recondition all of them as needed.

c) EEA should survey the location of the instrument transformers in the customer metering installations to insure that they measure the energy delivered at the highest tension point of the power transformers.

d) It is important for EEA to become more customer-oriented. Therefore, we believe that it is essential to create a customer service department designed to meet the needs of the 42 EHV and HV customers. This department's duties would include:

- maintaining close, frequent contact with the customers, and identifying their problems;
- assisting customers with their forecasts, thereby providing better inputs to EEA's planning; and
- developing new approaches to tariff structures and service that will benefit both EEA and its customers.

9 EXPANSION PLANNING AND FORECASTING

9.1 INTRODUCTION

Electric utility forecasting and system expansion planning is the process of first determining the need (or not) for new facilities and procedures in the future, and then finding the "best" way to serve that need. The best way of fulfilling future requirements is usually expressed in terms of "how much" (quantity) and "what kind" (features) of the facilities and procedures are needed to accomplish this objective function--while attaining the greatest net benefit (or incurring the least cost).

Of course, although the planning process should be essentially continuous in order to be most accurate and effective, it is usually centered around making only the very next decision which may be required. Once that decision is fixed, the planning inputs and future time horizon are recalibrated to include it as a given for the next decision analysis (in a subsequent time period). In addition, to the extent that any of the decisions which have already been made may still be amenable to modification in the future (for example, changes in size, timing, and/or other characteristics), such flexibilities should always be properly represented and considered a part of the continuing planning process.

Forecasting activities are concerned with projecting power usage patterns and quantities, as well as the future costs and technological characteristics of candidate facilities and procedures. These projections, along with a description of the starting point or initial conditions of the analysis, allow the derivation of alternative future plans of action. These plans of action are then evaluated using pertinent decision criteria in order to find the best combination of quantities and features which comprise the resultant plan.

To perform power system forecasting and expansion planning various models are used to represent situations and facilitate calculation of the quantitative factors needed to simulate and analyze alternatives. Details on the modeling considerations applicable here are covered in section 9.2. The need projection (load forecast) is then discussed in section 9.3, and expansion planning itself in section 9.5.

Finally, it is acknowledged that any decision making activity which involves human sensitivities as well as the inherent presence of economic and technical uncertainties and constraints must incorporate subjective judgments to some extent. Thus, the existence and effect of such factors are discussed in section 9.6.

9.2 MODELS USED FOR FORECASTING

Ideally the best, or optimum, expansion plan could be calculated in a single use of some comprehensive master model. Conceptually this would be one computer program which would represent the entire power system in sufficient detail from fuel source to end user, and also automatically perform the optimization of some user-specified objective functions.

However, such a one-step model does not exist today -- nor is its practical development foreseen in the near future. Thus, load forecasting (including Demand Side Management (DSM)), generation expansion, and transmission planning are currently done separately and sequentially with largely manual iterative techniques, and are then used to appropriately reconcile and integrate the results of those three major activities.

Given a suitable data base and the accurate representation of the utility system's present and future components and performance characteristics within the models used, reasonably optimal plans can be derived by experienced and skillful practitioners -- if the available models are correctly used and the results properly interpreted. Further, if the approach for deriving the plans is robust (that is, if the pragmatic effect of uncertainty is also an integral part of the modeling and decision making process) then the plans will be in a sense even better than some single inflexible theoretical optimum. This is because they will, in retrospect, most economically and reliably provide the load under a plausible range of input data assumptions -- and hence be more likely to capture in advance the simulation of eventual future conditions.

It has been found that the EEA is in possession of load forecasting, generation, and transmission system expansion planning models. For example, EEA has the following current versions of models for system expansion planning: i) WASP and EGEAS (automated new unit selection programs) for generation, ii) PSSE (load flow/stability/fault analysis), and iii) EMTP (electromagnetic transients simulation) for transmission. The remaining question, therefore, is are the models being properly applied?

Beyond the obvious needs to input accurate data, activate the appropriate program options, and suitably analyze the resultant output information, the most significant challenge in this process is to correctly integrate the generation plan with the transmission plan. This is critical in order to obtain the overall optimum plan (that is, the sum of the DSM, generation, and transmission expansions taken together is optimum rather than just one or the other by itself), and to maintain cohesion and consistency between different facets of the plan (that is, to ascertain the inherent technical and economic feasibility of the total system).

In summary, it has been have found that the EEA has some of the needed tools with which to do this work, and that they appear to conscientiously go about trying to integrate the necessarily piece-wise analyses in order to yield a suitably integrated optimum plan. However, some remaining disconnects are present versus real life -- due to subsequent unanticipated changes in some of the input assumptions which have not yet been fully reflected in the pertinent parts of the plans they have previously derived. These findings are described and discussed in detail below.

The models that are used for forecasting, or which are available to forecasters at EEA are very few. They are:

9.2.1 Econometric models

Econometric models are the primary forecasting tool. They have been developed "in house" and are described further in the text.

9.2.2 Load profile model

The Annual Peak Profile Analysis (APPA) model is used to convert hourly load data into typical load shapes. Once energy and peak demand have been forecast, load shapes can be applied to determine hourly loads that are likely to occur in future time periods. The APPA model came to EEA in 1989 through ESB-Ireland, as part of EEA's DSM program. The APPA model is extremely difficult for EEA to use. There are no graphics capabilities, and data must be re-entered into a Lotus spread sheet to obtain load shape graphs. There is very limited ability to extract data for specific periods for special analysis.[1] The user's manual which came with APPA is so poor it provides little guidance in using the model. Indeed, the model was not usable until one of the EEA staff members was able to read and interpret the underlying FORTRAN code.

9.2.3 End-Use

Some of the documents about forecasting at EEA state that there is an end-use model available for forecasting. While EEA staff are acquainted with the model, it has not been fully utilized due to lack of sufficient input data. The model was developed by Stone and Webster and, as end-use models go, it is a rather small, spread-sheet-based model. Nevertheless, all end-use models are very demanding of data that are hard to come by in Egypt. End-use models require data on appliance penetrations, efficiencies, rates of use and building types. They also require considerable detail on household composition (for residential applications), commercial customer types and space occupied (for the commercial sector), rates of investment in new equipment, replacement of old equipment and many other factors. None of this information exists in Egypt. Comprehensive information of this type is very time consuming, expensive and difficult to come by. It is not likely that EEA will have information of this type available for many years.

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[1] Extracting loads for specific periods is important for developing "typical" load shapes from historical data. Data from several years and for specific periods are normally compared and aggregated. Periods of interest include typical week days, system peak days, holidays, and so forth. Load profile models must be flexible enough to allow the user to extract the periods of interest. This is particularly important where major events do not occur at the same time each year. Events such as religious holidays and time of system peak are particularly important to analyze separately.

9.2.4 Growth-Rate-Specific Consumption (GRSC) model

The GRSC model is mentioned in some of the reports on forecasting in Egypt. The GRSC is a means to extrapolate past electricity consumption into the future using only information on past growth rates. The model was created by ESB-Ireland, and is entirely empirical. That is, it does not contain any theoretical link between electricity consumption and factors that may influence it. The model seems to have been created to extrapolate for short-run purposes. (i.e., one or two years) It requires that many arbitrary judgements about parameters be made by the forecaster. While the GRSC model has been run by EEA forecasters, it plays no role in the production of the official forecasts.

9.2.5 Regression Analysis for Time Series (RATS)

RATS is referred to as a "model" in some of the EEA forecasting documents. However, RATS is not a model per se. Rather, it is a statistical software package designed to deal with time series data. RATS is used at EEA to do the statistical analyses required to produce statistical estimates for the econometric models that are used in forecasting. It is a fairly standard statistical package that is used elsewhere for similar purposes.

As mentioned in Section 9.4, great improvements in related forecasting techniques were introduced in 1992.

9.3 METHODOLOGY USED FOR LOAD FORECASTING

The methodology for forecasting at EEA has at its center the development of a series of econometric forecasting equations which produce sectoral energy forecasts. The logic surrounding the forecasting procedure is as follows.

9.3.1

Data on energy consumption and numbers of customers by major customer class have been collected for the period 1980 to the present. These data ares expanded as new information becomes available. Customer classes of particular interest are: residential, commercial, public sector, industry taking delivery at less than Extra High Voltage (EHV)[2], large industry taking delivery at EHV, agriculture, and public utility use. Data are kept separately for each distribution company[3] and can be added to create a country-

[2] 500 kV

[3] There is one exception. Data for the two distribution companies in Upper Egypt are combined into one category.

wide total.[4] Data are organized into what EEA forecasters refer to as the "big sample" and the "small sample". The big sample contains the annual data (1980-92) for each of seven areas of the country. The small sample shows the aggregated, country-wide totals for 1980-present.

9.3.2

A second data set is maintained containing information on those variables that are thought to influence electric consumption. These data include information on population, GDP, price indices, electric prices and so forth. As new data becomes available they can easily be added to this set.

9.3.3

Data are read by the RATS program, which in turn produces statistical estimates of econometric equations. The latter can take many forms. The analyst must specify which equations are to be estimated and must eventually choose which equations to use for the forecasts. RATS produces the statistical information necessary to support that choice.

9.3.4

Information is sought on forecasted values for the independent variables which have been found "significant" in explaining electric consumption in the past. These are the variables which "drive" the forecasts and include forecasts of population, GDP and others. A major difficulty in this process is that forecasts of the future differ among sources. For example, both the Egyptian Central Bank and the World Bank forecast GDP. Both banks are credible sources, but they forecast different figures. The choice of sources to use is a major problem for EEA.

9.3.5

Forecasted values of "driving" variables are plugged into econometric equations and forecasts are produced. These are checked for "reasonableness" and final forecasts are produced.

[4] Data on the non-integrated parts of the EEA system are kept separately. They do not enter into the country-wide aggregate used for econometric purposes. Separate forecasts are made for the non-integrated areas, but these account for only a small percentage of total national electric energy consumption.

9.3.6

Customers taking delivery at EHV are dealt with separately from the others. Forecasts by enterprise are sought from the organizations themselves and/or the Ministry of Industry. Normally, official forecasts for these firms are reflected in the contracts which each firm has with EEA. However, some adjustments for these firms' forecasts may be appropriate under some economic conditions.

9.3.7

Energy forecasts for all sectors are combined for a system-wide energy forecast.

9.3.8

Load factor information is applied to create peak demand forecasts. In the past, an "hours-used" procedure was used to estimate non-coincident peak demands for each sector. Non-coincident peaks were then added and compared to system peak. It was then assumed that the non-coincident peak to system peak relationship would hold for the forecast period. During the current forecast exercise (March, 1993) the hours-used method was dropped in favor of direct analysis of the load factor, using class specific information. This is an improvement over the hours-used method.[5]

9.3.9

Hourly loads are analyzed with the APPA model and an hourly load profile is determined based on the historical record. The hourly load profile is then applied to the electric loads forecast for each year in the future to determine future load profiles.

[5] The hours-used method is based upon a large number of somewhat arbitrary assumptions. The most important of these is the hours of capacity use by each customer class. Second, the assumption that the non-coincident peak, system peak relationship will hold for the forecast period is critical. Neither set of assumptions is supported empirically in Egypt. Rather, both assumptions are based purely upon judgement. Thus, the move to making judgements directly about changes in the load factor is not a move from empiricism to judgement.

9.4 AN ASSESSMENT OF FORECASTING

Considerable improvement in EEA's forecasting methods occurred over the past three years. Documents[6] show that as recently as 1991, EEA forecasts were based upon simple econometric equations that were driven only by population and GDP. (These variables continue to play a central role). No estimates of price elasticities were possible and no ad hoc adjustments for price effects were made. Equations were based upon very short time-series data and many data had not been properly examined for internal consistency (see RCG/Hagler, Bailly, Inc.). Furthermore, original statistical relationships had not been subject to systematic tests of significance. Advances were made during 1992 by expanding and improving the data base used in forecasting and testing statistical relationships more completely. Price effects were recognized, though, as of late 1992, no empirically-based elasticity estimates were available (see El-Sayed, et.al.).

The forecasts produced in 1991 and 1992 are shown in Table 9-1. The 1991 forecasts were done using only growth in real GDP as a driving variable. When similar calculations were done in 1992, which are labelled 1992 A, in Table 9-1, similar results were obtained. However, the econometric formulation recommended by El-Sayed et.al., labelled 1992 B in Table 9-1, included an assumed price response, since no price elasticities could be estimated at the time. Note that the assumption of even a moderate price response decreased the energy forecast from about 6.8% per year over the first ten years of the forecast to about 4.0%.

Important improvements were made in late 1992 as a result of a UNDP consultancy involving John Buchanan. Mr. Buchanan visited EEA for several weeks, reviewed forecasting methods, explained and prioritized appropriate statistical tests and provided specific steps for improvement. Most importantly, Mr. Buchanan suggested and demonstrated methods for producing and using price elasticity estimates. As a result of Mr. Buchanan's suggestions, EEA staff has been able to estimate price elasticities and to incorporate them in the latest forecasts. While the 1993 forecasts are still under development, preliminary estimates of price elasticities have been formulated for High Voltage (HV) industrial customers (elasticity = -.222), other industrial customers (e = -.218), residential customers (e = -.085), commercial customers (e = -.32) and agricultural customers (e = -.051). These elasticities have several important properties. First, they seem to be supported by data and statistical tests. Second, they are consistent with economic theory. Third, they are similar in magnitude to elasticities found elsewhere for similar customers. Mr. Buchanan also demonstrated that the method of assumed elasticities used in El-Sayed, et.al. was done in a way that under-estimated the impact of GDP

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[6] There are four basic documents that describe fully the evolution of forecasting at the EEA. These are:

1. RCG/Hagler, Bailly Inc., Electricity Pricing Strategy Study, January, 1992.
2. El-Sayed and others, The Strategical Generation Alternatives for the Egyptian Unified Power System, Vol.1, September, 1992.
3. UNDP (by John Buchanan) Electric Price Elasticity November 1992.
4. EEA, Load and Energy Forecast for the period 1991/92 to 2006/2007, preliminary and partial draft as of March, 1993.

TABLE 9-1
FORECASTS OF ENERGY SALES (TWh)

Year	EEA 1991	El Sayed et al 1992 A	El Sayed et al 1992 B
1989/90	34.4*		
1990/91	36.6	36.3*	36.3*
1991/92	39.1	38.2	38.1
1992/93	41.6	40.3	39.7
1993/94	44.2	42.9	41.4
1994/95	46.9	45.8	42.6
1995/96	49.7	49.3	43.6
1996/97	52.9	53.0	44.6
1997/98	56.3	56.9	45.9
1998/99	59.8	61.1	47.8
1999/2000	63.5	65.5	50.4
2000/01		70.2	53.8
2001/02		75.2	57.7
10-YR GROWTH	6.4%	6.8%	4.0%

SOURCES: EEA, 1991 is as reported in RCG/Hagler, Bailly, Inc. 1992 are from El-Sayed et.al.

A = Forecasts without price elasticity
B = Forecasts with price elasticity assumed.
* = actuals

on energy sales.

Besides price, equations forecasting energy sales are driven mainly by real GDP and population. In all sectors, energy sales are related to changes in real GDP, and the coefficients reflecting this relationship are both statistically significant and similar to coefficients found elsewhere. However, whether the GDP/energy relationship will, in the future, remain as it has been in the past is doubtful, because:

- Energy price restructuring is now under way. While some of the effects of this restructuring are reflected in price elasticities, there may be additional long run effects operating through changes in the country's production mix. Energy price restructuring may imply restructuring of the kinds of things that Egypt produces along with changes in the technologies used to produce them. Price elasticities alone are likely to understate these effects.

- Privatization is occurring and is expected to occur more rapidly in the future. Since private entrepreneurs (instead of public ones) are expected to respond differently to opportunities in Egypt, the energy/GDP relationship could easily shift in the future.

- Economic reforms, such as freeing prices, interest rates and exchange rates, are likely to change Egypt's incentive structure. The increase in efficiency expected implies that fewer resources, which may include electric power, will be used less intensively in production. Other reasons for questioning the continued statistical relationship between GDP and electrical energy use could probably be identified[7].

Population plays a special role. In the cases of the commercial and residential sectors the forecast is conducted in two parts. Energy consumption per customer is forecast by considering real GDP and electric prices. Numbers of customers are forecast using population as a driving variable.[8] If the relationship between the growing population and increasing customer numbers changes during the forecast period, from what it was during the historical period (1980 to the present), then the number of customers forecast may be inaccurate. The forecast method used now assumes that the relationship remains constant. However, there are some events that could alter this view:

- The historical period includes the push for rural electrification, which was largely completed by about 1985. During that period, customer numbers increased faster than population; however, this process will not be repeated.

- Prior to the Gulf War, Egyptians working in the Gulf, brought money home and many invested in new housing, which of course, results in new customers. Now that there are fewer opportunities in the Gulf, new housing growth, and new customer growth, have probably slowed. This has occurred independently of population growth. Therefore, it may be productive for EEA forecasters to revisit their methods for forecasting customer numbers to account for changes of this sort.

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[7] An underlying concern here is that there is something systematic at work. Indeed, the factors identified imply that a given increment in GDP in the future will in turn imply a smaller increment in energy consumption than has occurred in the past. Thus, forecasts may over estimate future demand.

[8] Total energy forecast for the sector is the product of numbers of customers times kWh per customer.

As forecasting methods improved, forecasted growth rates for system sales dropped. Ten-year annual growth rates of system energy sales were 6.3% in the 1991 forecast and dropped to 4.0% in the forecast recommended in 1992[9]. The 1993 forecasts were being done at the time of this report, but preliminary results indicated that the forecasted 10-year growth rate confirm the drop in expected demand[10]. The medium scenario for the equations that seem to be producing the best statistical properties in the 1993 exercise, indicate a 10-year growth rate for system energy sales of about 4.7%[11]. These figures are consistent with the recent history about their service area. In this context, the progress that has been made in the past two years is remarkable.

The progress in EEA's forecasting is particularly impressive given the small staff dedicated to it and the very limited training given to the staff in forecasting . Forecasting is done in the Forecasting and Economic Studies Department. Staff involved in forecasting include the director of the department and four others (though additional people may be involved from time to time) who spend about half of their time on other matters. All staff members have at least the equivalent of B.S. degrees in electrical engineering (and some have advanced degrees), but none have specialized formal training in econometrics, statistics, operations research or other forecasting tools[12]. They all had "on-the-job" training, using the resources at hand, which are very limited. There is only one statistical program (RATS). Furthermore, unlike forecasting departments in the U.S., the EEA staff does not have access to detailed economic information about their service area, nor are there forecasting services to provide detailed forecasts of driving variables. In this context, the past two years' progress is remarkable.

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[9] EEA produces several alternative model specifications and for each creates scenarios based upon different assumptions about growth in real GDP. Growth rates reported here are for the "medium" scenario produced by the "recommended" equations.

[10] Recall that Buchanan pointed out that the elasticity assumption technique used by El-Sayed et.al. in late 1992, underestimated the effect of GDP on electric sales. If the El-Sayed et.al method had correctly captured the effect of GDP then the rate of growth in energy sales from the "recommended" model would have been somewhat higher than the 4.0% rate of growth that the model forecast.

[11] The preliminary results for 1993 were available only in rough draft form and were provided with the agreement that the details of the exercise would not be revealed at this time.

[12] In an electric utility, with comparable load (7 000 MW), in the U.S., the forecasting staff may include 6-8 people working full time. Typically most of them would have specialized training in statistics and econometrics. They would have available very detailed and reliable data about their service territory, which data can usually be disaggregated to small parts of the service area (e.g. to the county level). Furthermore, a utility of this size would almost always rely upon customized outside forecasting services for future values of variable interest.

Over the past three years reasonable decisions have been made about the choice of forecasting techniques to pursue: i) end-use forecasting has been dropped for the time being -- forecasters correctly saw that the data requirements of end-use forecasting could not be met given the resources available, ii) the GRSC model has not been used -- the GRSC has been recognized as being based upon arbitrarily chosen parameters and as merely a means to extrapolate past trends, and iii) rather than sticking with the hours-used method to create peak demands from energy forecasts, the forecasting staff is now making explicit judgements about customer-specific peak loads and coincidence with system peak -- this change recognizes the shifts that have been initiated by economic reforms in Egypt and the fact that EEA is now engaged in a program of demand side management (DSM) which has the objective of changing peak loads and their coincidence.

9.4.1 Demand Side Management

Demand side management is now an important activity at the EEA. The DSM program was initiated in 1985 with the help of ESB-Ireland, which provided technical help and training. 120 load recorders were placed on selected customers. Customers were selected from a group containing all customers with loads exceeding 500 kW (there were 1300 such customers). Detailed information is kept on all 1 300 customers, and recorders are rotated among customers to generate load information on the sampled group. Placement of the recorders is done so that the customers sampled represent a variety of load factors, economic activity, etc. The information available now on this group of customers includes not only the load information, but also information on the economic activity of the customers (mostly industrial, and some large commercial customers), the distribution company serving them, the ministry responsible, and the installations at the site (building types, kinds of equipment installed, whether there is back-up power and so forth). Given this information, EEA personnel have analyzed the energy-consuming characteristics of their large customers and have provided assistance to many of them to reduce or otherwise manage their loads.

Large customers are becoming increasingly interested in load management. When the program began in 1985, electricity tariffs were so low that there was little interest. However, since 1987 when tariffs began to increase, and especially in the past year as tariffs head toward long-run marginal cost and time-of-use rates come into effect (in 1993/94), large customers are now seeking EEA assistance to manage their loads. EEA reports that customers themselves are adding load management personnel to their own staffs and requesting that EEA install load recorders at their sites. Metering problems prevent direct load research on individual residential customers. However, some load research has been done recently by placing recording equipment on local feeders to residential areas. Residential results so far have been sufficient to analyze several DSM options at the residential levels.

DSM considerations have increasingly become part of the least-cost planning process of EEA. The main integrated resource planning model (EGEAS) has been modified to account for DSM options. EEA training (via. Stone and Webster) on the integration of DSM with the resource plan took place in July, 1992. At that time, the connection of DSM with financial models was not complete, but there are plans for that connection to be made. Nevertheless, the integrated resource plan at EEA now contains some DSM options that have been shown to have favorable cost/benefit ratios.

These observations allow the identification of several items and/or activities that are likely to greatly improve upon the forecasting abilities of EEA. These are as follows:

a) Data

Current availability of data limits the kinds of forecasting models that can be used and/or developed in Egypt. About three years ago, EEA forecasters made the choice to develop econometric models instead of developing the end-use model provided by Stone and Webster.[13] This choice was on target, because data support for an end-use model is not currently available in Egypt. Nevertheless, econometric forecasting is also limited by data quality and availability. Some data problems are "in house" and it appears that EEA is attending to those difficulties as best they can. Often, some important data are outside the influence of EEA, and is provided to it by outside sources. Most important, historical GDP figures are used to estimate forecasting equations and projected GDP is used for forecasting. Historical data and projections are available from both the Egyptian Central Bank (ECB) and the World Bank (IBRD), but unfortunately both institutions offer different figures.

ECB and IBRD figures agree until 1987; they have differed since. 1987 is the last year in which the Egyptian statistical office (CAPMAS) estimated national accounts and therefore 1987 is the last year in which there is a good measure of GDP and agreement between the IBRD and the ECB. Since then the ECB estimates GDP by applying assumed growth rates to various components of GDP to come up with its figures. The ECB conducts no systematic surveys and uses no formal forecasting methodology for projecting GDP. The price index used by the ECB for deflating GDP to real terms, is based upon a consumer expenditure survey which was conducted in 1981.[14] The IBRD does continually and systematically monitor activities that are important to estimating GDP. On this

[13] Nor did EEA search for other end-use models, of which there are several that are readily available.

[14] This is particularly inappropriate in a country, like Egypt, that has undergone some structural adjustment, especially where large parts of the economy are government controlled and where price controls have been relaxed (or strengthened). Under these circumstances price index information should be updated more often. Indeed, CAPMAS did conduct a consumer expenditure survey in 1991 with this in mind, but as yet the results have not been published and the price indices have not been revised.

basis alone one would expect IBRD estimates to be more accurate than those of the ECB. Also, the IBRD developed (and continues to develop) a formal model for forecasting GDP and has an independent view on price changes. The 1992 report by El-Sayed et.al. (page 45) observed that when estimating the forecasting equations, the IBRD data gave "the best results".

Use of IBRD data instead of ECB data makes a significant difference. For example, in the latest (March 1993) forecasting exercise, use of ECB historical data and forecasts results in a forecast 10-year rate of growth of energy sales of 4.7% in the "medium" scenario. IBRD data for the same exercise yields a 10-year growth rate of 5.7%. The difference between these two amounts to energy sales of about 5 880 GWh differential by the fiscal year 2002/03, the equivalent to a demand difference of 932 MW in that year.

Some of the improvements needed for econometric work probably are possible to make within reasonable time and resource limits. Priorities for improving data should include:

- The application of some measure of disaggregation to forecasting. For example, it may be useful to distinguish large customers from smaller ones in both the industrial and commercial sectors. It may be useful to distinguish public from private industrial and commercial customers. Residential customers should probably be divided into at least two categories, large and small consumers. Data should be consistent across distribution companies so that geographical distinctions can be made.

- Being fully informed about the characteristics of the national income data and projections that they use. More routinized interaction between forecasters and the ECB and IBRD would be useful, but first EEA personnel would require some instruction as to the composition of GDP figures, how they are constructed and how to interpret them.

- The integration of information from the DSM program with forecasting (this now appears to be the case). The DSM program can provide considerable information on loads and load factors which is particularly useful for forecasting load factors and, therefore, peak demand.

- The improvement of availability of data at the distribution companies. The distribution companies do not conduct formal forecasting and have no load management program and no load information. Implementation of forecasting methodology and procedures by the distribution companies would improve the information available to EEA and would be useful for the distributions companies' own purposes.

b) Special Attention Should Be Paid To Special Customers

Several very large industrial customers account for a large proportion of the EEA load. Nag Hammadi and Kima together account for about 14% of total electric consumption, and several other large customers account for large proportions as well. These customers alone are large enough to influence the sector's forecast. While the largest companies (EHV customers) are now dealt with on a case by case basis, information on them comes almost exclusively from the companies themselves. EEA has a limited ability to apply its own independent judgement, and has limited access to independent judgements from outside the firms in question. Perhaps more importantly, the largest electricity consumers in Egypt are also those who are likely to be most affected by the country's current economic reforms. Econometric methods cannot easily take into account reforms that will affect some customers more than others. Specialized knowledge should be brought to bear to generate independent forecasts for large customers that may not behave like the rest of the sector of which they are a part. For EEA planning purposes, it may be useful to include alternative scenarios about large customer consumption that are different from the forecasts made by those customers themselves. For example, it may be useful to create scenarios where Kima converts to natural gas (or some other feedstock) and where Nag Hammadi consumes much less electricity.

It is recommended that closer cooperation be established between EEA and the large EHV and HV industrial consumers to obtain the impact of their production planning on their product demand.

c) Staff Training

While the forecasting staff is very competent, it requires further training in advanced forecasting techniques and statistical analysis. What the staff has learned through on-the-job experience has been very well learned, but it is not broadly based. As a minimum, some staff should receive formal training in statistics, data development and data management. The UNDP project conducted by Buchanan is an excellent example of the specialized training that the EEA staff can benefit from. The pay-off from that exercise is clearly reflected in the latest forecasting work. Additional opportunities of this kind and quality would be useful.

It is recommended that EEA's planning and forecasting personnel receive additional specialized training in country economics, advanced forecasting techniques, and statistical analysis.

d) Software

Some of the software used by EEA could be either improved or replaced. The RATS program is a standard statistical package that is adequate for current needs. However, as more data become available data storage and handling software will become increasingly important. Also, the program that is now used to estimate

load profiles (APPA) is very deficient. It is time consuming to run, inflexible, and requires many manual inputs. It should be replaced. Whenever software is replaced, formal staff training in its use should be provided.

It is recommended that the computer models currently in use be upgraded.

e) Peak Demand Forecasts

Technical assistance, and perhaps software, should be provided on forecasting peak demand. Currently, peak demand is forecast by making judgements about changes in load factors that may occur. Load factors are then applied to energy forecasts to forecast peak demand. Egypt is at a point where load factors may change significantly and ad hoc judgements about load factors may not be adequate. Economic restructuring may cause large industrial customers to change their loads considerably. Energy price restructuring (including electricity prices) may provoke shifts in electricity consumption patterns. Overall, it should not be automatically assumed that system load factors will be similar in the future to what they have been in the recent past. Indeed, EEA has in place a DSM program which has as one of its objectives changing load factors , (i.e. increasing them) and shifting loads to off-peak periods. For these reasons, either a more sophisticated approach is required to do load factor analysis or alternative peak forecasting methods are called for.

f) Coordination With Demand Side Management

EEA has begun a DSM project which is designed to improve efficiency among electricity customers, thereby reducing loads or shifting loads to off-peak periods. There are two important by-products of the DSM program for forecasters: i) the DSM project will require several surveys of customers -- these surveys, with little modification, can collect customer-specific information of interest to forecasters -- this is especially true of industrial or commercial sector surveys, and ii) forecasters must make judgements about loads and load factors -- the objective of the DSM program is to change loads and load factors -- individuals involved in both activities have much in common. For these reasons it is important that there be a free flow of information between forecasters and DSM personnel. In an ideal setting the two activities should be organized under the same administrative function. This observation reinforces the current organization at EEA.

g) DSM Support

The DSM project is well under way and is receiving continued support from AID via the Energy Conservation and Efficiency Project (ECEP) which is aimed at industrial firms and large institutional buildings[15]. However, some additional

[15] See the ECEP annual reports March 1990 and 1991/92.

equipment may be needed. EEA has only 120 load recorders, which were obtained in 1985. Additional recorders seem justified given recent increased interest in DSM among large customers. Furthermore, since 1985, recorder technology has improved and some equipment upgrading should therefore be considered.

h) Short Term Forecasts

Technical assistance and software for producing short-term forecasts are required. The econometric methods now used for forecasting produce long-term forecasts. The econometrics take into account trends in driving variables that occur over the long term. They do not account for factors that are not foreseeable in the long run, but which may nevertheless affect energy use in the short run. These short run factors may include the response to economic restructuring, recovery from natural disasters, temporary impacts from the international business cycle, political events and others. Econometric methods are designed to produce forecasts that are best if they are used for the 3 to 10-year time horizon. They are not usually accepted if they yield poor results for the short term, while they are accepted if the results are pleasing. A solution, of course, is to use short and long-term models together.

i) Distribution Companies (EDCOs) Should Participate

An improved flow of disaggregated information from the distribution companies (EDCOs) would be a great help to forecasters at EEA. Unfortunately, the EDCOs do no real forecasting of their own and do not keep data in a form which is very useful to EEA. A project of technical assistance could be aimed at reorganizing EDCOs so that they do produce useful information for themselves and for EEA.

Short-term forecasting capabilities could be installed at the EDCOs. Indeed, if short-term forecasting methods are installed somewhere in the system, it may be appropriate for that capability to be installed at the level of the EDCOs rather than at EEA. As predictions for the near future (i.e., for "next year"), are needed and pressure is placed upon the forecasters to come up with a forecast. The forecasters may respond by choosing econometric formulations that seem to make sense in the short run (and there are ways to "adjust" the models so that they do). In so doing, the forecasters may be rejecting the forecasts that are indeed best in the long run. The outcome can be that what econometric formulations does best (forecast long term) is rejected, while something it does poorly (forecast short term) is accepted if they happen to turn out a pleasing result for the short run. A solution of course is to use short-term and long-term models together. In the next point it is suggested that the distribution companies do short-term forecasts.

It is recommended that the EDCOs participate in the forecasting process.

9.5 METHODOLOGY FOR LEAST COST FORECASTING

9.5.1 Load Data

There appears to be a further need to continue to improve the accuracy of the load forecasting process and integrate the resultant enhanced input information more thoroughly with the actual expansion planning work. Of all the input data assumptions used for determining how much and what kind of resources are needed to optimally accommodate the EEA's future growth, changes in the load projection have the greatest degree of leverage on the derivation of the best plan and its timing. That is, a relatively small percentage change in the demand forecast can have a larger affect on various aspects of the resultant system expansion and its timing.

In addition, given the inherent uncertainty of any load growth forecast, a meaningful range of variance should be studied for all the EEA planning scenarios. Consider Table 9-2, which shows the projected load assumptions used in the various documents we were given for review. Note the relatively large changes between the various plans.

TABLE 9-2
FORECASTED PEAK LOAD (MW)

Document	Study	
	1994/1995	1999/2000
El Kureimat	10 508	13 537
Sidi Krir - 1/2 (1991)	9 189	12 472
Sidi Krir - 3/4 (1992)	8 112	10 056
Current Projection	8 940	11 346

We understand that the EEA's planning procedure currently tries to examine the effect of a 5% deviation in load growth. That is, per the above statistics, if the deterministic 1999/2000 forecast is 11 346 MW they would also obtain expansion plans assuming that the load could be as low as 10 779 MW (95% of the expected value) or as high as 11 913 MW (105%), and so on -- for every year being studied. However, the 5% spread being used is evidently arbitrary and not based on a focused statistical analysis or with the *a priori* goal of capturing and interpreting a meaningful range of plausible load growth scenarios.

Thus, the reasonable contingency impact of the fact that no load forecast can be perfect is not fully reflected in the EEA's plans. However, we also realize that enough data may not currently be available to develop and apply a rigorous statistical approach to the resolution of this problem.

It is therefore suggested that instead of using an arbitrary uncertainty criterion the load growth projection should be iteratively perturbed as much as is necessary in order to eventually obtain a change in the indicated timing or preferred technology of the future generating unit (or transmission expansion) in question. Once that change in the results occurs, the reasonableness of the amount by which the load had to deviate in order to bring about the change in the expansion plan can then be assessed.

If the change is inherently plausible then further uncertainty analysis may have to be undertaken to look more closely at the pitfalls which may be present if only the effects of the expected value of the load forecast are taken into account in the planning process. However, if it is judged that the amount of load deviation which was necessary to put the deterministic decision in doubt was so large as to be implausible then the base case forecast plan can probably be described as being quite robust from the standpoint of being relatively immune to later moderate changes in the system load.

9.5.2 Other Input Data

Analogous comments as for the load forecasts also apply to the necessary treatment of the fuel and capital cost input data assumptions -- the other two factors which can have a relatively high leverage on the result of the planning process. That is, arbitrary plus and minus percentage deviation studies are often not objectively useful for establishing the robustness and resilience of the base plan; nor is the equally subjective approach of assigning abstract probabilities to the occurrence (or not) of a range of possible outcomes.

Rather, a plausible internally consistent approach should be taken towards assessing such uncertainties. For example, a very high load growth case -- if assumed to occur at the same time as very high fuel and capital cost scenarios -- probably represents a patently contradictory situation. This is because high costs would normally act to depress load growth or at least make their simultaneity have an extremely low probability of occurrence. This approach should be explicitly represented in any uncertainty analysis.

9.5.3 Demand-side Resources

Per the discussion of 9.2 and 9.4.1, in spite of the great strides in adopting DSM techniques, it appears that the evaluations of DSM options are not globally optimized by EEA along with the supply-side (or transmission) parts of the overall planning equation. Hence, a complete "level playing field" integration of the impact of system loads into the overall EEA expansion derivation process is advisable and required.

In other words the load forecast is apparently given as a deterministic data set to those at EEA who are then charged with finding the best generation plan to serve that load projection. As we were told, part of the reason for this may be that all of the necessary economic and technical data on DSM options which would be used as inputs to an integrated planning study are not yet available for use by EEA personnel.

In general, EEA's current approach presents several drawbacks, including:

- Both the load forecast and the resultant optimum generation addition characteristics and schedule can be incorrect as a result (hence, the transmission plan is also likely to be sub-optimal).

- The true net benefit to the system from the available DSM options may not be obtained as a result, and thus the candidates that are being further considered for implementation in the field may also not be correct as to their features or quantity.

However, EEA's current situation is not a typical utility case. Therefore, such a piecewise treatment of the load forecasting/DSM portion of EEA's planning process may be somewhat acceptable. This is true at least for the near term -- as the sum of the factors mentioned below all tend to act in concert to make many if not most unsubsidized DSM options largely uncompetitive when evaluated versus supply-side options due to the ability of the existing and planned EEA generating system to reasonably effectively serve all parts of the load curve. This is because the EEA has many existing gas turbine generating units which appear to be well suited for continued peaking applications. Through the planning horizon it also has a significant amount of relatively new high efficiency combined cycle plants which are capable of operating effectively across most of the entire system load range. Further, there is not an extremely large spread in reported operating costs between EEA's best and worst units.

Perhaps most importantly, an examination of EEA's detailed generation expansion planning computer program outputs indicates that the clear-cut economic choice for new plants (when needed) is base-loaded low fuel cost additions. That is, other technological options which could be modeled analogously to DSM if they were to be considered by the EGEAS model's automatic optimization logic would probably not be the economic choice in any case -- at least not for a few years.

Of course, significant possible exogenous changes in the basis of these observations -- such as policy decisions affecting fuel costs, electricity rates, and the like -- would be cause for the re-examination of the way DSM options are identified and treated in the planning process.

9.5.4 Supply-Side Resources

The EEA process for generation addition optimization currently appears to be well organized and comprehensive but perhaps not as robust as it could be. Basically, a large menu of alternative generation options is first defined and run through a preliminary simplified automated screening process available with the overall EGEAS model. Based on an approximate but conservative "bus bar" cost-of-electricity calculation, a hierarchy of expansion preferences is initially determined. This analysis allows the planner to evaluate many types and sizes of new generating units in order to see which ones hold the reasonable potential of being competitive for the EEA's use.

In the typical utility case three strata of choices usually emerge from this first-step process:

- candidates which are obviously too costly
- candidates which may warrant further consideration
- candidates which are very attractive

However, the EEA is not an average utility and in their particular case relatively few options emerge from this initial screen because the makeup and character of their existing system, the cost of the fuels readily available, and the high load factor characteristics of their system demand curve all combine to lead towards the choice of conventional technology gas/oil fueled, steam or combined cycle power plants in the currently approved plan (that is, in the 1990s). Hence, it is only in the implementation details of such a plan's guidelines that further refinement may be worthy of consideration -- and that is the basis for most of the remarks made in this report.

For example, a significant amount of the EEA's older generating units are candidates for retirement, refurbishment, life extension, or conversion to different duty cycles. However, these options are not explicitly integrated into the menu of capacity alternatives to be considered simultaneously along with the brand new candidate plants in the decision-making process.

As an example, a number of EEA gas turbines, with a total capacity of about 500 MW, located at different sites (e.g. Talka) could possibly be transported to central points (Damanhour, Mahmoudia) and converted to combined cycle operation. This would improve their longevity as well as their fuel consumption efficiency. Yet this possibility is not evaluated simultaneously with all the other load-serving resource options.

Another phenomenon affecting the accuracy of the whole planning process is the apparent inconsistent formulation and use of the necessary assumptions regarding existing plant

retirement dates. For example, we had the opportunity to review the detailed evaluation/feasibility reports for the El Kureimat, Sidi Krir, and Ayoun Mousa power stations. These were published respectively in 1989, 1991, and 1992. Each apparently used different retirement schedules for some units, thus making it impossible to compare them directly.

It is recommended that a consistent retirement program for high heat rate plants should be developed and adhered to in order to reduce production costs throughout the system.

However, each of the reports forecasted that many of the older plants would in fact be retired by certain specific dates. These assumptions helped to at least partially justify a need for new capacity to be filled by the units being considered in the successive reports. In retrospect, it can now be seen that the older plants have not been retired, or the planned dates for those actions have merely continued to slip -- even though some of their capacity is not even currently needed.

Thus, not only did it occur that the target commercial operation dates for the new units were projected as being sooner than they might have been otherwise, it is even possible that a somewhat different technology for some or all of the new plants might have been chosen by EGEAS as the best plan -- if the retirement/refurbishment options had been more accurately represented. For example, combined cycle instead of the currently planned base load steam units.

This is because the choice of the optimum new plant is always dependent on the composition and characteristics of all of the existing units assumed to be in place on the system through time. It is also understood that subjective reasons (that is, a desire for technological diversity -- reflected in potential concerns about possibly ending up with too large a percentage of combined cycle plants in operation in the future) might have entered into this decision-making process. However, such preferences should be consciously identified and treated separately from the quantitative parts of the planning process -- which should always employ the most accurate and consistent information available to the practitioners.

No part of this discussion should be interpreted as in any way questioning the true original intent of the basis for these new unit plans. Rather, the conclusion which may apply to this subject is that a non-arbitrary implementable retirement policy should be put into place and then consistently carried out.

We have also been told that some older plants which otherwise might not still be operable obtained incremental funding for maintenance and improvements sufficient to allow their continued active status. It is possible that considered cumulatively the total of these ad hoc expenditures could be substantial. If evaluated competitively with all the other resource appropriation options available to the EEA, they might not be individually approved if they were considered as an integral part of the overall planning process.

Thus, it is suggested that this entire rehabilitation-versus-retirement decision procedure be reviewed.

Of course, if there are other reasons why some or all of these older and less efficient plants are needed on the system in their particular locations such as for area spinning reserve or voltage support requirements, they should be identified as such and treated accordingly as part of the optimum plan. Further, in any case, each existing EEA generating unit should be assigned its own realistic retirement date based on its actual condition and economic value, rather than a generic assumption, such as 25 years, which is based on its technology type (as the present practice is).

TABLE 9-3
EEA GENERATION EXPANSION PLAN - MW

	Years							
Plant Name	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00
Talkha Ext.	210				210			
Damietta C.C.	3x125							
Cairo South C.C.			165					
Damanhour C.C.		50						
Mahmoudia C.C.		100						
Assiut Ext.			300					
Cairo West		300	300					
El Kureimat				600	600			
Sidi Krir (Phase 1)						2x300		
Sidi Krir (Phase 2)							2X300	
Ayoun Mousa								2x300
Total	585	450	765	600	810	600	600	600

9.5.5 EEA Generation Expansion Plan 1992/2000

Table 9-3 shows the additional generating capacity contemplated by EEA, in fiscal year 1992/93, to the end of this century. Subsequent forecasts have modified these requirements. Referring to the analysis previously made about EEA's load forecasting methodology and the elasticity of growth relative to pricing, it is difficult to accept the

large amount of additional capacity projected in this table which totals more than 5 000 MW for a system that had a peak load of 7 793 MW in 1991/92, with an increase of only 3.1% over the previous year. It should be pointed out that the above forecast was subsequently reduced to an increase of 3 800 MW until the year 2000 and that the additional 1 200 MW were deferred to the years 2001/03.

It is recommended that a new load-forecast be made, taking into consideration current and expected conditions. This forecast should take into account:

- *demand elasticity in response to the new pricing policy*
- *the effect of Demand Side Management program to be implemented by EEA*
- *private and public sector energy conservation programs, financed by AID and other donors*
- *Privatization of industry which should result in greater attention to production costs and profitability*

It is also recolmmended that the expansion plan for generation to the year 2000 should be revised to take into consider all options, including:

- *new plants, grassroots and expansions;*
- *the refurbishment and upgrading of existing plants;*
- *the retirement of old and high cost units.*

9.5.6 Transmission Resources

Transmission planning is usually more complex and difficult to optimize than generation planning. In fact, in a practical working utility sense, there is actually no such thing as an absolute optimum through-time transmission plan. That is, one cannot readily prove mathematically that some other better plan might exist. Nevertheless, transmission planners press on and arrive at defensible robust expansion scenarios by experience and iteration.

As mentioned before, the ideal situation would be to possess a single integrated model which simultaneously optimized all the generation and transmission addition selections as well as DSM. Since that is not currently available, not only must transmission planners manually experiment and try many alternatives to best serve a static generation expansion scenario -- with the generation planners as part of their team they must further iterate to insure total power production and delivery optimality, and cohesiveness.

The EEA staff generally does quite well in meeting these challenges. It is observed that transmission inputs were considered both before and after the generation planning process, and that substantial iteration appears to be carried out. For example, before the

new generation expansion planning decision-making work cycle starts, plant sites allowing suitable transmission access (including right-of-way considerations to the rest of the system) are identified to evaluate the placement of new units.

The fact that no large or persistent system operating problems evidently exist which would require significantly better generation/transmission integration by EEA also speaks to our feeling that this necessarily iterative process is working. For example we have been told that transmission overloads or bottlenecks have only localized effects on economic generation dispatch. These bottlenecks around Damietta and Suez are presently being attended to.

On the other hand, the reason for this may be at least partially due to significant transmission system excess capacity and, hence, unused operating flexibility.

Having stated the above, the core transmission planning process at EEA can be described as proceeding straightforwardly using power system simulation tools in order to identify and evaluate the new line and terminal equipment additions which may be needed to allow the generation to flow economically and reliably to the load. This procedure is further simplified on EEA system by virtue of its relatively isolated geographic position. Interconnections with countries such as Jordan and Libya have been proposed for the future, because of the likely location and size of such new lines they should not be difficult to implement if designed properly from a technical standpoint.

9.5.7 Adjustments for Financial and Other Considerations

The above discussions on system expansion planning focused on the engineering and cost evaluation aspects of the EEA's decision making process. However, other significant factors can rightfully play a role in the final determination of the plan.

For example, it appears that the World Bank and/or other bilateral financing entities recommend that additional or different tests and criteria be employed to rank and justify specific new projects -- regardless of the extent to which they may be the best option from a traditional system expansion planning standpoint. This is exhibited by the fact that the EGEAS generation optimization model selects the lowest cost plan based on a calculation keyed to minimizing present worth costs as compared to the financing institution's approach of maximizing the present worth of net benefits.

Thus, depending on the assumptions and methodology used to translate costs into benefits, it is possible that the best plan under EGEAS might drop down in preference for financing and be replaced by another choice which might not have the lowest present worth cost gauged by the original planning criteria. For example, on some studies the World Bank supposedly specified that a ten percent discount rate be used for their analysis as compared to a lower value used internally by the EEA for their own EGEAS work.

An internationally respected consultant was retained to conduct the feasibility study for the El Kureimat power plant and to select the optimum size of the units. The study, which was endorsed by EEA, selected 600 MW as being the optimum unit size.

However, EEA's expansion plan seems to project only 300 MW units to the end of this century, apparently in order to set up some sort of local manufacturing program for that particular size. This proves once again that the least cost expansion generation program is not entirely based on economic considerations.

Some analogous comments also apply in the transmission arena. For example the justification for using the 500 kV voltage level (instead of just more of the existing 220 kV) for both the Sidi Krir generation extension (that is, units 3 and 4 at that site) and the Ayoun Mousa power plant (as a whole) seems to be based at least partially on non-technical or non-economic factors.

Another consideration involves plans for eventual 500 kV ties to Libya and Jordan. These plans have some effect on the overall justification for building the Sidi Krir and Ayoun Mousa stations (respectively) and also have a bearing as to the voltages at which the proposed plants are tied into the system. If the inter-country ties were not a part of the overall plan or were forecasted as occurring later in time, the two power stations mentioned might only be justifiable at a different size or further out in the future. Of course, if the commercial operation dates for all of these new generation and transmission facilities do not occur on a phased basis as currently planned, in retrospect, it may become apparent that the original decisions taken one at a time were not optimum.

9.6 STATION REFURBISHING AND RETIREMENTS

Thermal units are being refurbished at Cairo West and several gas turbine plants in the Delta have been refurbished and upgraded to combined cycle units. Cairo South is being modernized and upgraded. While the above is laudable and usually an effective and economic way to increase the installed power using a lower investment, refurbishments and overhauls should still be considered as part of a general expansion and upgrading plan and not as an isolated instance. It is not clear that there is a consistent integration of information or working philosophy between the EEA's operations, projects, and planning organizations with respect to the treatment of plant modernization/retirement as compared to considerations for evaluating and implementing completely new generating units.

In EEA planning organization, for example, generic (average assumption) lifetimes for existing generating units are evidently assigned, and hence those plants are assumed to be fully retired in certain future planning years almost regardless of their currently known actual condition or worth to the system as a whole. Yet, in reality we know that this has not been, and is not likely to become, the way that things are done. In practice each station will most likely be evaluated separately.

A generic or average approach may sometimes be acceptable for the planning of future years which are well beyond the proposed installation date for the new capital expenditure being evaluated at the time a study is being conducted. However, the nearer-term horizon input data should be more realistic and specific when it comes to stating existing plant lives.

In addition, decisions on whether to modernize or not are evidently not as integral as they should be to the overall expansion planning process at the EEA. Thus, additional expenditures are sometimes made on old plants while, at the same time, the "best" new plants are independently being investigated and chosen by the planning organization. This can result in an inconsistent economic and technical decision basis and even cause new plants to be scheduled for installation earlier than they are needed. Instead, all new capital expenditures should be evaluated using standardized criteria at the same time by appropriate EEA organization(s).

TABLE 9-4
YEARS OF RETIREMENTS ASSUMED IN DIFFERENT STUDIES

Plant	Planning Study				
	El Kureimat (1989)	Ayoun Mousa (1991)	Sidi Krir 1/2 (1991)	Sidi Krir 3/4 (1992)	Current Forecast (1993)
Old Suez	1990	none	none	1995	2000
Cairo North	1991	*	*	1992	1992
Talkha	1991	none	none	1992	1991
El Tebeen	1995	none	none	1992	1994
Damanhour	1996	none	none	1992	1995
Ismalia	1998	*	*	1997	1997
El Max	none	*	*	1992	1992
El Suif	2005	*	*	1992	1996

* It appears that the units were assumed to have been retired before the start of this particular planning study's first year of analysis; that is, no reference to them could be found in the subject report itself

Some of the resultant confusion and potentially incorrect global decisions the current procedure can bring about can be seen on Table 9-4, which displays excerpts from various planning reports (with the dates issued shown in parentheses below) and compares the projected retirement years shown in those documents for the specific units listed down the left hand column. Perhaps most striking, the current planning forecast given to us shows some units as already having been retired even though they are still currently in active operation.

9.7 SUMMARY OF RECOMMENDATIONS

a) Closer cooperation should be established between EEA and the large EHV and HV industrial consumers to obtain the impact of their production planning on their product demand.

b) EEA's planning and forecasting personnel should receive additional specialized training in country economics, advanced forecasting techniques, and statistical analysis.

c) The computer models currently in use should be upgraded.

d) The EDCOs should participate in the forecasting process.

e) A consistent retirement program for high heat rate plants should be developed and adhered to in order to reduce production costs throughout the system.

f) New load-forecast should be made, taking into consideration current and expected conditions. This forecast should take into account:

- demand elasticity in response to the new pricing policy;
- the effect of Demand Side Management program to be implemented by EEA;
- private and public sector energy conservation programs, financed by USAID and other donors;
- Privatization of industry which should result in greater attention to production costs and profitability.

e) The expansion plan for generation to the year 2000 should be revised to take into consider all options, including:

- new plants, grassroots and expansions;
- the refurbishment and upgrading of existing plants;
- the retirement of old and high cost units.

10 SYSTEM DISPATCH

EEA's system is controlled from a modern National Energy Control Center. It is a centralized operation, under the Vice Chairman of operations.

A regional control center in Nag Hamadi is in service to control the 132 kV transmission network in Upper Egypt. A regional control center in Alexandria is being procured. EEA plans to install regional control centers in all operating zones. These centers are not designed to control generation.

10.1 DESCRIPTION OF THE NATIONAL ENERGY CONTROL CENTER (NECC)

The NECC is equipped with a Control Data Corporations system of computers, consoles and programs. It was placed in operation in April 1983 to control the 500 kV and 220 kV transmission network and all the power generating stations. At the time, it was a state-of-the-art installation.

GLOSSARY OF TERMS

Automatic Generation Control (AGC)
AGC is a control system that keeps the power output of a generating unit very close to an established power level. It can also insure that the total load to be delivered by shared individual units in accordance with a set proportion.

Least Cost Dispatch
The process by which instructions are given to the generating plants to operate their units in the fashion that produces the least fuel and operational costs. These instructions are the result of computer programs that continuously calculate the best operating levels from each of the generating units.

New specifications have been prepared and bids are currently being requested to upgrade the existing computer system. This new system, when installed, will add new programs designed to improve fault analysis, provide on line load flow and state estimation in addition to the existing standard functions of SCADA, automatic frequency control, least cost generation dispatch, short term load forecasting and other off line computer programs.

The existing staff is well versed in system control and dispatching.

Natural gas is the preferred fuel for the EEA generators. The gas supply is not yet adequate to meet the total requirements, and is therefore supplemented by fuel oil. The fuel allocations are done by means of a production costing program which considers the fuel types and quantities available and allocates them between power plants in the least cost manner for the next week, month and year. A program has also been developed to dispatch the hydro power produced by the three hydro stations within the constraints of water availability.

10.2 EFFECTIVENESS OF THE DISPATCH CENTER

The weighted overall efficiency of the EEA thermal system was 32.7% (10,437 Btu/kWh) in fiscal year 1991/92 and, while this report was written, it was claimed that it was increased to 33% (10,342 Btu/kWh). Later data produced by EEA showed an increase to 37.5%[1] The factors which may have contributed to this improvement include:

- The installation of larger and more efficient generators.
- The rehabilitation of older units.
- Improvements in dispatching.

At the present time there are several constraints to the best operation of the NECC. These include:

10.2.1 Operation of Aging and Inefficient Plants

The dispatching system should be capable of attaining much higher efficiency if more load were transferred to the larger and more efficient units (which are not fully loaded at all times), instead of operating old and inefficient units. Rough calculations show that a 15-18% reduction of the present fuel costs could be achieved by this improved dispatching. However, social constraints constitute a major impediment to shutting down inefficient plants.

It is suggested that the NECC be requested to run simulations to identify what actual fuel savings could be achieved by running the EEA system under true least cost dispatching. Some of these simulations have been run after this report was prepared, but their results were not analyzed by us. These simulations would not be required if non-technical/economic constraints can be removed from dispatching guidelines, since least-cost dispatching automatically and continuously calculates the best combination of generation to supply the existing load.

Further, it is suggested that EEA consider the possibility of converting the old plants into different facilities, training their present employees to perform different duties and to retire the obsolete equipment.

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[1] It should be borne in mind that these efficiencies are calculated using unaudited fuel heat contents and quantities. Both these data are subject to discrepancies that are discussed in other chapters.

10.2.2 Alexandria Area

In the East Alexandria area, the existing 66 kV system is not strong enough to import power from more efficient generators located elsewhere in the system; thus, more expensive local generation must be employed. Plans have been made to construct two new 220 kV lines, between Abo Kir and Suif and between Suif and Abis which will eliminate this condition. These lines are scheduled for completion in 1997.

10.2.3 Efficiency Curves

The NECC does not have a complete set of updated efficiency vs. load curves for the existing production machines. It also appears that some of the instrumentation necessary to establish these curves is not available.

It is suggested that instrumentation be acquired and personnel be trained to run periodic efficiency tests on all the generating units. These tests should be performed on a recurring basis, in accordance with a strict schedule and should take into account changes in characteristics which take place after major changes in a generating unit.

10.3 COMMUNICATIONS BETWEEN THE NECC AND THE PLANTS

There appears to be effective communication between the plants' operators and the NECC Plants inform dispatch of any circumstances that require unit derating.

The NECC has System Control and Data Acquisition (SCADA) facilities which would permit it to operate remotely some of the equipment in the system. Provisions have also been made to add these functions to most of the remaining equipment. However, most of the operations are performed by local operators, in accordance with instructions received from the NECC. This type of operation requires skilled local operators and is time consuming, since messages must go back and forth between the NECC and the local operator, prior to performing the operation -- this could jeopardize the operation of the system under emergency conditions.

It is recommended that EEA consider installing in the NECC full remote control breaker and transformer operations in all substations.

In order to maximize system efficiency, the NECC should be able to set the generation level of any unit and be sure that this setting is maintained. Automatic Generation Controls (AGC) provide this desirable feature. However, not all the major units have AGC.

It is recommended that EEA consider installing AGC in all major units that are not so equipped. Consideration should also be given as to whether this feature should be controlled by the NECC or the plant operators.

10.4 SUMMARY OF RECOMMENDATIONS

(a) The NECC should run simulations to identify fuel savings that could be achieved by running the EEA system under true least cost dispatching.

(b) EEA should consider the possibility of converting aging plants into different facilities, training their present employees to perform different duties, and retiring obsolete equipment.

(c) Instrumentation should be acquired, and personnel trained to run periodic efficiency tests on all the generating units.

(d) EEA should consider installing full remote control breakers in the NECC, and transformer operations in all substations.

(e) EEA should consider installing AGC in all major units that are not already so equipped.

11 FINANCE AND ACCOUNTING

GLOSSARY OF TERMS

Accumulated Depreciation - Depreciation is recorded every three months to recognize the physical deterioration of fixed assets. The accumulated depreciation account represents the cumulative balance of depreciation of an asset since its acquisition. The accumulated depreciation for an asset should be removed from the accounts when the asset is retired.

Accumulated Provision for Bad Debts - At any point in time, a portion of the accounts receivable of an entity represent amounts which will not be collected, thus becoming bad debts. The entity, however, is not able to identify the specific bad accounts. To account for this, the entity periodically records a provision for bad debts as an expense. The cumulative amount of these provisions is carried in an account titled Accumulated Provision for Bad Debts.

Invested Capital/Capitalization - consists of the ownership investment in the entity, earnings retained in the business, and long-term debt incurred to provide funds necessary to carry out the business.

Consolidated Financial Statements - the method of presenting financial statements wherein the parent company and its controlled subsidiaries' assets, liabilities, income and expenses are combined and shown in total. Inter-company accounts receivable and payable and income and expenses transactions between two or more of the consolidated entities are eliminated in the consolidated financial statements.

Equity Method Financial Statements - the method of presenting financial statements wherein the parent company shows its net investment in one or more controlled subsidiaries as a single line item in its balance sheet and shows its share of the earnings of such subsidiaries as a single line item in its income statement. Under this method, the individual assets and liabilities and the individual components of income and expense of the subsidiaries are not shown in the parent company financial statements.

Imputed Interest - the procedure prescribed within the Egyptian Unified System of Accounts whereby, in addition to interest actually paid, an imputed amount is recorded in the accounts as an operating expense and as non-operating income (having no effect on net income). It is calculated in a manner which assumes that all of the entities' assets other than land and buildings, net of all liabilities other than long-term debt, are financed by debt bearing an interest rate equal to that of the Egyptian Central Bank (21.5% for the year 1991-1992).

Imputed Rent - the procedure prescribed within the Egyptian Unified System of Accounts whereby, in addition to rent actually paid, an imputed amount is recorded in the accounts as an operating expenses and as non-operating income (having no effect on net income). It is intended to reflect operating expenses as if the entity owned no buildings, but paid rent for those buildings which it actually owns.

Inter-company Receivables and Payables - amounts owed by one member of a controlled group of companies to another member of the group.

Internal Cash Generation - funds provided to an entity through the operation of its business. This is generally calculated by adding back to net income charges for depreciation, additions to reserves and other changes to income which do not involve an expenditure of cash.

Replacement Cost Depreciation - a procedure advocated by some whereby depreciation expense would be based on the current replacement cost of a fixed asset rather than the original cost of the asset.

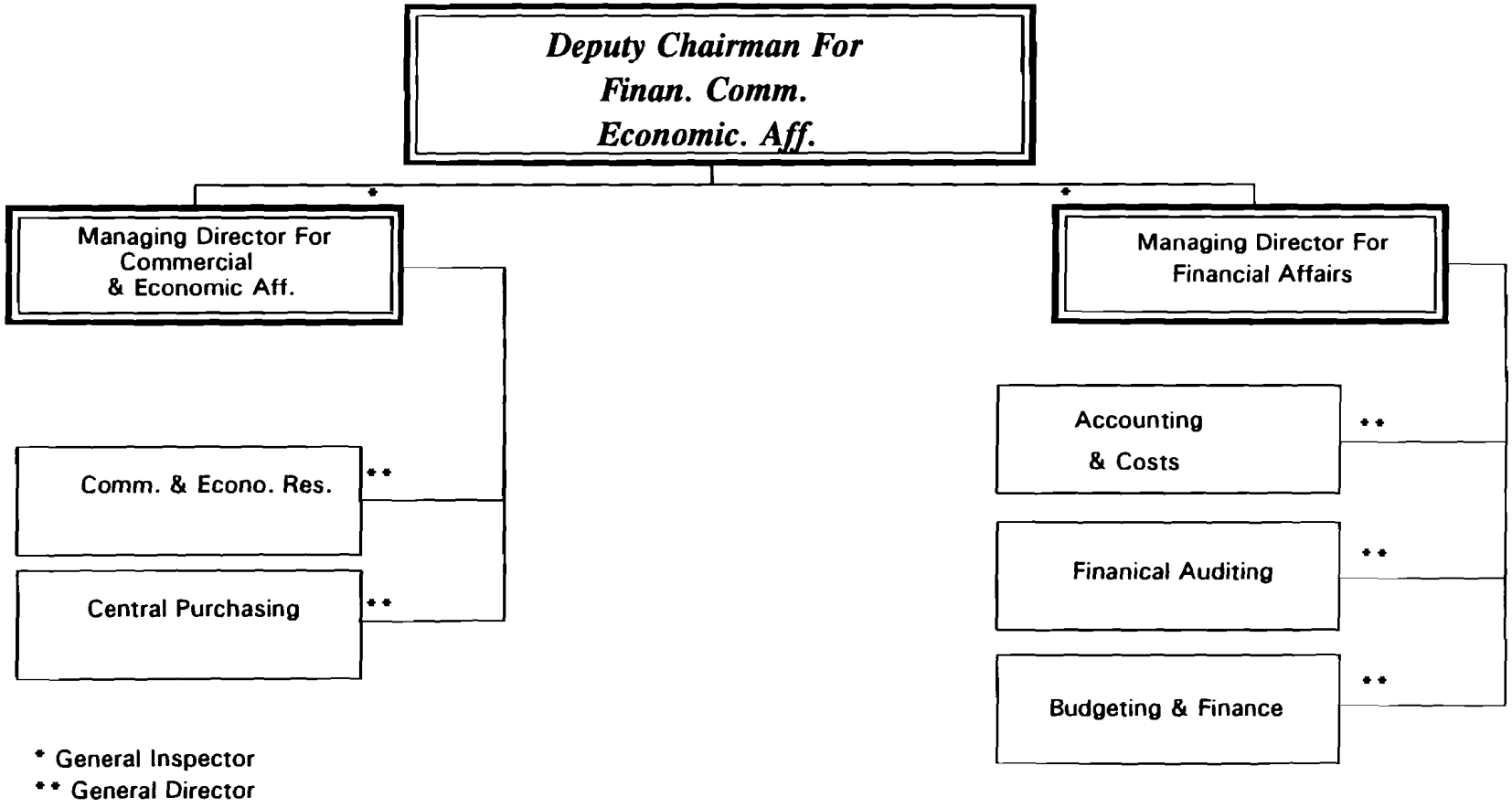
The review was not intended to represent an audit of the accounts and should not be used in that respect.

The accounts of EEA are maintained by the Finance and Accounting Division, Figure 11-1, in accordance with the Egyptian Unified System of Accounts which is applicable to government entities in general. While such system of accounts is not designed particularly to meet the require

Figure 11-1

EGYPTIAN ELECTRICITY AUTHORITY

Revised 11/8/93



ments of the electricity authority, EEA has implemented sub-accounts to the prescribed system where it is considered and utilizes a system of cost accounts to provide detailed expenses in a format suitable to an electric utility.

11.1 FINANCIAL STATEMENTS

The Financial Statements of EEA for the fiscal years ended June 30, 1988 through June 30, 1992 are presented below. Comments on specific components are presented in the following sections.

11.1.1 Egyptian Electricity Authority - Income Statement June 30, 1988 to June 30, 1992

	1988	1989	1990	1991	1992
			(in Millions L.E.)		
Operating Revenue	735	841	1,143	1,716	2,508
Operating Expenses:					
Fuel & Purchases for Sale	257	266	333	512	801
Operations Salaries & Wages	58	70	82	102	124
Materials & Services	62	112	138	229	183
Administrative & Financial	43	52	61	79	110
Depreciation	133	180	243	310	429
Total Operating Expenses	553	680	857	1,232	1,647
Income From Operations	182	161	286	484	861
Gross Interest Expense	247	284	432	488	837
Interest During Construction	76	116	169	188	285
Net Interest Expense	171	168	263	300	552
Net Operating Income	11	(7)	23	184	309
Non-operating Revenue	51	82	89	46	101
Non-operating Expense	49	51	88	190	279
Net Non-operating Income (Loss)	2	31	1	(144)	(178)
Net Income	13	24	24	40	131

11.1.2 Egyptian Electricity Authority - Balance Sheet
June 30, 1988 to June 30, 1992

	1988	1989	1990	1991	1992
			(in Millions L.E.)		
ASSETS					
Fixed Assets:					
Fixed Assets in Service	5,634	6,440	8,472	11,590	14,107
Accumulated Depreciation	746	925	1,165	1,514	1,947
Net Fixed Assets in Service	4,888	5,515	7,307	10,076	12,160
Work in Progress	1,661	2,537	2,469	3,390	4,222
Total Net Fixed Assets	6,549	8,052	9,776	13,466	16,382
Investments	56	56	56	56	57
Long-term Receivables	106	131	173	241	237
Current Assets:					
Cash	139	135	193	81	261
Accounts Receivable, Clients	305	388	524	903	1,286
Other Accounts Receivable	205	253	260	284	438
Inventories	242	344	434	644	790
Total Current Assets	891	1,120	1,411	1,912	2,775
Total Assets	7,602	9,359	11,416	15,675	19,451
CAPITAL & LIABILITIES					
Capital & Reserves:					
Capital	651	651	1,570	1,817	2,035
Reserves & Provisions	413	431	470	579	737
Retained Net Income	62	86	110	150	281
Total Capital & Reserves	1,126	1,168	2,150	2,546	3,053
Long-term Debt:					
Foreign Long-term Debt	3,278	3,739	4,840	6,837	8,118
Local Long-term Debt	1,489	1,923	1,600	2,451	3,222
Total Long-term Debt	4,767	5,662	6,440	9,288	11,340
Current Liabilities:					
Foreign Debt Current Portion	329	423	655	1,204	1,177
Local Debt Current Portion	52	65	91	102	7
Ministry of Finance	590	870	1,190	1,775	2,476
Suppliers	24	22	34	63	130
Accrued Expenses	80	109	78	149	584
Other Accounts Payable	634	1,040	778	549	684
Total Current Liabilities	1,709	2,529	2,826	3,842	5,058
Total Capital & Liabilities	7,602	9,359	11,416	15,676	19,451

11.1.3 · Egyptian Electricity Authority - Source and Application of Funds
June 30, 1988 to June 30, 1992

	1988	1989	1990	1991	1992
		(in Millions L.E.)			
Sources of Funds					
Internal Cash Generation:					
Net Income	13	24	24	40	131
Depreciation	118	180	242	351	435
Reserves & Provisions	6	17	37	107	155
Total Internal Cash Generation[1]	137	221	303	498	721
External Sources:					
Foreign Loans	2,163	888	1,693	2,940	1,909
Local Loans	420	495	(168)	925	856
Capital Contributions	0	0	919	247	218
Total External Sources	2,583	1,383	2,444	4,112	2,983
Total Sources of Funds	2,720	1,604	2,747	4,610	3,704
Application of Funds:					
Increase in Fixed Assets	3,158	1,681	1,964	4,039	3,349
Long-term Debt Amortization	141	382	489	458	833
Investments	3	0	0	0	1
Increase in Long-term Receivables	69	25	42	68	(4)
Change in Working Capital	(651)	(484)	252	45	(475)
Total Application of Funds	2,720	1,604	2,747	4,610	3,704

[1] Internal cash generation in this Statement differs from the calculation in EEA's Source and Application of Funds in that EEA added net interest expense back to net income in arriving at internal cash generation and treated such interest as an application of funds separate from operations.

11.2 FIXED ASSETS

The fixed assets of EEA consist primarily of electric generating stations and high voltage and medium voltage transmission facilities as reflected in the following table showing balances as of June 30, 1992:

TABLE 11-1
FIXED ASSETS OF EEA

	Generating Stations	Transmission Facilities	Operations Facilities	Administrative Facilities	Total
		(in Millions L.E.)			
Land	9	7	0	2	18
Buildings	702	116	6	13	837
Machinery & Equipment	9,914	3,052	148	10	13,124
Transportation Equipment	25	8	2	25	60
Instruments & Tools	16	6	4	8	34
Office Furniture & Equipment	9	2	2	16	29
Deferred Expenditures	0	0	0	4	4
Totals	10,675	3,191	162	78	14,106

Machinery and Equipment is recorded in total for each generating station in the detailed fixed asset records, rather than being recorded by major components, such as boiler plant, steam engines, engine-driven generators, turbogenerator units, and accessary equipment. The absence of such detail reduces the ability to accurately record retirements of machinery and equipment when less than the entire generating station is retired.

We understand that there is an ongoing effort to execute a capital cost program to obtain detail costs of the major components of machinery and equipment in generating stations, but that this information is intended only to assist in the evaluation of bids for construction of future generating stations.

We recommend that this program be further expanded to achieve an allocation of machinery and equipment costs between the major components to facilitate the retirement on the Accounting Records of more reasonable units of property.

In addition to original cost, the fixed asset accounts also include approximately L.E. 2.9 billion for adjustments in connection with the periodic devaluations of the Egyptian pound relative to other currencies. Please see further discussion of this matter in the Capitalization section of this report.

As noted by the Central Audit Agency, assets built by the Rural Electrification Authority since June 30, 1987, amounting to approximately L.E. 236.7 million, have not been recorded in EEA's accounting records. EEA responded that a committee has been formed to assess the value of these assets and they will be recorded after approval from the Ministry of Finance. EEA noted that these assets were indeed approved and recorded as of June 30, 1993.

11.3 DEPRECIATION OF FIXED ASSETS

Depreciation is recorded on a straight-line basis at rates approved by a special committee in the Central Audit Agency responsible for changes in the Unified System of Accounts, in consultation with Engineers and Technical Specialists. Depreciation rates used for the most significant fixed asset categories are as follows:

TABLE 11-2
DEPRECIATION RATES

Machinery and Equipment:	
Hydroelectric Stations	2.0%
Thermal & Steam Stations	3.0%
Gas-based Power Stations	4.0%
Transmission Substations and Transmission Lines:	
High Voltage (33-500 kV)	2.0%
Medium & Low Voltage (Underground)	4.0%
Medium & Low Voltage (Overhead)	3.3%

While the rates used appear to be reasonable, depreciation studies have not been performed. Such studies could provide data which would allow the recording of depreciation more in keeping with the economic consumption of the fixed asset costs.

After fixed assets in operations are fully depreciated, EEA continues recording annual depreciation at 50% of the normal rate. This policy is in accordance with the Egyptian Unified System of Accounts, and is stated to be for the purpose of having depreciation reflect the higher current prices of fixed assets. This appears to be an attempt to approximate what is commonly called Replacement Cost Depreciation and is intended to provide sufficient funds to permit the replacement cost of retired assets at current higher prices. The method used does not achieve that goal. For instance, even in a time of rapidly increasing prices, no additional depreciation would be recorded if none of the fixed assets had become fully depreciated. Conversely, even if prices had not increased significantly, the additional depreciation would still be recorded when fixed assets reached their expected life.

This additional depreciation, credited to an account called Reserve for Higher Prices of Assets, has not been a significant item to date (L.E. 2.4 million in 1991-1992 and L.E. 14.4 million cumulative through June 30, 1992) but its significance will increase as the average age of EEA's facilities increases.

11.4 REVENUES AND ACCOUNTS RECEIVABLE

EEA's revenues are derived from the sale of electric energy from seven regional zones to eight regional distribution companies and to approximately 35 companies which receive energy at high or medium voltage. The distribution companies accounted for 79% of EEA's sales revenue in 1991-1992. EEA implemented significant rate increases in recent years and in April 1993, and was preparing to implement an increase of approximately 7 to 8% retroactive to July 1, 1992.

The timely collection of accounts receivable is a significant factor in optimizing the results of operation of EEA and reducing the amount of external financing required.

As customers of EEA encountered cash flow difficulties, EEA negotiated "deferred payment" plans with such customers. While this may be a reasonable approach to working with their customers and ultimately achieving collection of the accounts, EEA should carefully monitor this situation so that the deferrals do not escalate to the point that customers would not be able to pay. Further, the period allowed before a debt is considered bad should be reduced. Currently, EEA considers a debt bad after 15 years of its due date.

As of June 30, 1992, customer accounts receivable, by Zone, are reflected in the following table:

TABLE 11-3
CUSTOMER ACCOUNTS RECEIVABLE

	Customer Accounts Receivable		Accumulated Provision for Bad Debts	
	(L.E. 000's)	As % of Annual Sales	(L.E. 000's)	As % of Accts. Rec.
Cairo	342,326	35.1%	0	0%
Alexandria	233,879	62.2%	7,637	3.3%
Middle Delta	99,157	36.3%	203	0.2%
West Delta	137,461	125.8%	263	0.2%
North Upper Egypt	109,422	73.8%	17,431	15.9%
South Upper Egypt	255,837	75.2%	887	0.3%
Canal	158,092	55.8%	19,188	12.1%
Totals	1,336,174	53.5%	45,609	3.4%

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While the amount of the provision for bad debts should be based upon a review of individual account balances (which was beyond the scope of our review), the small balance in the provision account would appear to be inadequate when the age of the accounts is considered.

The customer accounts receivable as a percentage of annual sales has grown from approximately 42.8% in 1988, 47.6% in 1989, 47.3% in 1990, to 54.3 in 1991 and its 1992 level of 53.3%.

11.5 INVESTED EQUITY

The invested equity of EEA consists of contributions from the Egyptian government, reserves and retained net income resulting from operations, and long-term debt to foreign and domestic lenders. The following table reflects the capitalization of EEA at the end of each of the latest five fiscal years:

TABLE 11-4
CAPITALIZATION OF EEA
(In Million L.E.)

June 30	Capital & Reserves	Long-term Debt	Total Capitalization	Reserves as % of Total
1988	1,126	4,767	5,893	19.1%
1989	1,168	5,662	6,830	17.1%
1990	2,150	6,440	8,590	25.0%
1991	2,546	9,288	11,834	21.5%
1992	3,053	11,340	14,393	21.2%

In its 1992 report on EEA's financial status, the Central Audit Agency commented on the fact that Capital & Reserves represent an unsatisfactory percentage of the Total Capitalization. As a point of comparison, investor-owned utilities in the United States typically maintain a capitalization ratio of approximately 50% equity and 50% long-term debt.

As pointed out by EEA in its reply to the Central Audit Agency's comments, this ratio is low partially because of recent devaluations in the Egyptian currency. In 1991 and 1992, EEA revalued its long-term debt dominated in foreign currencies. During these two periods, the value of the Egyptian currency generally declined relative to the applicable foreign currencies. The result is that the repayment of long-term debt payable in foreign currencies will require a greater amount of Egyptian currency than the original book value of the long-term debt. The resulting accounting entries increased the long-term debt by approximately L.E. 2.1 billion in 1991, and L.E. 0.8 billion in 1992. The off-setting entry was to increase the book value of fixed assets which were financed by such foreign long-term debt. If such devaluations had not occurred, the above ratio for 1992 would have been 24.1%.

Although there are no firm international accounting standards prescribing the accounting treatment of currency devaluations, EEA's entry to increase the book value of fixed assets would not have been permitted under procedures generally followed in European countries. Under those practices, the loss from currency devaluations would have been charged directly to the equity accounts. If these practices had been followed, the equity ratio would have been further impaired.

In reviewing the schedule of EEA's foreign long-term debt, it was noted that use of an incorrect foreign currency exchange rate resulted in the understatement of foreign long-term debt by approximately L.E. 130,000,000 in the June 30, 1992 Balance Sheet.

11.6 INTERNAL CASH GENERATION

The Source and Application of Funds Statement presented earlier in this report details the amount of internal cash generation, the external sources of funds, and the application of those funds for the years ended June 30, 1988 through 1992. From that Statement, we can derive the portion of EEA's construction requirements which is provided by internal cash generation, as demonstrated in the following table:

TABLE 11-5
CONSTRUCTION REQUIREMENTS PROVIDED BY INTERNAL CASH GENERATION

	1988	1989	1990	1991	1992
Internal Cash Generation[1]	137	221	303	498	721
Construction Expenditures[2]	3,158	1,681	1,964	1,939	2,549
Percentage of Construction Expenditures Provided by Internal Cash Generation	4.3%	13.1%	15.4%	25.7%	28.3%

The internal cash generation ratio for EEA has improved significantly in the last two years, primarily because of the tariff increases which have been implemented. The current rate of 28.3% is, however, still below what would normally be considered acceptable. Further, according to the agreement with the World Bank, EEA is expected to achieve the internal cash generation level of 30% by FY93 and 40% by FY94.

Investor-owned electric utilities in the United States during the period of rapid growth in electric demand in the 1970s and early 1980s generally sought to achieve internal cash generation equal to 40% of construction expenditures. From 1980 to 1985, the actual rate varied from 32.3%

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1 See note to the Source and Application of Funds Statement regarding the calculation of Internal Cash Generation.

2 Excluding additions to fixed assets of approximately L.E. 2.1 billion in 1991 and L.E. 0.8 billion in 1992 as a result of currency devaluations as discussed in the section on Capitalization.

to 50.7%. Since 1985, with a substantial reduction in construction requirements, the rate has been between 62.5% and 72.1%.

A projection prepared by EEA in 1991 reflected internal cash generation and construction expenditures as shown in the following table:

TABLE 11-6
EEA PROJECTED INTERNAL CASH GENERATION AND CONSTRUCTION EXPENDITURES

	1993	1994	1995	1996
Internal Cash Generation	1,192	1,414	1,360	1,023
Construction Expenditures	4,233	4,480	3,609	3,420
Percentage of Construction Expenditures Provided By Internal Cash Generation	28.2%	31.6%	37.7%	29.9%

As stated above, this projection falls short of the World Bank requirement of 35% self-financing capability by FY94. Nonetheless, EEA shows good progress through 1995 toward meeting the Bank's requirements through internal cash generation. However, this progress is projected to be reversed in 1996. The cause of this reversal is two-fold.

First, the projected gross profit (sales revenue minus fuel expense) increases steadily through 1995, but due to projected fuel cost inflation, was projected to increase minimally in 1996. Second, net interest expense is projected to increase by L.E. 389 million in 1996.

Largely as a result of these two items, the projected net income for 1996 is L.E. 444 million lower than in 1995.

11.7 COST ALLOCATION TO ZONES

EEA consists of seven regional zones plus operations and headquarters offices. Each zone maintains its own accounting records and prepares periodic balance sheets and income statements.

The usefulness of these financial statements for the purpose of reflecting the financial position or results of operation of each zone is impaired due to failure to allocate costs in two important areas.

First, each zone reflects the fuel and operating costs of generating stations within its zone and records revenue with respect to customers in its zone. However, the cost or value of energy transferred between zones is not recorded on the accounting records of either zone. Therefore, a zone which generates electricity in excess of its customers' requirements is penalized in its

results of operations, while a zone which sells more electricity than it generates does not bear the full cost of the electricity it sells.

Also, the costs of the Operations Department and the Headquarters Office represent overhead benefiting the operating zones. The costs of these two departments should be allocated to the zones to reflect the total cost of the operating entities.

Both of these cost allocations were recommended by the Central Audit Agency in its report on the 1991-1992 fiscal year and are under study by EEA. The effect of these allocations on the results of operations for 1991-1992, using one possible method of valuing the energy and the overhead services, is presented in the following table (amounts in L.E. thousands).

TABLE 11-7
EFFECT OF COST ALLOCATIONS

	Reported Net Income (Loss)	Energy Exchanges[1]		Allocation of Operations Costs[2]	Allocation of HQ Costs[3]	Adjusted Net Income (Loss)
		Million kWh	Value			
Cairo	320,120	(3,106)	(82,006)	(14,698)	(39,966)	183,450
Alexandria	66,084	(874)	(23,084)	(5,589)	(19,637)	17,774
Middle Delta	(8,392)	(1,635)	(43,162)	(5,910)	(18,254)	(75,718)
West Delta	(63,917)	1,396	36,860	(1,891)	(10,372)	(39,320)
N. Upper Egypt	24,253	(2,366)	(62,455)	(3,385)	(11,202)	(52,789)
S. Upper Egypt	173,649	2,032	53,653	(8,001)	(18,807)	200,494
Canal	(199,340)	4,553	120,194	(3,985)	(20,052)	(103,183)
Operations	(43,459)	0	0	43,459	0	0
Headquarters	(138,290)	0	0	0	138,290	0
Totals	130,708	0	0	0	0	130,708

[1] Energy exchanges were valued at average EEA fuel costs of 2.06 piasters per kWh plus Variable Operation and Maintenance costs of 0.58 piasters per kWh.

[2] Excluding

[3] Headquarters costs were allocated using a formula giving equal percentage weighing to Sales Revenue, Fixed Assets, and Number of Employees.

11.8 AUTOMATION OF ACCOUNTING FUNCTIONS

Although some automation exists, essentially, all accounting records at EEA are maintained manually. This is for an entity with over 40,000 employees and assets exceeding L.E. 19 billion. We were informed that the Headquarters accounting group alone processes approximately 250,000 documents per year. For an organization of this size, significant benefits can be achieved by automating the accounting process.

Among the benefits which could be achieved through automation are:

1. Report Preparation. With data entry through an appropriately designed account coding structure, reports to aid management can be produced rapidly and with flexibility to meet the needs of various groups of managers.

2. Accuracy. Computerization allows checks and balances to be built into the system. Reports of items which fail designed tests can be produced at the time of data entry and investigated prior to final entry into the accounts.

3. Data Manipulation. Once entered into the system, data can be retrieved based on differing parameters to produce reports which meet changing needs in managing the entity.

Automation does not necessarily result in direct cost savings. Although the cost of computer hardware has been significantly reduced in recent years, it still represents a significant investment. Computer software for the many applications which EEA could benefit from would likely to be an even greater investment. Manpower in the accounting area would not necessarily be reduced. Some personnel presently preparing and entering documents manually would be replaced by or retrained as computer programmers and operators or data entry clerks.

The most promising area for cost saving through automation of the accounting process is through providing better and more timely information to managers which will permit them to operate their departments more efficiently.

We recommend that automation be implemented with the following concepts in mind:

1. Design of the system should involve managers and other users from throughout the company. Not only can they provide information about how the system can best help them manage their function, but seeking their input enhances their acceptance of the system.

2. A phased implementation can help avoid overwhelming users. Completion of the basic design should be followed by installation of the basic general ledger system. A logical progression of systems to be installed would be accounts payable, and payroll, followed by fixed asset detail, stores inventory, and construction cost records.

11.9 BUDGETING AND PROJECTIONS

Budgets are prepared annually by a committee formed for that purpose. The committee receives input from similar committees representing each EEA zone.

The budget process is apparently carried out with little direct involvement of personnel in the many operating departments. Therefore, it is likely that department heads do not feel personal accountability to meet the budget goals.

Five-year projections are prepared in connection with the five-year plans of the Egyptian government. The last such plan completed was for the period 1987-1992. As of April 1993, the five-year plan for 1992-1997 had not been completed and was not, therefore, available to be used as a management tool.

We recommend that a process be established to produce an annual budget initiated at the lowest departmental level. After upper management provides general guidelines and goals, each department would submit a budget for its operations for the next year, in such detail as would be manageable and to which the department head could be held accountable.

To be effective as a management tool, there will also need to be periodic reporting back to the departmental supervisor, comparing actual performance to the budget. The supervisor then can and should be held accountable for controlling expenses in his/her department. This type of expenses reporting will likely require the automation of accounting records -- as suggested previously in this report.

We also recommend that a five-year projection of income and operating expenses also be prepared each year. The second through fourth years could be prepared in less detail than the budget for the ensuing year. This five-year projection should be used to plan cash flow and capital requirements.

11.10 IMPUTED INTEREST AND RENTS

In accordance with the Egyptian Unified System of Accounts, EEA records amounts known as Imputed Interest and Imputed Rent. The amounts calculated are charged to Operating Expenses and credited to Non-operating Revenues.

Imputed rent is intended to reflect operating expenses as if EEA owned no administrative buildings. The calculation is to multiply the value of land and buildings, used for administration, owned by 6.4% and subtract the amount of building depreciation and actual rents paid. The subtraction of actual rents paid in the calculation prevents a meaningful result in the calculation. If more buildings were rented, it could result in zero imputed rent although there are buildings owned on which no rent is paid.

Imputed interest is calculated in a manner that assumes all assets other than land and buildings, net of all liabilities other than long-term debt, are financed by debt bearing an interest rate equal to that of the Egyptian Central Bank. This rate for the year 1991-1992 was 21.5%. The resulting imputed interest for EEA was L.E. 3,122,010,597. This compares to actual interest of L.E. 551, 913,837.

The net effect of imputed interest and rent is useful only in an analysis which ignores the actual capital structure and asset ownership of the entity. We were unable to determine that it is actually useful to management, or, if it is used by them, in their management of the authority.

Imputed interest and rents have been eliminated in the accompanying statements of income.

11.11 SUMMARY COMPARISON BETWEEN EEA AND COMPARABLE FOREIGN UTILITIES

In Table 11-8, a comparison illustrates some of EEA's key characteristics in comparison to U.S. and Thai utilities. EGAT was chosen because of the similarities it has with EEA in terms of installed capacity (Table 11-1), gross generation, number of employees and nature of customers (no distribution). It was also chosen because it is highly regarded by the World Bank and is considered among the most efficient utilities that borrows from the bank. Furthermore, we also chose Carolina Power and Light and Ohio Power Company because of the similarities they have with EEA in terms of installed capacity and gross generation. They will help set a comparative basis between commercial non-government-owned utilities and EEA. However, it should be noted that both CP&L and Ohio Power both purchase and sell power from/to Cogenerators and Independent Power Producers.

TABLE 11-8
INSTALLED CAPACITY COMPARISON

Type	EEA	EGAT
Thermal	51.7%	51.5%
Gas	24.5%	23.5%
Hydro	23.8%	25.0%

TABLE 11-9 SUMMARY COMPARISON BETWEEN EEA AND COMPARABLE FOREIGN UTILITIES				
DESCRIPTION	EEA EGYPT[1]	EGAT THAILAND[2]	CAROLINA POWER & LIGHT USA[3]	OHIO POWER CO. USA[3]
Installed Capacity MW	11,536	9,627	9,613	8,805
Peak Generation MW	7,154	7,893e[4]	9,236	8,500
Energy Generated & Purchased GWh	41,513	45,837	42,768	44,958
Sales of Energy GWh	40,751	41,102e	43,778	43,778
Revenue From Sales (in $1,000)	$753,315	$2,247,360	$2,649,067	$1,669,590
Average Price/kWh sold	$0.018	$0.068	$0.0831	$0.0646
Fuel and Purchased Power (in $1,000)	$240,000	$1,152,760e	$758,583	$763,315
Operations & Maintenance Costs (in $1,000)	$122,448	$197,145	$618,470	$349,417
Total Interest (in $1,000)	$166,000	$171,480	$259,667	$97,453
Depreciation (in $1,000)	$129,000	$260,240e	$3,012	$121,472
Net Income (in $Millions)	$40	$468	$380	$161
Employee	40,579	14,057	8,288	4,683[5]
Equity (in $Millions)	$925	$3,929e	$3,009	$1,465
Long-Term Debt (in $Millions)	$3,795	$3,879e	$2,717	$1,343
Customers (% Wholesale)	100%	96%	15%	34%
(% Other)	0%	4%	85%	64%
Population (in $Millions)	58	53	N/A	N/A
Per Capita Income[6]	$650	$1,200	N/A	N/A

1 SOURCE: EEA, Annual Report, 1991/1992 latest available to us.

2 SOURCE: 1993 Electric Utility Databook for the Asian and Pacific Regions, Asian Development Bank, and EGAT 1991 Annual Report.

3 SOURCE: Electric Utility Performance Profile, Carolina Power and Light, and Ohio Power Co. 1992 Annual Reports.

4 e = Estimated

5 Wholly-owned subsidiary of American Electric Power; therefore, it may not have as many administrative employees as the other utilities.

6 Source: The World Bank

11.12 SUMMARY OF RECOMMENDATIONS

Our recommendations for action regarding the accounting systems of EEA are summarized in the following paragraphs, listed by what we consider to be order of priority.

a) Although some automation already exists, EEA should adopt a specific and comprehensive plan for the full automation of its accounting records. The plan should be implemented in phases, with automated systems operating in parallel with the manual system before each phase is finalized. The automated system should be designed with substantial input from management and other prospective users throughout EEA.

b) EEA should prepare annual construction and operation budgets after guidelines and goals are provided by upper management, beginning at the lowest departmental level. Departmental budgets should be prepared to a level of detail which is controllable by the department head, who should receive periodic reports comparing budget to actual performance, and be held accountable for the department's performance relative to established goals. Five-year projections should also be prepared each year to plan cash flow, revenue requirements, and financing requirements.

c) EEA should maintain fixed asset records in greater detail not just for new construction bid evaluation, but also to provide cost information by major component within generating stations, substations, etc. Detailed information should be collected first with respect to new construction, but should eventually include (through allocations, if necessary) existing fixed assets. This would allow the cost of retired assets to be removed from the accounting records accurately, and would facilitate the depreciation study recommended below.

d) EEA should make allocations of these two significant cost areas between zones to make the accounting results of operations for such zones more representative of their actual performance. First, the cost or value of energy transferred between zones should be recorded in the accounts of the zones. Second, the costs of the Operations Department and the Headquarters Office should be allocated to the zones in order to accurately evaluate zone performance.

e) EEA should conduct a depreciation study to establish depreciation rates more reflective of the economic consumption of the fixed asset costs.

f) EEA should seek approval to discontinue the procedure of continuing charging depreciation at the level of 50% of the normal rate after fixed assets are fully depreciated, since this method does not achieve the stated goal.

12 BUSINESS PLAN

After reviewing the legal, human management, technical, and financial aspects of the EEA operations and having formulated various recommendations on all aspects we strongly recommend that EEA establish a Business Plan and consider it as a key element in the commercialization process. This portion of the planning process must be integrated with the financial and human resources that will be required to maintain and augment the physical system. At the managerial level, the purpose of the Business Plan is to define incremental improvements in the organization, maintenance and efficiency of the system, while continually striving to lower maintenance costs, and improve service.

A business plan will require early agreement on the definition of the Enterprise Mission Statement as well as on the first year's major objectives. As an example, the mission of the enterprise, in this case EEA, may be "to provide low cost electric service at the highest level of quality possible from a financially stable, independent commercial operation", while one of the associated objectives may be "to achieve a 40% internal cash generation rate by 1995". However, regardless of the specifics, appropriate agreements and overall managerial direction will have to be in place in order to define the pace and direction of the desired development of EEA. These matters will concern GOE as well as EEA and will evolve over time.

The business plan outline (Figure 12-1) and the associated business plan development process suggested herein can act as a guide for the development of EEA's business plan. These figures envision a process that anticipates adoption of the recommendations contained in the report. The business plan table of contents is different for EEA and the EDCOs, as they will probably be substantially modified as GOE determines which organizational model will be implemented for the commercialization process. The development of EEA's business plan will evolve and change each year because it requires a great deal of interaction and communication internal to EEA and the EDCOs as well as with other GOE entities. This process itself is almost as important as the product.

12.1 DISCUSSION AND BACKGROUND FOR DEVELOPING A BUSINESS PLAN

EEA and the Distribution Companies have been successful in electrifying over 95% of Egypt. The basic system is reliable and of recent design. Senior managers and officials are clearly dedicated to maintaining a reliable supply of electricity to the country.

Having accomplished pervasive electrification, the challenge is to develop the most efficient delivery of service. The term "efficiency" implies least cost delivery, resulting ultimately in electric supply service which is as competitive as possible.

The term "service" implies providing the power and energy required by customers in a manner satisfactory to the customers at a price which accurately reflects the cost of providing the electricity.

Whether or not privatization occurs, the goals stated above recognize that EEA and the EDCOs should be run on a commercially sound, self-supporting basis without receiving or providing subsidies to other sectors. Nor should intra-sector subsidies be allowed. The business plan process described herein will explain what processes are required to achieve self-sustained, or "enterprise" operations. However, one must realize that the goals stated within this report will accomplished on a schedule generally determined by policy makers. We say "generally", because if reasonable near term progress is not made, other forces will in time make Egypt uncompetitive and unable to obtain financing.

12.2 SPECIFIC CONSIDERATIONS FOR THE FIRST YEAR BUSINESS PLAN

- The overall objectives of self sufficiency and competitiveness should be agreed upon within the GOE and the concerned financial organizations. In other words, EEA's and the EDCOs' mission statement should be subject to approval at the highest levels.

- Government related issues need to be studied, considered and resolved. Among these issues are transfer pricing from EEA to the EDCOs customer redress, competitive access for independent power producers, etc.

- The establishment of timing methods and financing for the programs to reduce overemployment.

- Alternative models of commercialization and privatization should be studied. This would include consideration of whether further segmentation of the electric power sector is desirable, or whether there are businesses that should be removed from the electricity sector.

- Clarification of managerial authority to allow efficient, independent management subject to market and regulatory constraints.

- The provision of incentives to the work force and to managers to promote results-oriented attitudes and customer-oriented service.

- The creation of conditions which will help to assure the commercial success of the enterprise, including the authority to collect its revenues from <u>all</u> customers.

Figure 12-1

EGYPTIAN ELECTRIC AUTHORITY SUGGESTED BUSINESS PLAN OUTLINE

Table of Contents

- **Mission Statement of EEA and Overall Objectives During Plan Period**

- **Industry Overview, Review of Current EEA Status:**

  - Discussion of the Business Environment;
  - Government Policy Environment and;
  - Macro economic situation
  - EEA Organizational Chart
  - Review of Prior and Ongoing Goals and Objectives

- **Chairman's Letter to the Board of Directors** (an Executive Summary of the Business Plan and his personal comments)

- **Major Goals and Objectives**
  - Forecast Peak Load and Energy Sales
  - Financial Targets
  - Personnel
  - Performance Compensation
  - Policy Analysis and Decisions
    - * Training Academy
    - * Demand Side Management
    - * Load Shaping Programs
    - * Tariffs
      - ○ Electric Distribution Companies
      - ○ EHV Customers
      - ○ HV Customers
  - -Decision Criteria
    - * Least Cost Expansion Investment
    - * Reliability
    - * Others
  - Financial Planning
    - * Capital Investment Plan
    - * Sources of Financing
    - * Operating Statement
    - * Cash Flow
    - * Balance Sheet
  - Research and Development

- **Executive Summary of System Plans**
  - Generation
  - Transmission
  - Customer service
  - Others

- **Financial Model Results** (1 year actual; 3-5 Year Projections)
  - Base Plan
  - Downside Scenario
  - Upside Scenario

12.3 THE BUSINESS PLANNING PROCESS

The business plan document is the result of an extensive planning effort conducted throughout the organization. While the majority of the planning effort will develop from the bottom of the organization, it is very important that the mission statements, goals and objectives first be developed by the very top levels of management. After this top managerial task in concluded, mission objectives will be relayed to the next level down, who will use them to develop objectives for their respective areas of responsibility. This process should be continued through successive reporting levels down to the level of the first line supervisors.

It must be stressed that the goals and objectives of each level of management must support the goals and objectives of the organization as a whole, as well as the goals and objectives of the next higher level of management. By following this process managers take responsibility for their contribution to the success of the organization. This constitutes an important step in increasing accountability. The goals and objectives established by any manager (in conjunction with his immediate supervisor) may also form the basis for that manager's performance evaluation and any performance-based compensation.

As one might expect, this can be a very lengthy process. However, upon its completion, every level of management will become fully aware of its role and responsibilities in the organization's overall mission.

12.4 FUNCTIONAL AREA OPERATIONS AND MAINTENANCE BUDGETS

The individual department budgets must be designed to accomplish the objectives defined by the manager. The budget should consist of all employee expenses (including payroll, travel, training, etc.), department manuals, subscriptions, office and computer supplies, and office equipment. It should also include all standard maintenance expenses which are not part of a specific capital improvement project. All expenses such as document reproduction, floor space, employee overhead expenses (medical, vacation, retirement), and Management Information System (MIS) costs should be allocated or charged directly to the group using the service. This adds to the level of accounting effort, but results in increased control over these expenses.

The individual department budgets will then be consolidated into the next higher level of organizational budgets. At each higher level budget details may be reduced if the manager feels that it is not necessary to track all of the individual expenses that the various departments might identify or wish to track themselves. However, there must be a minimum that is reported in order to satisfy the financial reporting requirements of the financial models.

12.5 FUNCTIONAL AREA CAPITAL IMPROVEMENT BUDGET

This section of the capital improvement is intended for those projects not directly associated with the construction or development of a generation or transmission project. These might include such projects as the development of a new accounting system, the acquisition of new computers, the development of a new financial reporting system, or the construction of a new office building. Essentially, these are projects that also create an asset. The development of this budget must be coordinated with the development of the Operations and Maintenance budget. For example, when an employee is scheduled to spend time working on the development of a new computer software system, it will be necessary to remove that employee's payroll expenses from the operations budget and apply it to the project budget to avoid double counting the employee's wages. This applies to all other department expenses to ensure that the true cost of the project is being accounted for.

As with the operation and maintenance budget, the level of budget detail reported is up to management. For capital projects, it can include as little as the annual cash construction requirements along with an in-service date and an expected depreciation life, or it can provide full revenue calculation for each project. These revenue calculations should represent the amounts saved or generated by the implementation of the project being budgeted over a reasonable period of time. These revenue calculations should justify the inclusion of the project's expenses in the budget.

12.6 LOAD GROWTH DOCUMENT

Load forecasting activities should be reported in a Load Growth Document. These activities center around an econometrically based model of energy sales, customers, and seasonal peak demands. The details of these activities are beyond the scope of this section. However, we include a brief overview of the process.

The econometric model identifies the relationship between energy use and customer growth. Underlying factors affecting market behavior include the price of electricity, the prices of competing sources of energy (fuels), economic activity as measured by employment levels or gross national product, population, climate, etc. Statistical analysis is used to determine the most representative mathematical expression from an empirical data base. Forecasts of energy sales and demand are made by combining forecasted values of the underlying factors with the econometric equations. Peak demands are forecast by customer class and other load factors that are derived from historical load research data.

The load growth document provides the system expansion plan with projected load shapes, peak demand in kilowatts (kW), and energy consumption patterns in kilowatt hours (kWh). It also provides the rate model with the kWh and kW projections separated by customer class so that the expected revenues can be developed for input to the financial planning process. These inputs are illustrated in Exhibit 5 (The Integrated Planning Loop).

12.7 REVENUE PROJECTIONS

Revenue projections are calculated using a rate model that uses kWh and kW projections by customer class as provided by the load growth document. Revenue projections, in turn, are used to design the financial plan. The rate model takes into account the impact of fuel as well as planned rate changes. This model must interact with the financial planning model to receive inputs on revenue requirements and the timing of rate changes. The rate model, in addition to providing revenue information to the financial model, will provide the new projected energy prices for load forecasting so that the impact of prices on load growth projections and energy consumption projections can be determined (Refer to Figure 12-2).

12.8 SYSTEM EXPANSION PLAN

The system expansion plan is probably the most complex portion of the business plan process due to the vast number of alternatives that must be tested and evaluated. While the details of this activity are beyond the scope of this section, an overview is provided for continuity. Figure 12-3 provides an index for a future system expansion plan. In its final form the plan should include the following individual plans:

- Economic Dispatch Analysis
- System Expansion Plan Project Capital Budget
- 10 year Generation Plan (could be 15 - 20 years)
- 10 Year Transmission Plan
- 10 Year Environmental Plan
- 10 Year Fuel Source Plan
- 5 Year Operations and Maintenance Systems Plan
- 5 Year Demand Side Management Plan

Figure 12-2

GENERATION PLAN DEVELOPMENT PROCESS

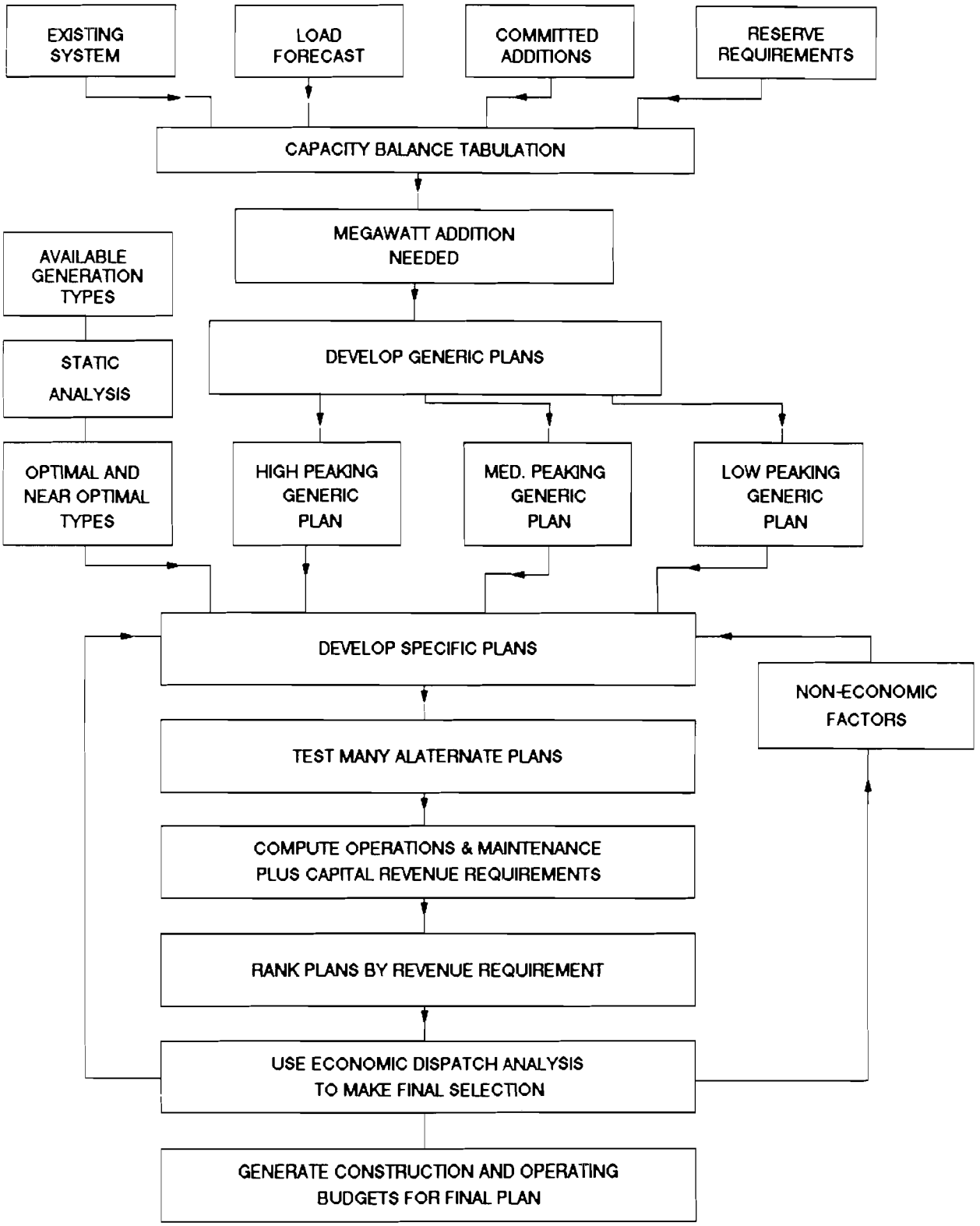


Figure 12-3

EEA: SUGGESTED CONTENTS OF THE SYSTEM EXPANSION PLAN

- **Introduction**

- **Objectives**

- **Forecast**
  - Forecast Approach
  - Outlook
  - Power Demand and Energy Sales
  - Ten Year Forecast
  - Forecast Scenarios (Base, High, Low)
  - Methods

- **Figure/Tables**
  - EEA System Peak Demand
  - EEA Projected System Peak Demand Scenario
  - EEA Projected Energy Requirements Scenario

- **Generation**
  - Background
  - Planning Philosophy
    - * Generation Resource Criteria
    - * Resource Requirements
  - EEA Resources by year
  - Supply Side Options
    - * Refurbishment
    - * Upgrading
    - * New Generation Additions (including private suppliers)
    - * Identification of Options
      - ○ Conventional Energy Resources
        - ▫ Thermal
        - ▫ Steam
        - ▫ Combined Cycle
        - ▫ Gas
        - ▫ Hydro
      - ○ Alternative Energy Resources(Solar,Wind,Etc.)
  - Technology Screening
    - * Methodology
    - * Results
  - Purchased Energy
    - * Regional (Jordan, Libya)
    - * Cogeneration and Small Power Production (Mehalla, EGPC, etc.)
  - Demand Side Management
  - Integration of Alternatives

- **Transmission**
  - Introduction
  - State of the System
    - * General EEA system Overview
    - * General Operating and Planning Philosophy
    - * System Requirements and Capabilities
    - * 1993 System Performance Discussion
  - Transmission Planning Process
    - * Characteristics
    - * Criteria
    - * Issues/Constraints

- **Figure/Tables**
  - System Load (High/Low & Planning Load Forecast)
  - EEA Load & Resources Projection:
    Installed Resources for Winter of Each Year
  - Minimum and Maximum Generation Needs:
    Resources Available for Sales
  - EEA 1993 Generation Resources

- **Figures/Table**
  - Transmission System Map
  - Transmission Requirements and Capability Curves
  - Projected EEA System Peak:
    Summer Requirements
    Winter Requirements

An example of the planning process required to develop the generation plan is provided in Exhibit 4. Although this process is specific to the generation system the same type of iterative process must be applied to each of the other plans.

The system expansion plan evaluates the various alternative ways to supply future loads. These alternatives must take into consideration the following:

- refurbishing of existing plants;
- plant extension programs
- upgrading of existing generating resources
- retirement of older plants
- expansion of existing facilities
- grassroots plants

There are two primary tools used to accomplish this. The first is a deterministic generation expansion model which computes both capital and operation and maintenance related revenue requirements for a given scenario. That is, it can be used to evaluate the impact of high and low load growth scenarios to determine an optimal generation mix. This exercise provides information on the flexibility of a given system expansion plan. The second tool is a production costing system which uses a probability approach to the economic dispatch of the sources of power to meet a given load. It is used to provide detailed estimates of fuel consumption, load

related maintenance costs, and unit usage for a generating system for a specified period of time. Some of the data required for system description includes load information (peak demand, energy, costs), fuel data (cost,heat content, availability), and system data (spinning reserve requirements, hourly sub-period definition, emergency energy cost). This method of economic dispatch ensures that the least-cost resource is always dispatched first, thus keeping the incremental cost to the customer as low as possible.

After the optimal plan is selected, a complete budget must be developed for each project within each of the identified plans. The project budget data is incorporated into the construction budget, to be integrated with the functional area capital improvement budgets. The fuel and variable O&M data from the economic dispatch analysis should be incorporated into the financial plan for inclusion in the financial planning model.

12.9 CONSTRUCTION BUDGET

The construction budget is simply an accumulation of all of the capital expenditures from the System Expansion Plan and the Functional Area Capital Improvement budgets. It is generally treated as a separate document for tracking purposes so that Management and the Board can specifically review and approve selected projects. The data from this budget can be fed into the financial plan at any level of detail desired by the manager.

12.10 FINANCIAL PLAN

The financial plan is the point at which all of the resulting data, generated throughout the business plan process, is brought together and the final test applied. The primary method to develop the financial plan is the financial planning model. This model integrates the required inputs to generate income statements, cash flows and balance sheets. From these reports the financing needs of the organization can be determined as well as the organization's ability to actually meet financing requirements. Various techniques can be used to determine the type of financing that will best fit the plan and how the cost of the financing will affect the overall performance of the organization. The financial analysis will also indicate if the organization can meet the financial targets defined by the lending institutions. If internal cash generation, debt/equity ratios, debt coverage ratios and net income are inadequate, then additional analysis will determine how much additional revenue will be required to trim these indicators to adequate levels. Revenue requirements analysis performed in the rate model will determine if the amount of revenue required is actually achievable and justifiable and additional analysis in the load forecast model will indicate the impact on energy use and future load growth.

12.11 DOES THE PLAN MEET THE STATED GOALS AND OBJECTIVES?

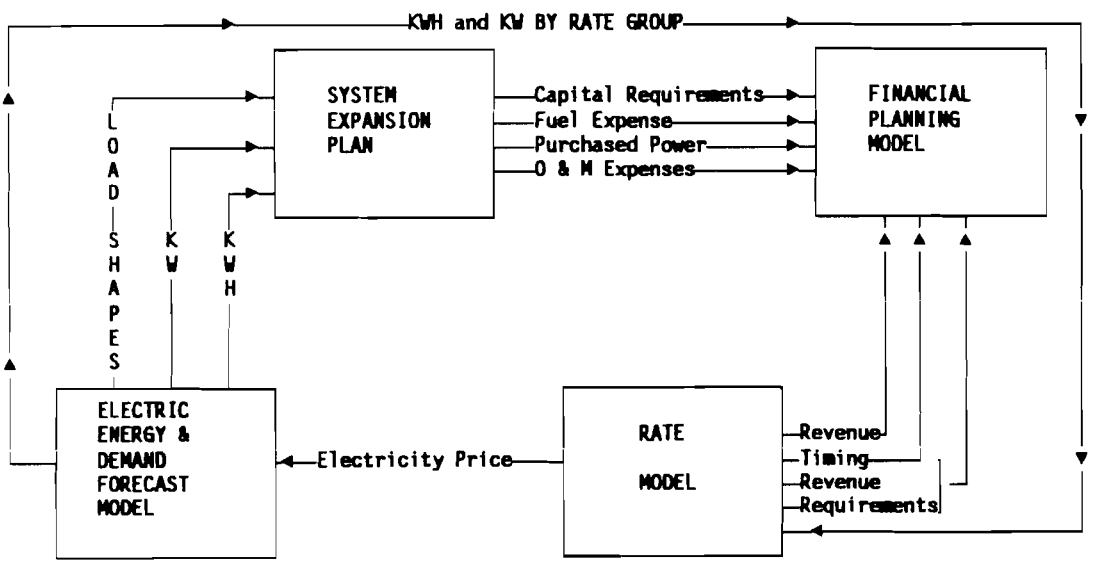
After the Business Plan is completely assembled management must review it, and test it against the objectives that defined at the beginning of the business process. If they have been met, the process has been successful and the plan may go to the Board for final review and approval. If not, then the points of disparity must be determined and discrepancies corrected.

12.12 THE INTEGRATED PLANNING LOOP

The key planning activities associated with the development of the business plan necessitates the consideration and integration of three major issues; Demand, Supply, and Finance. The Integrated Planning Loop illustrated in Figure 12-4 presents graphically the major planning tools and how they are integrated in the business planning process. The loop itself merely consists of a committee of those individuals that either run the associated computer modelling tools or perform the required analysis. They will meet to discuss and coordinate the scenarios that must be analyzed. This greatly improves the quality of the analysis as well as the time required to complete the analytical task. The use of computer models in each of the identified analytical steps enhances the planning process by allowing for a greater number of simulations of potential economic, energy, and financial conditions. Numerous questions concerning the impact of real or potential changes can be analyzed by use of the models. By judicious analysis of the model results, the impact of various scenarios can be evaluated by management to determine a course of action. The primary models are concerned with load forecasting, supply planning, and financial planning including rate impact assessment. Considerable preparation, data collection, and judgement are necessary to make proper inputs to the models. Considerable experience is also required to properly interpret the information provided by the models. However, by analyzing a greater number of scenarios there is a much greater likelihood that the true least-cost business plan will be developed.

Figure 12-4

INTEGRATED PLANNING LOOP



12.13 SUMMARY OF RECOMMENDATIONS

It is strongly recommended that EEA start, as soon as possible, to develop a business plan. The first step will consist of a definition of the "Mission" of EEA and the financial objectives it wishes to achieve. The whole exercise of the Business Plan will help to focus the attention at levels through the organization on the direction the enterprise is heading and what objectives are to be achieved. It will integrate the efforts of all the departments and become a yardstick to measure the accomplishments of the organization.

APPENDIX A

LAWS AND REGULATIONS OF THE EGYPTIAN POWER SECTOR

SECTIONS A-G

SECTION A

A.R.E. PRESIDENTIAL DECREE NO. 1472 FOR THE YEAR 1964 ESTABLISHING THE EGYPTIAN GENERAL AUTHORITY FOR PRODUCTION AND TRANSFER OF ELECTRICAL ENERGY

HIS EXCELLENCY, THE PRESIDENT

With reference to the Constitution issued on March 25, 1964,

Law No. 60 for the year 1963 issuing The General Authorities Law,

Presidential Decree No. 1301 for the year 1964 forming the Cabinet and establishing the Ministry of Electrical Energy,

Presidential Decree No. 1407 for the year 1964 organizing the industry and Mineral Resources Sector,

And to the National Council,

IT IS HEREBY DECIDED:

ARTICLE 1:

A general authority is to be established and named The Egyptian General Authority for Production and Transfer of Electrical Energy Distribution under the Ministry of Electrical Energy.

ARTICLE 2:

The Authority is to act in a corporate entity basis. The reference Law No. 60 for the year 1963 is applicable to it.

ARTICLE 3:

This Authority is responsible for management, operation and maintenance of the substations, and transfer to the main networks in various parts of Egypt. It is responsible for load transfer between Cairo Zone and east Delta and Mid Delta, Alexandria Zone and West Delta and Upper Egypt Zone.

ARTICLE 4:

The Authority's capital is composed of:

(a) The state equity in capitals of the subsidiary companies, cooperative associations and establishments owned by the Authority and;

(b) The funds allocated by the State to the Authority.

ARTICLE 5:

The Authority's resources are composed of the following:

(a) The net profits of the subsidiary companies, cooperative associations, and establishments owned by the Authority, as well as the Board of Directors members' equity in its controlled subsidiary companies;

(b) The loans it obtains;

(c) The funds allocated to it by the State;

(d) Any other funds resulting from their activities or in return for jobs or services which it renders to the subsidiary companies, cooperative associations, or establishments owned by it.

ARTICLE 6:

His Excellency, the President issues a decree forming the Authority's Board of Directors, which is the highest authority controlling all its affairs and proposing the general policy to be followed. His Excellency may issue whatever necessary decrees to achieve its main goal, especially:

(1) Issue the decrees, internal regulations, and decisions concerning the financial, administrative, and technical affairs of the Authority, regardless of the governmental regulations.

(2) Issue the decrees for appointment of the Authority's employees, their promotion, transfer, termination and fixing their salaries remunerations, and pensions.

(3) Approve the Authority's annual budget.

(4) Study all issues which the Minister or Chairman of the Board may deem as falling within the Authority's specializations and;

(5) Study the periodical progress reports on operation of the Authority and its financial position.

The Board of Directors may form within its members a committee or more to whom some specializations may be delegated. The Board may also delegate to the Chairman or the Head of the Authority some of its specializations. The Board may also delegate one of its members or one of the managers to carry out certain duties.

ARTICLE 7:

The Chairman of the Board manages the affairs of the Authority, represents it in its relations with the other entities, and represents it at the court of law. The Chairman is responsible to His Excellency, the Minister of Electrical Energy for executing the general policy set for achieving the Authority's objectives. He may designate some of his authorities to one or more managers.

ARTICLE 8:

The Board of Directors meets at least once a month with an invitation by the Chairman. His Excellency, Minister of Electrical Energy, may invite the Board to hold a meeting whenever he deems it necessary.

The Board's quorum is correct only if the majority of the members attend. The decisions are issued by majority votes of the attendants. If the voted two sides are equal, the Chairman's side supersedes.

ARTICLE 9:

The Board Secretary records the minutes of the meetings and the text of decrees issued, which are signed by the Chairman and the Secretary of the Board.

ARTICLE 10:

The Authority's Chairman presents the Board's decrees to His Excellency, the Minister of Electrical Energy, for sanctioning them, and present to His Excellency, the President the issues which require issuing a Presidential Decree.

ARTICLE 11:

The general authorities may utilize various methods to achieve their goals, especially:

(a) Establish joint stock companies or cooperative associations solely, with a partner or with other partners. The shares of these companies may be put in circulation with effect from their establishment;

(b) Extend credit to the companies or cooperative associations under its supervision, or guaranteeing them when they take loan agreements, after the companies use up all available credit capabilities;

(c) Acquire shares and stocks of the companies by subscribing or purchasing them, regardless of the period stated before putting the shares and stocks of new companies in circulation and;

(d) Issue letters of guarantee that are as powerful as the letters of guarantee issued by the banks to its subsidiary companies and cooperative associations in all their transactions with others. In such cases, the Authority must stand by its obligations which are committed in such guarantees.

ARTICLE 12:

The Authority Board of Directors may acquire credit from banks, organizations, companies and others in order to achieve its goals.

ARTICLE 13:

The Authority opens an account with the Central Bank, wherein its revenues are directed. It utilizes this account within the funds allocated to it in the Budget.

If this revenue becomes less than the total funds allocated to the Authority in the Budget, the Treasury is responsible to settle the deficit from the National Balance Sheet along the fiscal year in accordance with the regulations set by it thereof.

If this revenue becomes positive, it goes to the National Balance Sheet.

The revenue is the difference between the Authority's resources and its periodical expenses, i.e., total operational expenses and the transferable expenses projected in the budget.

ARTICLE 14:

The Authority's Board of Directors prepares a Balance Sheet and a Profit and Loss Account for every fiscal year. The Board also has to prepare a report on the Authority's activity during the current fiscal year and its financial position at the end of that year.

The fiscal year of the Authority is July 1st through June 30th.

ARTICLE 15:

Without contradicting the inspection of the Central Accounting Authority, the Authority's Board of Directors may appoint one of more persons as Accounts Auditors who fulfill the legal requirements stated in Law No. 133 for the year 1951 for Accountants and Auditors. The Board of Directors fixes the Auditor's fees. The auditor will have the auditor's rights and duties as is valid in the joint stock companies. If there are several auditors, they are jointly responsible.

ARTICLE 16:

His Excellency, Minister of Electrical Energy, has the authority to supervise and guide the Authority. He presents to His Excellency, the President, a report on the Authority's activity at the end of the elapsed year, enclosing therewith a copy of the Board of Director's Annual Report and the Central Accounting Authority's report.

ARTICLE 17:

The Authority may make procedures for direct and administrative sequestration in accordance with the regulations of Law No. 308 for the year 1955 on Administrative Sequestration in order to obtain its rights.

ARTICLE 18:

This Decree is to be published in the Official Gazette.

Issued at the Presidency
8 The El Hegga 1383 - 20 April 1964

Gamal Abdel Nasser

SECTION B

A.R.E. PRESIDENTIAL DECREE NO. 1474 FOR THE YEAR 1964 ESTABLISHING THE EGYPTIAN GENERAL AUTHORITY FOR EXECUTING ELECTRICAL PROJECTS

HIS EXCELLENCY, THE PRESIDENT

With reference to the Constitution issued on March 25, 1964, Law No. 60 for the year 1963 issuing The General Authorities Law,

Presidential Decree No. 1301 for the year 1964 forming the Cabinet and establishing the Ministry of Electrical Energy,

Presidential Decree No. 1470 for the year 1964 organizing the industry and Mineral Resources Sector,

And to the National Council,

IT IS HEREBY DECIDED:

ARTICLE 1:

A general authority to be named The Egyptian General Authority for Executing Electrical Projects is to be established under the Ministry of Electrical Energy.

ARTICLE 2:

The Authority has a corporate entity. The referred Law No. 60 for the year 1963 is applicable to it.

ARTICLE 3:

This Authority is responsible for executing the projects pertaining to electricity and to the production, transmission, and distribution of electrical energy.

ARTICLE 4:

The Authority's capital is composed of:

(a) The state equity in capitals of the subsidiary companies, cooperative associations and establishments owned by the Authority and;

(b) The funds allocated by the State to the Authority.

ARTICLE 5:

The Authority's resources are composed of the following:

(a) The net profits of the subsidiary companies, cooperative associations, and establishments owned by the Authority, as well as the Board of Directors members' equity in its controlled subsidiary companies;

(b) The loans it obtains;

(c) The funds allocated to it by the State;

(d) Any other funds resulting from their activities or in return for jobs or services which it renders to the subsidiary companies, cooperative associations, or establishments owned by it.

ARTICLE 6:

His Excellency, the President issues a decree forming the Authority's Board of Directors, which is the highest authority controlling all its affairs and proposing the general policy to be followed. His Excellency may issue whatever necessary decrees to achieve its main goal, especially:

(1) Issue the decrees, internal regulations, and decisions concerning the financial, administrative, and technical affairs of the Authority, regardless of the governmental regulations.

(2) Issue the decrees for appointment of the Authority's employees, their promotion, transfer, termination and fixing their salaries remunerations, and pensions.

(3) Approve the Authority's annual budget.

(4) Study all issues which the Minister or Chairman of the Board may deem as falling within the Authority's specializations and;

(5) Study the periodical progress reports on operation of the Authority and its financial position.

The Board of Directors may form within its members a committee or more to whom some specializations may be delegated. The Board may also delegate to the Chairman or the Head of the Authority some of its specializations. The Board may also delegate one of its members or one of the managers to carry out certain duties.

ARTICLE 7:

The Chairman of the Board manages the affairs of the Authority, represents it in its relations with the other entities, and represents it at the court of law. The Chairman is responsible to His Excellency, the Minister of Electrical Energy for executing the general policy set for achieving the Authority's objectives. He may designate some of his authorities to one or more managers.

ARTICLE 8:

The Board of Directors meets at least once a month with an invitation by the Chairman. His Excellency, Minister of Electrical Energy, may invite the Board to hold a meeting whenever he deems it necessary.

The Board's quorum is correct only if the majority of the members attend. The decisions are issued by majority votes of the attendants. If the voted two sides are equal, the Chairman's side supersedes.

ARTICLE 9:

The Board Secretary records the minutes of the meetings and the text of decrees issued, which are signed by the Chairman and the Secretary of the Board.

ARTICLE 10:

The Authority's Chairman presents the Board's decrees to His Excellency, the Minister of Electrical Energy, for sanctioning them, and present to His Excellency, the President the issues which require issuing a Presidential Decree.

ARTICLE 11:

The general authorities may utilize various methods to achieve their goals, especially:

(a) Establish joint stock companies or cooperative associations solely, with a partner or with other partners. The shares of these companies may be put in circulation with effect from their establishment;

(b) Extend credit to the companies or cooperative associations under its supervision, or guaranteeing them when they take loan agreements, after the companies use up all available credit capabilities;

(c) Acquire shares and stocks of the companies by subscribing or purchasing them, regardless of the period stated before putting the shares and stocks of new companies in circulation and;

(d) Issuing letters of guarantee that are as powerful as the letters of guarantee issued by the banks to its subsidiary companies and cooperative associations in all their transactions with others. In such cases, the Authority must stand by its obligations which are committed in such guarantees.

ARTICLE 12:

The Authority Board of Directors may acquire credit from banks, organizations, companies and others in order to achieve its goals.

ARTICLE 13:

The Authority opens an account with the Central Bank, wherein its revenues are directed. It utilizes this account within the funds allocated to it in the budget.

If this revenue becomes less than the total funds allocated to the Authority in the Budget, the Treasury is responsible to settle the deficit from the National Balance Sheet along the fiscal year in accordance with the regulations set by it thereof.

If this revenue becomes positive, it goes to the National Balance Sheet.

The revenue is the difference between the Authority's resources and its periodical expenses, i.e., total operational expenses and the transferable expenses projected in the budget.

ARTICLE 14:

The Authority's Board of Directors prepares a Balance Sheet and a Profit and Loss Account for every fiscal year. The Board also has to prepare a report on the Authority's activity during the current fiscal year and its financial position at the end of that year.

The fiscal year of the Authority is July 1st through June 30th.

ARTICLE 15:

Without contradicting the inspection of the Central Accounting Authority, the Authority's Board of Directors may appoint one of more persons as Accounts Auditors who fulfill the legal requirements stated in Law No. 133 for the year 1951 for Accountants and Auditors. The Board of Directors fixes the Auditor's fees. The auditor will have the auditor's rights and duties as is valid in the joint stock companies. If there are several auditors, they are jointly responsible.

ARTICLE 16:

His Excellency, Minister of Electrical Energy, has the authority to supervise and guide the Authority. He presents to His Excellency, the President, a report on the Authority's activity at the end of the elapsed year, enclosing therewith a copy of the Board of Director's Annual Report and the Central Accounting Authority's report.

ARTICLE 17:

The Authority may make procedures for direct and administrative sequestration in accordance with the regulations of Law No. 308 for the year 1955 on Administrative Sequestration in order to obtain its rights.

ARTICLE 18:

This Decree is to be published in the Official Gazette.

Issued at the Presidency
8 The El Hegga 1383 - 20 April 1964

Gamal Abdel Nasser

SECTION C

A.R.E. PRESIDENTIAL DECREE NO. 3726 FOR THE YEAR 1965 ESTABLISHING THE EGYPTIAN GENERAL AUTHORITY FOR ELECTRICITY

HIS EXCELLENCY, THE PRESIDENT

With reference to the Constitution,

Law No. 60 for the Year 1963, issuing the General Authorities Law;

Law No. 44 for the Year 1965, organizing Accounts Audit of General Authorities and Establishments,

Law No. 3546 for the Year 1962, issuing the Regulations for Employees of Subsidiary Companies Controlled by General Authorities,

Presidential Decree No. 800 for the Year 1963 on Application of Companies Regulations to the Employees of General Authorities,

Presidential Decree No. 1472 for the Year 1964, establishing the Egyptian General Authority for Production and Transfer of Electrical Energy,

Presidential Decree No. 1473 for the Year 1964 establishing the Egyptian General Authority for Distribution of Electrical Energy,

Presidential Decree No. 1474 for the Year 1964, establishing the Egyptian General Authority for Executing Electrical Projects,

Presidential Decree No. 1475, reorganizing the Ministry of Electrical Energy,

Presidential Decree No. 2011 for the Year 1965, sanctioning the Budget for the Financial Year 1965/1966,

Presidential Decree No. 3366 for the Year 1965, forming the Cabinet,

And the National Council,

IT IS HEREBY DECIDED:

ARTICLE 1:

A general authority to be named The Egyptian General Authority for Electricity is hereby established. It is a General Authority with regards to applying the regulations of Law No. 60 for the Year 1963. It is under the Ministry of Industry, Mineral Resources, and Electricity headed by His Excellency, the Minister of Industry, Mineral Resources and Electricity. It is to be located in Cairo.

This Authority replaces the Egyptian General Authority for Executing Electrical Projects, the Egyptian General Authority for Production and Transfer of Electrical Energy, and the Egyptian General Authority for Distribution of Electrical Energy.

ARTICLE 2:

The General Authority is responsible for:

(1) Executing the projects pertaining to production, transmission, and distribution of electrical energy;

(2) Managing, operating and maintaining power substations, transferring and organizing loads among the main networks in the various parts of Egypt and;

(3) Distributing and selling electrical power in various parts of Egypt.

ARTICLE 3:

The Authority's capital is composed of:

(a) The state equity in capitals of the subsidiary companies, cooperative associations and establishments owned by the Authority and;

(b) The funds allocated by the State to the Authority.

ARTICLE 4:

The Authority's resources are composed of the following:

(a) The net profits of the subsidiary companies, cooperative associations, and establishments owned by the Authority, as well as the Board of Directors members' equity in its controlled subsidiary companies;

(b) The loans it obtains;

(c) The funds allocated to it by the State;

(d) Any other funds resulting from their activities or in return for jobs or services which it renders to the subsidiary companies, cooperative associations, or establishments owned by it.

ARTICLE 5:

His Excellency, the President issues a decree forming the Authority's Board of Directors, which is the highest authority controlling all its affairs and proposing the general policy to be followed. His Excellency may issue whatever necessary decrees to achieve its main goal, especially:

(1) Issue the decrees, internal regulations, and decisions concerning the financial, administrative, and technical affairs of the Authority, regardless of the governmental regulations.

(2) Issue the decrees for appointment of the Authority's employees, their promotion, transfer, termination and fixing their salaries remunerations, and pensions.

(3) Approve the Authority's annual budget.

(4) Study all issues which the Minister or Chairman of the Board may deem as falling within the Authority's specializations and;

(5) Study the periodical progress reports on operation of the Authority and its financial position.

The Board of Directors may form within its members a committee or more to whom some specializations may be delegated. The Board may also delegate to the Chairman or the Head of the Authority some of its specializations. The Board may also delegate one of its members or one of the managers to carry out certain duties.

ARTICLE 6:

The Chairman of the Board manages the affairs of the Authority, represents it in its relations with the other entities, and represents it at the court of law. The Chairman is responsible to His Excellency, the Minister of Electrical Energy for executing the general policy set for achieving the Authority's objectives. He may designate some of his authorities to one or more managers.

ARTICLE 7:

The Board of Directors meets at least once a month with an invitation by the Chairman. His Excellency, Minister of Electrical Energy, may invite the Board to hold a meeting whenever he deems it necessary.

The Board's quorum is correct only if the majority of the members attend. The decisions are issued by majority votes of the attendants. If the voted two sides are equal, the Chairman's side supersedes.

ARTICLE 8:

The Board Secretary records the minutes of the meetings and the text of decrees issued, which are signed by the Chairman and the Secretary of the Board.

ARTICLE 9:

The Authority's Chairman presents the Board's decrees to His Excellency, the Minister of Electrical Energy, for sanctioning them, and present to His Excellency, the President the issues which require issuing a Presidential Decree.

ARTICLE 10:

The general authorities may utilize various methods to achieve their goals, especially:

(a) Establish joint stock companies or cooperative associations solely, with a partner or with other partners. The shares of these companies may be put in circulation with effect from their establishment;

(b) Extend credit to the companies or cooperative associations under its supervision, or guaranteeing them when they take loan agreements, after the companies use up all available credit capabilities;

(c) Acquire shares and stocks of the companies by subscribing or purchasing them, regardless of the period stated before putting the shares and stocks of new companies in circulation and;

(d) Issue letters of guarantee that are as powerful as the letters of guarantee issued by the banks to its subsidiary companies and cooperative associations in all their transactions with others. In such cases, the Authority must stand by its obligations which are committed in such guarantees.

ARTICLE 11:

The Authority Board of Directors may acquire credit from banks, organizations, companies and others in order to achieve its goals.

ARTICLE 12:

The Authority opens an account with the Central Bank, wherein its revenues are directed. It utilizes this account within the funds allocated to it in the budget.

If this revenue becomes less than the total funds allocated to the Authority in the budget, the Treasury is responsible to settle the deficit from the National Balance Sheet along the fiscal year in accordance with the regulations set by it thereof.

If this revenue becomes positive, it goes to the National Balance Sheet.

The revenue is the difference between the Authority's resources and its periodical expenses, i.e., total operational expenses and the transferable expenses projected in the budget.

ARTICLE 13:

The Authority's Board of Directors prepares a Balance Sheet and a Profit and Loss Account for every fiscal year. The Board also has to prepare a report on the Authority's activity during the current fiscal year and its financial position at the end of that year.

The fiscal year of the Authority is July 1st through June 30th.

ARTICLE 14:

Without contradicting the inspection of the Central Accounting Authority, the Authority's Board of Directors may appoint one of more persons as Accounts Auditors who fulfill the legal requirements stated in Law No. 133 for the year 1951 for Accountants and Auditors. The Board of Directors fixes the Auditor's fees. The auditor will have the auditor's rights and duties as is valid in the joint stock companies. If there are several auditors, they are jointly responsible.

ARTICLE 15:

His Excellency, Minister of Electrical Energy, has the authority to supervise and guide the Authority. He presents to His Excellency, the President, a report on the Authority's activity at the end of the elapsed year, enclosing therewith a copy of the Board of Director's Annual Report and the Central Accounting Authority's report.

ARTICLE 16:

The Authority may make procedures for direct and administrative sequestration in accordance with the regulations of Law No. 308 for the year 1955 on Administrative Sequestration in order to obtain its rights.

ARTICLE 17:

The employees of the Egyptian General Authority for Executing Electrical Projects, The Egyptian General Authority for Production and Transfer of Electrical Energy, and the Egyptian General Authority for Distribution of Electrical Energy are transferred with their grades to the Egyptian General Authority for Electricity or any other authority by a decree from the Prime Minister based on the proposition of the Central Authority for Organization and Administration.

ARTICLE 18:

The referenced Presidential Decrees No.'s 1472, 1473, and 1474 for the Year 1964 are hereby cancelled as also any ARTICLE contradicting the regulations of this Decree.

ARTICLE 19:

This Decree is to be published in the Official Gazette and is valid with effect from the date of publishing.

Issued at the Presidency
on 24 Gamada El Akher 1385 - October 19, 1965

Gamal Abdel Nasser

SECTION D

LAW NO. 12/1976
FOR SETTING UP
THE EGYPTIAN ELECTRICITY AUTHORITY

In the Name of the People

HIS EXCELLENCY, THE PRESIDENT OF THE REPUBLIC

The People's Assembly has approved of the following Law which is hereby promulgated.

ARTICLE 1:

A public authority to be named "Egyptian Electricity Authority" shall be set up. It shall be a legal entity, affiliated to the Ministry of Power and shall have its head office in the city of Cairo.

The said Authority shall be subject to the rules and regulations spelled out in this Law.

ARTICLE 2:

The Authority shall be exclusively assigned the following duties:

(a) Implementation of the projects related to production of electric power, its transmission and distribution throughout the Republic.

(b) Management of electric power stations, their operation and maintenance, as well as regulation of the loads on the main networks throughout the Republic.

(c) Distribution of electric power and its sale throughout the Republic.

(d) Carrying out of studies and research regarding everything connected with the Authority's activities.

(e) Rendering of expert advice and implementing which fall within the Authority's jurisdiction, whether internal or external, and with the Authority's capabilities and experience or which are attainable through it.

ARTICLE 3:

The Authority's capital is composed of:

(1) The funds of the Egyptian Electricity Authority founded by virtue of Republican Decree No. 3726 of 1965;

(2) The funds to be appropriated by the State.

ARTICLE 4:

The Authority's revenues are made up of:

(1) The sums appropriated by the State;

(2) Proceeds of the sale of electric energy;

(3) The price differential resulting from sale of electric current at prices lower than the approved tariff for development purposes which are borne by the Public Treasury;

(4) Proceeds of the Authority's activities and in consideration of works and services rendered to third parties internally or externally;

(5) Loans advanced to the Authority by the State;

(6) Credit facilities secured by the Authority;

(7) Donations and grants-in-aid.

ARTICLE 5:

The Authority shall have a special budget to be prepared in advance with the rules set out in its status without being restricted by the laws and regulations governing preparation of the State budget. Also, the Authority shall have a special account for depositing its revenue, and any surplus in the Authority's budget shall be carried forward from year to year.

ARTICLE 6:

The Council of Ministers shall set the interest rate of the loans to be advanced by the State to the Authority.

ARTICLE 7:

The Authority shall be entitled to engage in all actions and deeds designed to accomplish the purposes for which it is set up, including direct contracting with individuals, companies, banks as well as local and foreign organizations, in consonance with the rules set forth in the Authority's statutes.

ARTICLE 8:

The Authority is entitled, within the boundaries of its budget, to import itself or through another party without an import permit, its requirements of production, materials and instruments, tools, spare parts, and means of transportation required for its activities in conformity with the rules as set by the Authority's statutes, without being restricted by the laws and regulations governing importation or foreign currency.

ARTICLE 9:

The Authority's imports of equipment, instruments and materials required for its projects shall be exempt from customs duties and other taxes and dues. Also, imports by companies, organizations and bodies with the Authority of instruments, equipments, tools, motor vehicles, materials and other movables are exempted from customs duties and other taxes and dues, provided that they are subject to inspection and the Authority's declaration that the exempted commodities are imported and required for its project's implementation. Such exempted commodities shall be liable to the payment of taxes and dues in respect thereof if they are disposed of to another party within five years from the date of their enjoying the franchise.

Also, interest on loans and external credit facilities contracted for by the Authority shall be exempted from taxes.

ARTICLE 10:

The Authority shall have a Board of Directors. Its Chairman shall be appointed by Republican decree, which shall also set his salary; whereas appointment of Members of the Board shall be by an Order of the Prime Minister upon the recommendation of the Minister of Energy.

ARTICLE 11:

The Board of Directors is the supreme body responsible for the management of the Authority's affairs. It discharges its functions as laid down in this Law. It has the discretion to take whatever decisions it deems for the attainment of the objective for which the Authority was founded, particularly:

(1) Approval of the Authority's regulative structure;

(2) Proposal of the tariff for the distribution and sale of electric energy to the various users of electricity after seeking the opinion of the Central Agency for Accountancy and the costings to be approved by the Electricity Sector, Higher Council and the competent and Ministerial Committee;

The said tariff shall not be enforced until after its approval by the Council of Ministers.

(3) Approval of the Authority's annual draft budget and its draft balance sheet;

(4) Transfer of credit from one item to another within the boundary of the same category;

(5) Laying down the Authority's internal regulations related to financial, accounting, administrative, trading, technical and supply matters, as well as other general organization regulations;

(6) Framing the regulation related to the Authority's personnel, including social insurance, traveling allowance and transportation expense.

(7) Formulating a system for surveillance and standards of performance in accordance with economic criteria.

(8) Proposing the contracting for loans.

(9) Accepting donations and grants-in-aid offered the Authority which are not inconsistent with its aims and purposes.

(10) Reviewing the periodical reports to be submitted concerning the progress of works at the Authority and its financial position.

(11) Reviewing whatever the Minister of Energy or the Chairman of the Board deems to submit to the Board regarding issues falling within his competence.

The Board may set up from among its members a committee or more to be entrusted temporarily with some of its assignments.

The Board is entitled to delegate one of its assignments upon one of its members or entrust to him a certain mission.

ARTICLE 12:

The Board meets at least once a month upon the invitation of its Chairman, provided that a quorum of the majority of its members are present. Its resolutions are passed with the absolute majority of its members. When the votes for and against are equal, the Chairman shall have the deciding vote. In the case of absence of the Board Chairman, the Board elects a substitute. The Board is entitled to invite whoever it deems to attend its meetings in an advisory capacity without having the right to cast their votes.

ARTICLE 13:

The Authority's Board Chairman shall communicate to the Minister of Energy the Board's resolutions within three days from their adoption for their approval. The said resolutions shall be considered enforceable unless the Minister objects to them in writing to the Authority's Board within thirty days from the date of his receiving them.

ARTICLE 14:

The Authority's Board Chairman is assigned the following duties:

(1) Execution of the Board's resolutions;

(2) Management of the Authority, development of its system of works, and establishing its organization;

(3) Supplying the Minister of Energy and the State bodies with information, details and documents they request.

The Authority's Board Chairman may delegate upon a Director or more some of his assignments.

ARTICLE 15:

The Authority's Board Chairman shall represent it at the courts of Law in its relations with other parties.

ARTICLE 16:

The Minister of Energy shall nominate a delegate to replace the Chairman temporarily in the event of his absence or should his post be rendered vacant.

ARTICLE 17 :

The Authority's Board may, with the consent of the Minister of Energy, dispose of the foreign currency allotted to the Authority in favor of the State's monetary budget, or the foreign currency accruing from the loans advanced to it, or resulting from its activity, or in consideration of the works and services it renders to other parties, or the donations and grants-in-aid it receives, in accordance with the rules set out in the statutes.

ARTICLE 18:

The decisions of public utility respecting the real estate required for the Authority's projects rests with the Minister of Energy. The provisions of the Law regulating the expropriation of property for public or utility improvement shall apply.

ARTICLE 19 :

In order to acquire its rights, the Authority may take legal proceedings to serve attachments in accordance with the provisions of Attachments Law.

ARTICLE 20 :

The Authority's statutes shall be issued by Republican decree without being restricted by the State's rules and regulations applicable in the Government machinery, within six months from the date of publication of this Law in the Official Gazette. The statutes shall take into consideration the following:

First: Linking the wage to productivity.

Second: The maximum pay scale annexed to Law No. 58 of 1971 related to the Government's civil servants.

Third: The additional and incentive bonuses and allowances to be set for the Authority's personnel should not exceed double the salaries set for them.

Fourth: The main principles of the standard social insurance scheme as spelled out by Law No. 79 of 1975.

Fifth: Traveling allowances and transportation expenses of the Authority's personnel according to the hierarchy of their grades and original salaries should not exceed the actual expenses they incur.

Sixth: Adoption of the rules of the standard accounting system.

Seventh: No direct contract awards are to be made except to monopolistic foreign firms or those with specialized international expertise or in cases of urgency, subject to the approval of the Minister of Energy.

Eighth: Adopt the most up-to-date procurement contract rules applied in similar projects.

ARTICLE 21:

The Authority shall supersede the General Egyptian Electricity Corporation (GEEC) set up in virtue of Republican Decree No. 3726 of 1965 as regards its rights and obligations.

ARTICLE 22:

The GEEC personnel shall be transferred to the Authority without taking any further measure.

ARTICLE 23:

Presidential Decree No. 3726 of 1965, setting up the GEEC, is hereby cancelled, as well as any other provision contrary to the rulings of this Law.

ARTICLE 24:

The Minister of Energy shall issue the necessary Orders for the execution of this Law.

ARTICLE 25:

This Law shall be published in the Official Gazette, and shall become operative as from the date of its publication.

This Law shall be embossed with the State Seal, and shall be executed as one of its laws.

Published on February 12, 1976.

SECTION E

LAW NO. 13/1976
ESTABLISHING THE AUTHORITY OF NUCLEAR PLANTS TO GENERATE ELECTRICITY

On behalf of the people,

HIS EXCELLENCY, THE PRESIDENT,

The People's Assembly has passed the following Law, which we have issued:

ARTICLE 1:

A general authority is established named "Authority of Nuclear Plants for Generating Electricity". The Authority has a corporate entity and is supervised by His Excellency, the Minister of Electricity. It is located in Cairo.

The regulations in this Law apply to this Authority.

ARTICLE 2:

The Authority is responsible for the following:

(a) Proposing establishment and utilization of nuclear power plants to generate electricity and to pretreat and demineralize water within the framework of a general national plan.

(b) Carrying out research and studies necessary for projects establishing nuclear power plants.

(c) Designing the basis for specifications for projects establishing nuclear power plants and preparing them for execution.

(d) Executing projects for construction of nuclear power stations and other related or consecutive projects, and supervise their management by following the necessary preventive international technology methods.

(e) Doing consulting services and executing the projects which fall within the Authority's specialization locally or internationally which are within the Authority's capabilities and expertise available to or through it.

The Authority carries out its specializations in coordination with the electricity sector authorities, with the Nuclear Power Authority, and other concerned authorities.

ARTICLE 3:

The Authority's resources are composed of:

(1) The funds allocated by the State;

(2) The funds resulting from its activities or in return for jobs or services which it renders to others locally or abroad;

(3) Loans provided by the State;

(4) Credit facilities acquired by the Authority; and

(5) Grants and Aids.

ARTICLE 4:

The Authority has a special budget prepared in accordance with the internal regulations, regardless of the laws and regulations organizing the General National Budget. The Authority also has a special account wherein it deposits its resources.

The profit is carried forward in the Authority's budget from year to year.

ARTICLE 5:

The Authority may carry out all transactions which may enable it to achieve its goals. The Authority may directly hold transactions with persons, companies, banks, local authorities and foreign authorities in accordance with the rules set by the internal regulations of the Authority.

ARTICLE 6:

The Authority may, within its budget, import itself, or through others without license, any production requirements, materials, machinery, equipment, spare parts and means of transportation which it may need for its operation. This is in accordance with the Authority's internal regulations, regardless of the legal regulations, import regulations or foreign currency regulations.

ARTICLE 7:

The tools, equipment and materials imported by the Authority for its projects are exempt from customs duties, taxes, and other fees. The machinery, equipment, tools, automobiles, requirements and other movables which are imported by the companies, authorities and contractors dealing with the Authority are exempt from the customs, duties, taxes and other fees.

This is based on inspection and the Authority's certification that the exempted goods are imported and necessary for executing its projects. Taxes and duties must be paid for these exempt goods if any transactions to others are being made within five years from date of their exemption.

The interest on loans and international credit facilities held by the Authority is exempt from all taxes.

The foreign contractors and subcontractors are exempt from all taxes and due duties as they are fulfilling their obligations in accordance with the contracts executing the Authority's projects.

The foreign employees working in the Authority's projects are exempt from all taxes on payroll, wages, remunerations, free enterprises, and income tax. This exemption applies to the assessed income resulting from their work in executing the Authority's projects.

ARTICLE 8:

The Authority has a Board of Directors formed as follows:

(1) Chairman: Minister of Electricity;

(2) An Executive President of the Authority, whose appointment and salary are by Presidential Decree;

(3) Chairman of the Egyptian Electricity Authority;

(4) Manager of the Nuclear Power authority;

(5) Chairman of the Board of Directors, The General Authority for Land Reclamation and Cultivation;

(6) State Under Secretary for Ministry of Electricity;

(7) Manager, Nuclear Researches Center at the Nuclear Power Authority;

(8) One of the State Under Secretaries of the Ministry of finance to be appointed by the concerned Minister;

(9) One of the State Under Secretaries of the Ministry of Planning to be appointed by the concerned Minister;

(10) The Authority's legal consultant;

(11) Head of the Nuclear Reactors Department at the Nuclear Power Authority;

(12) Three specialists in the Authority's affairs to be appointed by Ministerial Decree by His Excellency, the Minister of Electricity, who sets their remunerations. This appointment is for a period not to exceed two years and is renewable.

ARTICLE 9:

The Authority's Board of Directors is the highest authority controlling its affairs. The Board carries out its specializations as indicated in this Law. The Board may issue decisions which it may deem necessary to achieve the Authority's goals, especially:

(1) Approving the Authority's Organizational Chart;

(2) Organizing and providing means of training qualified laborers and technicians required for executing and managing the Authority's projects.

(3) Approving the Authority's Annual Planned Budget and Planned Final Account;

(4) Transferring funds from one item to another under the same category;

(5) Establishing the Security and Radiation Control Criteria which provide human and environmental safety;

(6) Establishing the Authority's internal regulations regarding the financial, accounting, administrative, commercial, technical and warehousing affairs as well as other general regulations;

(7) Establishing the personnel regulations for the employment system, employees' insurance, travel per diem, and their transportation fees;

(8) Establishing a control system and performance evaluation criteria according to the economic circumstances;

(9) Suggesting loans acquisition;

(10) Studying and looking into the problems of civil liability towards third party or towards others for the risks resulting from the Authority's activity in accordance with the international agreements valid in A.R.E. Making the necessary procedures in this concern;

(11) Accepting grants and donations offered to the Authority which do not conflict with its objectives;

(12) Studying the periodical reports presented on the Authority's operation and its financial position;

(13) Studying any issues presented by His Excellency, the Minister of Electricity or the Authority's Executive President to the Board concerning any problems within its specialization.

The Board of Directors may form among its members a committee or more to whom some duties may be delegated. The Board may also delegate to the Executive President of the Authority or to one of its managers to temporarily replace some of its specializations. The Board may also delegate to one of its members or one of its managers a specific duty or specialization.

ARTICLE 10:

The Chairman of the Board of Directors convenes a meeting at least once a month. The meeting is considered correct only if quorum attendance is made. The Board issues its decisions by quorum voting. If the two voting parties' numbers are equal, the Chairman's party supersedes. In the case of the Chairman's absence, the Authority's Executive President replaces him. The Board may invite to its meetings whomever it deems necessary to utilize his experience without having the right to vote.

ARTICLE 11:

The Executive President of the Authority passes the Board of Directors decision on to His Excellency, the Minister of Electricity, within three days from date of issuing them for approval. These decisions are considered valid unless His Excellency, the Minister, objects to them in writing to the Authority's Board of Directors within thirty days from date of receiving them.

ARTICLE 12:

The Authority's Executive President is responsible for:

(1) Executing decisions of the Board of Directors;

(2) Managing the Authority, handling its affairs, and developing the operation systems;

(3) Providing His Excellency, the Minister of Electricity, and the State authorities with required data, information and documents.

The Authority's Executive President may delegate some of his authorities to a manager or more.

ARTICLE 13:

The Executive President represents the Authority in court and in its transactions with others.

ARTICLE 14:

His Excellency, the Minister of Electricity, delegates someone to temporarily replace the Executive President of the Authority in case of his absence or his position being vacant.

ARTICLE 15:

The Authority's Board of Directors may, after His Excellency, the Minister of Electricity's approval, hold transactions in the foreign currency allocated to the Authority in the National Budget or resulting from the loans it obtains, its activity, or in return for jobs and services rendered by it to others, or grants and donations which it may acquire in accordance with the internal regulations.

ARTICLE 16:

The Authority's Board of Directors may, pending approval by the Minister of Electricity, temporarily appoint foreign employees in the positions which require certain scientific qualifications or special experience which is not available in Egypt. The Board may temporarily delegate some jobs or services to foreigners in accordance with the rules of internal regulations.

The referenced foreigners may transfer a portion not to exceed 50% of their salaries and remunerations in foreign currency abroad.

The Authority's Board of Directors, pending approval of His Excellency, the Minister of Electricity, may temporarily appoint Egyptians with high qualifications or certain scientific experience according to the rules of internal regulations.

ARTICLE 17:

Decisions on estates' public utility are made by decrees by His Excellency, the Minister of Electricity, in accordance with the regulations of the Law organizing estates' sequestration for public utility or improvement.

ARTICLE 18:

The Authority to obtain its rights and dues may make administrative seizure procedures in accordance with the regulations of the Law concerning administrative seizures.

ARTICLE 19:

His Excellency, the Minister of Electricity, in coordination with the concerned authorities in the State administration authority, issues the decrees concerning transfer of the employees required by the Authority from these authorities with their grades and categories. These employees maintain their same paid salaries, allowances, and remunerations to which they have been entitled. The value of these allowances and remunerations are amortized from he allowances and remunerations set for the employees of the Authority in accordance with the rules of the internal regulations.

ARTICLE 20:

The internal regulations of the Authority are issued by a Presidential Decree, regardless of the regulations applied in the State administration authority within six months from the date of publishing this Law in the Official Gazette. The rules of these regulations must take the following basis into consideration:

First: Establish salary in relation to performance evaluation.

Second: The maximum limits of the salaries scales annexed to Law No. 58 for the Year 1971, issuing the State civil employment system as regards the permanent employees of the Authority.

Third: The original remunerations which are granted to the temporary highly qualified employees are not to exceed five times the maximum limits of the salaries set in the scale annexed to the referenced Law No. 58 for the Year 1971. The contract with these employees is not to exceed five years, which may be renewable.

Fourth: The additional incentive remunerations and allowances to which the employees are entitled should not exceed double the salary or the original remuneration set for the employee.

Fifth: The basic principles for the unified social insurance system issued as per Law No. 79 for the Year 1975.

Sixth: The values of travel or transportation allowances to the Authority's employees -- classified according to their categories or original remunerations -- is not to exceed the actual costs which they pay.

Seventh: Follow the Unified Accounting System Regulations.

Eighth: Direct Purchase Orders are not to be issued except to monopolizing or highly specialized foreign authorities, or in the cases of emergency, after prior approval by His Excellency, the Minister of Electricity.

Ninth: Apply the most recent warehousing methods as used in similar projects in industrialized nations.

ARTICLE 21:

His Excellency, the Minister of Electricity, issues the necessary decrees to execute this Law.

ARTICLE 22:

This Law is published in the Official Gazette and is operative from the date of publishing.

Issued at the Presidency
on 4 Safar 1396
(Lunar Year)

February 4, 1976 - Anwar El Sadat

SECTION F

LAW 14/1976
ESTABLISHING AUTHORITY FOR EXECUTING THE KATTARA DEPRESSION PROJECT

In the People's Name

HIS EXCELLENCY, THE PRESIDENT

The People's Assembly has passed the following Law which we have issued:

ARTICLE 1:

A general authority named "Authority for Executing the Kattara Depression Project", which has a corporate entity, is hereby established. The Authority is supervised by His Excellency, Minister of Electricity, and is located at Cairo.

This Authority is controlled by the regulations indicated in this Law.

ARTICLE 2:

The Authority is responsible to execute the Kattara Depression Project and all its relevant issues, including the following:

(1) Holding all necessary technical research and economic studies concerning generation of electricity from the Kattara Depression as also its related or subsidiary projects, whether by itself or in coordination with other local or foreign authorities.

(2) Executing all agreements held with foreign governments, local and foreign authorities concerning the project.

(3) Holding agreements with the specialized consultants for performing the designs of the project and their concurrence.

(4) Planning and setting the programs for the project execution.

(5) Studying and deciding the means for project execution and its related work.

(6) Setting basis for project specifications and prequalifications for its execution.

(7) Executing the project by itself, or in coordination with another specialized authority, delegation or companies to execute all or part of the project.

(8) Executing the related, subsequent, or resultant projects as indicated in Article (7).

(9) Prepare the project for operating, and manage it.

(10) Performing consultancy work and executing the projects supervised by the Authority locally or abroad which the Authority may provide itself or through its contacts.

ARTICLE 3:

The Authority's resources are composed of:

(1) The funds allocated by the State;

(2) The funds resulting from its activities or in return for jobs or services which it renders to others locally or abroad;

(3) Loans provided by the State;

(4) Credit facilities acquired by the Authority; and

(5) Grants and Aids.

ARTICLE 4:

The Authority has a special budget prepared in accordance with the internal regulations, regardless of the laws and regulations organizing the General National Budget. The Authority also has a special account wherein it deposits its resources.

The profit is carried forward in the Authority's budget from year to year.

ARTICLE 5:

The Authority may carry out all transactions which may enable it to achieve its goals. The Authority may directly hold transactions with persons, companies, banks, local authorities and foreign authorities in accordance with the rules set by the internal regulations of the Authority.

ARTICLE 6:

The Authority may, within its budget, import itself, or through others without license, any production requirements, materials, machinery, equipment, spare parts and means of transportation which it may need for its operation. This is in accordance with the Authority's internal regulations, regardless of the legal regulations or foreign currency regulations.

ARTICLE 7:

The tools, equipment, and materials imported by the Authority for its projects are exempt from customs duties, taxes, and other fees. The machinery, equipment, tools, automobiles, requirements and other movables which are imported by the companies, authorities and contractors dealing with the Authority are exempt from the customs, duties, taxes, and other fees.

This is based on inspection and the Authority's certification that the exempted goods are imported and necessary for executing its projects. Taxes and duties must be paid for these exempt goods if any transactions to others are being made within five years from date of their exemption.

The interest on international loans and credit facilities held by the Authority is exempt from taxes.

The foreign contractors and subcontractors are exempt from all taxes on salaries, wages, remunerations, and income tax. This exemption applies to the assessed income resulting from their work in executing the Authority's projects.

ARTICLE 8:

The Authority has a Board of Directors formed as follows:

(1) Chairman: Minister of Electricity

(2) Head of the Scientific Technological Research Academy

(3) Regional Governor

(4) An Executive President of the Authority, whose appointment and salary are set by Presidential Decree

(5) Chairman of the Egyptian Electricity Authority

(6) First Under Secretary for Ministry of Electricity

(7) Chairman of the Nuclear Power Authority

(8) Deputy Chairman of the Nuclear Power Authority

(9) Undersecretary for each of the following Ministries: Military Affairs, Finance, Agriculture, Irrigation, Housing, Planning, and Petroleum, each to be appointed by the Minister concerned.

(10) Legal Counselor of the Authority.

(11) Three specialists in the Authority's affairs to be appointed by Ministerial Decree by His Excellency, the Minister of Electricity, who sets their remunerations. This appointment is for a period not to exceed two years and is renewable.

ARTICLE 9:

The Authority's Board of Directors is the highest authority controlling its affairs. The Board carries out its specializations as indicated in this Law. The Board may issue decisions which it may deem necessary to achieve the Authority's goals, especially:

(1) Approving the Authority's Organizational Chart;

(2) Organizing and providing means of training qualified laborers and technicians required for executing and managing the Authority's projects;

(3) Approving the Authority's Annual Planned Budget and Planned Final Account;

(4) Transferring funds from one item to another under the same category;

(5) Establishing the Authority's internal regulations regarding the financial, accounting, administrative, commercial, technical and warehousing affairs as well as other general regulations;

(6) Establishing the personnel regulations for the employment system, employees' insurance, travel per diem, and their transportation fees;

(7) Establishing a control system and performance evaluation criteria according to the economic circumstances;

(8) Suggesting loans acquisition;

(9) Accepting grants and donations offered to the Authority which do not contradict with its objectives;

(10) Studying the periodical reports presented on the Authority's operation and its financial position;

(11) Studying any issues presented by His Excellency, the Minister of Electricity or the Authority's Executive President to the Board concerning any problems within its specialization.

The Board of Directors may form among its members a committee or more to whom some duties may be delegated. The Board may also temporarily delegate to the Executive President of the Authority or one of the managers some of its specializations. The Board may also delegate to one of its members or one of the managers a specific duty or specialization.

ARTICLE 10:

The Chairman of the Board of Directors convenes a meeting at least once a month. The meeting is considered correct only if quorum attendance is made. The Board issues its decisions by quorum voting. If the two voting parties' numbers are equal, the Chairman's party supersedes. In the case of the Chairman's absence, the Authority's Executive President replaces him. The Board may invite to its meetings whomever it deems necessary to utilize his experience without having the right to vote.

ARTICLE 11:

The Executive President of the Authority passes the Board of Directors' decision on to His Excellency, the Minister of Electricity, within three days from date of issuing them for approval. These decisions are considered valid unless His Excellency, the Minister, objects to them in writing to the Authority's Board of Directors within thirty days from date of receiving them.

ARTICLE 12:

The Authority's Executive President is responsible for:

(1) Executing decisions of the Board of Directors;

(2) Managing the Authority, handling its affairs, and developing operational systems;

(3) Providing His Excellency, the Minister of Electricity, and the State authorities with required data, information and documents.

The Authority's Executive President may delegate some of his authorities to a manager or more.

ARTICLE 13:

The Executive President represents the Authority in court and in its transactions with others.

ARTICLE 14:

His Excellency, the Minister of Electricity, delegates temporarily someone to replace the Executive President of the Authority in case of his absence or if his position becomes vacant.

ARTICLE 15:

The Authority's Board of Directors may, after His Excellency, the Minister of Electricity's approval, hold transactions in the foreign currency allocated to the Authority in the National Budget or resulting from the loans it obtains, its activity, or in return for jobs and services rendered by it to others, or grants and donations which it may require in accordance with the internal regulations.

ARTICLE 16:

The Authority's Board of Directors may, pending approval by the Minister of Electricity, temporarily appoint foreign employees in the positions which require certain scientific qualifications or special experience which is not available in Egypt. The Board may delegate temporarily some jobs or services to foreigners in accordance with the rules of internal regulations.

The referenced foreigners may transfer a portion not to exceed 50% of their salaries and remunerations in foreign currency abroad.

The Authority's Board of Directors, pending approval of His Excellency, the Minister of Electricity, may temporarily appoint Egyptians with high qualifications or certain scientific experience according to the rules of internal regulations.

ARTICLE 17:

Decisions on estates' public utility are made by decrees by His Excellency, the Minister of Electricity, in accordance with the regulations of the Law organizing estates' sequestration for public utility or improvement.

ARTICLE 18:

The Authority to obtain its rights and dues may make administrative seizure procedures in accordance with the regulations of the Law concerning administrative seizures.

ARTICLE 19:

His Excellency, the Minister of Electricity, in coordination with the concerned authorities in the State administration authority, issues the decrees concerning transfer of the employees required by the Authority from these authorities with their grades and categories. These employees maintain their same paid salaries, allowances and remunerations to which they have been entitled. The value of these allowances and remunerations are amortized from the allowances and remunerations set for the employees of the Authority in accordance with the rules of the internal regulations.

ARTICLE 20:

The internal regulations of the Authority are issued by a Presidential Decree, regardless of the regulations applied in the State administration authority within six months from the date of publishing this Law in the Official Gazette. The rules of these regulations must take the following basis into consideration:

First: Establish salaries in relation to performance evaluation.

Second: The maximum limits of the salaries scales annexed to Law No. 58 for the Year 1971, issuing the State civil employment system as regards the permanent employees of the Authority.

Third: The original remunerations which are granted to the temporary highly qualified employees are not to exceed five times the maximum limits of the salaries set in the scale annexed to the referenced Law No. 58 for the Year 1971. The contract with these employees is not to exceed five years, which may be renewable.

Fourth: The additional incentive remunerations and allowances to which the employees are entitled should not exceed double the salary or the original remuneration set for the employee.

Fifth: The basic principles for the unified social insurance system issued as per Law No. 79 for the Year 1975.

Sixth: The values of travel or transportation allowances to the Authority's employees -- classified according to their categories or original remunerations -- is not to exceed the actual costs which they pay.

Seventh: Follow the Unified Accounting System Regulations.

Eighth: Direct Purchase Orders are not to be issued except to monopolizing or highly specialized foreign authorities, or in the cases of emergency, after prior approval by His Excellency, the Minister of Electricity.

Ninth: Applying the most recent warehousing methods as used in similar projects in industrialized nations.

ARTICLE 21:

His Excellency, the Minister of Electricity, issues the necessary decrees to execute this Law.

ARTICLE 22:

The Law is published in the Official Gazette and is operative from the date of publishing.

This Law is stamped with the National Stamp and is valid as any National Law.

Issued at the Presidency
on 4 Safar 1396
(Lunar Year)

February 4, 1976 - Anwar El Sadat

SECTION G

LAW NO. 203 OF 1991
PROMULGATING PUBLIC BUSINESS SECTOR LAW

In the name of the people,

THE PRESIDENT OF THE REPUBLIC,

The people's Assembly has passed the following Law and we have issued it:

ARTICLE 1:

The provisions of the attached Law shall apply with regard to the public business sector, by which sector is meant holding companies and their subsidiary companies that are subject to the provisions of this Law.

Both types of these companies shall take the form of joint stock companies, and the provisions of the Law of joint stock companies, partnerships limited by shares and limited liability companies promulgated by Law 159 of 1981 be applicable thereto where no specific provision is made in this Law provided that these be not in contradiction with the provisions of this Law. The provisions of the Law of public sector organizations and companies promulgated by Law 97 of 1983 shall not apply to the companies referred to.

ARTICLE 2:

Holding companies shall replace public sector organizations (authorities) governed by the provisions of Law 97 of 1983 referred to, and subsidiary companies shall replace the companies supervised by those organizations with effect from the date of this Law's coming into force without the need to take any other procedure.

All rights, including usufruct and lease rights, of the cancelled public sector organizations and companies, holding and subsidiary companies as the case may be, shall be transferred to and they shall assume all their liabilities and shall be fully accountable therefor.

The statutes of each of the holding and subsidiary companies shall be published in the Egyptian Events Journal (Al Wakaie Al Missriya) and shall be recorded in the commercial registry at each company's cost and expense.

ARTICLE 3:

Boards of Directors of the holding and subsidiary companies shall be formed in accordance with the provisions of the attached Law within six months from the date of its coming into force.

Present Chairmen and Board Directors of public sector organizations and companies, as the case may be, shall undertake management of the said companies until their new Boards are formed.

ARTICLE 4

Employees at each of the public sector organizations and companies who are in service at the date of this Law's coming into force, shall be transferred to the holding or subsidiary companies at their same positions, wages allowances, leaves, cash and in-kind benefits and compensations.

These employees shall continue to be treated according to all the rules and regulations governing their employment affairs until personnel regulations of the companies to which they are transferred in accordance with the provisions of the attached Law are issued within one year from the said date.

The transferred employee shall retain, in a personal capacity, the wages, allowances, leaves, cash and in-kind benefits (privileges) and compensations which he receives even though they be more than what is entitled to him under these regulations, without affecting any future increment, or benefits entitled to him.

ARTICLE 5:

Without prejudice to what is specifically provided for in this Law or in the accompanying Law, public sector employees regulations issued by Law 48 of 1978 shall not be applicable to employees of the companies governed by the provisions of the accompanying Law with effect from the date of these regulations' coming into force.

ARTICLE 6:

Tribunals of the council of state shall continue to consider the following suits and appeals which were brought to these tribunals until a definite ruling be awarded with regard thereto in accordance with the rules currently in force without the need to take any other procedure.

First: Disciplinary actions, appeals of disciplinary penalties and other actions relating to employees of the companies governed by the provisions of this Law if they were brought prior to the application of the regulations specified in the preceding article.

Second: Other actions and appeals which those companies are parties thereto if they were brought prior to this Law's coming into force.

ARTICLE 7:

Companies governed by the provisions of this Law may not be deprived of any benefits or be charged with any burdens that are prejudicial to equating them with joint stock companies governed by the provisions of Law 159 of 1989 referred to engaged in the same activity. Item (1) of article 6 of Law 66 of 1971 concerning the establishment of a public organization named "Nasser Social Bank" shall be repealed, and the phrase "within the applicable monetary budget" stated in paragraph 1 of Article (1) of Law 118 of 1975 concerning import and export shall be repealed also.

ARTICLE 8:

The President of the Republic shall issue a decree specifying the Minister concerned in the application of the provisions of this Law, and he shall present to the Council of Ministers periodic reports, as specified in the Executive Regulations, on the results of operations of the companies governed by the provisions of this Law.

ARTICLE 9:

An economic authority, a public organization or a public sector company which have special systems decreed for them, may be a Presidential decree after approval by the Council of Ministers, be converted into a holding or an affiliated company under the provisions of this Law.

ARTICLE 10:

Provisions of Article 8 of this Law shall not affect (prejudice) the administrative and executive powers and authorities with which Ministers are vested by Laws, regulations and Presidential decrees.

ARTICLE 11:

The Council of State alone shall be the authority for reviewing the model memorandum of association and model of articles of association of companies governed by the provisions of this Law. The companies referred to may request the council of state through the concerned Minister to give opinion supported by reasons on matters related to their personnel affairs or their Board Directors or other matters relating to any of their affairs.

ARTICLE 12:

The Prime Minister shall issue the Executive Regulations of the accompanying Law within three months from the date of this Law's coming into force. He shall also issue model memorandum of association and model articles of association of companies governed by the provisions of this Law within months from the date of the Executive Regulations' coming into force.

Model articles of association may be multiplicated according to the nature of activity of the companies.

ARTICLE 13:

This Law shall be published in the official gazette, and shall come into force thirty days after the date of its publication.

This Law shall be stamped with the seal of the state and shall be enforced as one of its Laws.

Issued at the Presidency
on 7 Zue Hejja 1411 A H
June 19, 1991
Hosny Mubarak

PUBLIC BUSINESS SECTOR COMPANIES LAW

CHAPTER 1 - HOLDING COMPANIES

SECTION 1
INCORPORATION

ARTICLE 1:

A decree shall be issued by the Prime Minister upon a proposal by the concerned Minister, authorizing the incorporation of the holding company, the capital of which shall be fully owned by the state or by public (*) artificial entities, and it shall have its own artificial entity as of the date of its registration in the commercial registry. The holding company shall take the form of a joint stock company, and shall be considered as one of the special Law persons, and the decree issued for its incorporation shall specify its name, head office, duration, the purpose of its incorporation and capital. The decree issued for the incorporation of the company together with its statutes shall be published, at its cost and expense, in the Egyptian Events Journal (Al Wakaie) and shall be registered in the commercial registry.

ARTICLE 2:

Holding companies shall invest their funds through their affiliated companies, and may undertake the investment themselves when need be.

Holding companies shall contribute to the development of national economy in their field of activity and through their subsidiary companies within the framework of the public policy of the state.

To accomplish its objectives a holding company may:

(1) Establish joint stock companies by itself (alone) or in participation with public or private artificial entities or individuals.

(2) Purchase or sell shares of joint stock companies or participate in their capital.

(3) Form and manage a portfolio of the company with its included shares, stocks, debentures and other financial instruments or assets.

(4) Undertake all actions that would help achieve all or part of its objectives.

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* Judicial Persons

CHAPTER 1 - HOLDING COMPANIES

SECTION 2
BOARD OF DIRECTORS

ARTICLE 3:

A holding company shall be managed by a Board of Directors which shall be formed by a resolution of the General Assembly upon a proposal by the Chairman. The Board's term shall be for three renewable years, and shall comprise an odd number of Directors which shall not be less than seven and not more than eleven members, and it shall be formed as follows:

- A full-time Chairman.

- A number of members not less than five members to be selected from persons having experience in economic, financial, technical, legal and business administration aspects.

- A representative of the General Federation of the Trade Unions (syndicates) of Egypt to be selected by the Federation's Board of Directors.

Neither the Chairman nor the Board members are considered company's personnel.

The resolution issued for the formation of the Board shall specify the full-time Directors, and salaries to be received by the full-time Chairman and Directors. This resolution shall specify the membership remuneration and meeting attendance allowance to be received by the Chairman and the Directors of the Board. The company's statutes shall specify the annual remuneration that they are entitled to subject to the provisions of Article 34 of this Law.

ARTICLE 4:

A person, who has been sentenced to a feloning or a restraining in a crime of dishonesty or bankruptcy, or any of the penalties specified in the Articles 49, 50 and 51 of this Law, shall not serve as Chairman or as member of the Board of Directors of the company.

ARTICLE 5:

The Chairman and, all or part of, the members of the Board of Directors of the company may be removed during the term of office by a causative resolution of the General Assembly in accordance with the procedures set forth in Article 29 of this Law if their continuance in office would be detrimental to the company's interests. The Chairman and members of the Board of Directors of the company may not be re-appointed if the targeted objectives of the company are not achieved during the membership term.

ARTICLE 6:

The Board of Directors shall exercise all the powers necessary to (*) discharge the company's business, and shall undertake all actions required for the accomplishment of the company's purpose, except for those powers assigned to the General Assembly of the company, and in this connection the Board shall in particular:

(1) Lay out the general policies and specify the means required for their accomplishment.

(2) Manage the company's portfolio by sale and purchase of the shares, stocks, debentures and other financial instruments and assets included in it.

(3) Propose establishment of joint stock companies by the company alone or in participation with public or private artificial entities or individuals.

(4) Sale or purchase of joint stock companies or participate in their capital.

(5) Undertake all actions required to rectify financial structures and progress course of its unsuccessful subsidiary companies and to enhance their profitability and cut down (rationalize) costs.

(6) Approve the draft balance sheet and the closing financial statements prior to be presented to the General Assembly of the company.

(7) Set performance standards, evaluation and review reports submitted on the work progress of the company.

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* Dispose of

(8) Approve the company's organization structure and lay out internal regulations for financial administrative, technical and other aspects.

(9) Do what the Chairman of the General Assembly or the Chairman of the Board deem necessary to be presented to the Board.

ARTICLE 7:

The Board of Directors shall meet at least once every month upon a call by its Chairman, and in case of his absence the Chairman of the General Assembly shall assign one of the Board Directors to preside the meeting.

The convocation of the Board shall be valid only if attended by the majority of its members, and its resolution shall be passed by a majority of votes of the attendees, and in case of a tie (equality) the Chairman shall have the casting vote.

The Board may invite to its meeting whomever the Board deems would be of use to it from those having experience from the company's employees or other persons, however, they shall not be counted in the vote on the resolutions of the Board.

The Board may form from among its members a committee or committees to which it may delegate some of its powers, it may also delegate some of its powers to the Chairman or one of its managers. The Board may authorize one of its members or one of the managers to carry out a specific assignment provided that he shall present to the Board a report on the work he carried out.

ARTICLE 8:

The Chairman of the Board shall represent the company before courts and in its dealings with others, and shall be responsible for:

(1) Implementation of the resolutions of the Board.

(2) Management of the company and discharge of its business.

The Chairman shall exercise the powers prescribed by Law and regulations for the Managing Director and shall carry out his duties. He many delegate part of his powers to one or more Directors of the Board.

CHAPTER 1 - HOLDING COMPANIES

SECTION 3
THE GENERAL ASSEMBLY

ARTICLE 9:

The General Assembly shall consist of the following:

(1) The concerned Minister as Chairman.

(2) Members having experience in the field of activities undertaken by the companies affiliated to the holding company, whose number shall not be less than twelve and not more than fourteen members among whom shall be at least one representative nominated by the General Federation of the (Trade) Unions of Egypt. A decree by the Prime Minister shall be issued for the selection of such members, and shall specify the attendance allowance that they receive in accordance with the rules specified by the Executive Regulations.

The meetings of the General Assembly shall be attended by the Chairman and Directors of the Board of the company and auditors of the Central Auditing Agency who shall not be counted in the votes.

The resolutions of the General Assembly shall be passed by a majority of the votes of the attendees except in the cases where the Executive Regulations or the company's statutes require a special majority.

The Executive Regulations shall set forth the conditions required for the validity of the meeting of the General Assembly and the casting of votes on matters presented to the General Assembly at ordinary or extraordinary meeting as the case may be.

ARTICLE 10:

Subject to the provisions of this Law and its Executive Regulations and the company's statutes, the ordinary General Assembly shall:

(a) Approve the Board of Directors' report on the company's activity, and consider discharging the Board from responsibility for the reporting period.

(b) Approve the company's balance sheet and financial statements.

(c) Approve the continuance of the Board Chairman and Directors for another term in office relieving them by secret ballot.

(d) Approve profits distribution.

(e) Consider all that which the Chairman of the General Assembly or the Board of Directors deem necessary to be presented to it.

It shall not permissible to dispose of or sell any of the production lines assets except for after the approval of the General Assembly and to be according to the rules, determined by the Executive Regulations.

ARTICLE 11:

The company's statutes should not be amended except with the approval of the extraordinary General Assembly in accordance with the provisions of the Executives Regulations.

CHAPTER 1 - HOLDING COMPANIES

SECTION 4
THE COMPANY'S FINANCIAL SYSTEM AND AUDITING OF ITS ACCOUNTS

ARTICLE 12:

The statutes shall specify the beginning and end of the fiscal year of the company. The company's funds shall be considered as private property of the state. The company shall deposit its revenues in local and foreign currency in a bank account with the Central Bank of Egypt or one of the commercial banks.

ARTICLE 13:

The holding company shall prepare consolidated financial statements presenting the assets and liabilities, shareholders equities, revenues and expenses and applications (uses) of the company and its subsidiary companies in accordance with the positions, conditions and information set forth by the Executive Regulations.

ARTICLE 14:

The company's net profits shall be determined and distributed by a resolution of the General Assembly in accordance with the provisions of this Law and its Executive Regulations.

The state share in these profits shall revert to the treasury.

ARTICLE 15:

The Central Auditing Agency (CAA) shall audit the accounts of the company and evaluate its performance in accordance with the CAA Law.

CHAPTER 2
SUBSIDIARY COMPANIES
OF THE HOLDING COMPANY

SECTION 1
INCORPORATION

ARTICLE 16:

In the application of the provisions of this Law, a company in which at least 51 % of its capital is owned by a holding company, shall be considered an affiliated.

If this percentage is owned by more than one holding company, public artificial entity or public sector bank, the Prime Minister shall issue a decree specifying the holding company to which this company shall be affiliated.

An subsidiary company shall take the form of a joint stock company and shall have its artificial entity as of the date of registering it in the commercial registry.

ARTICLE 17:

Upon a proposal by the Board of Directors of the holding company, the concerned Minister shall issue a decree for the incorporation of the subsidiary company. This decree, together with the statutes, shall be published, at the company's expense, in the Egyptian Event Journal (Al Wakaie), and the company shall be registered in the commercial registry.

CHAPTER 2
SUBSIDIARY COMPANIES
OF THE HOLDING COMPANY

SECTION 2
COMPANY'S CAPITAL AND SHARES

ARTICLE 18:

The company's capital shall be divided into equal nominal shares. The statutes shall specify (100) shares's nominal value which shall not be less than (5) five Egyptian pounds and not more than one hundred Egyptian pounds. This provision shall not apply to subsidiary companies that replaced, under the provisions of this Law. Companies which were supervised by public sector organizations.

A share shall be indivisible, and shall not be issued at a value lower than its nominal value. It also may not be issued at a higher value except in the cases and at the conditions specified in the Executive Regulations, and such increase shall be added to the Reserve.

The issuance expenses shall not, under any circumstances, exceed the limit to be specified by a resolution of the General Authority for Money Market.

The Executive Regulations shall set forth the information to be contained in the shares' certificates, substitution for lost or damaged certificates and what action is to be taken with regard to these certificates when an amendment is made to the statutes of the company.

ARTICLE 19:

If in-kind tangible or intangible shares are to be included in the capital of the company upon its incorporation or when an increase in its capital is made, the founders or the Board of Directors, as the case may be, shall request the concerned to verify whether these shares have been accurately valuated.

Verification of the accuracy of valuation shall be undertaken by a committee to be formed by a decree of the concerned Minister, and shall be chaired by a counsellor from a Legal Authority to be selected by the Chairman of that Authority. The committee's membership shall comprise no more than four persons having economic, accounting, legal and technical experience, a representative of the founders or the share holders to be selected by the Board of Directors of the holding company or the Board of Directors of the affiliated company, as the case may be, and a representative of each of the ministry of finance and the Central Agency for Accounting.

The committee shall submit its report to the concerned Minister within a period no more than sixty days from the date of referring the papers to it, and the valuation shall become final only when approved by him.

ARTICLE 20:

The company's shares shall be negotiable in accordance with the provisions set forth in the general regulations of the Stock Exchange promulgated by Law 161 of 1957, and the Law of joint stock companies, partnerships limited by shares and limited liability companies promulgated by Law 159 of 1981.

Incorporation share, in-kind shares, and shares subscribed in by the company's founders may be negotiated as of the date of its registration in the commercial registry.

CHAPTER 2
SUBSIDIARY COMPANIES
OF THE HOLDING COMPANY

SECTION 3
THE BOARD OF DIRECTORS

ARTICLE 21:

Subject to the provisions of Article (4) of this Law, a company whose capital is fully owned by a single holding company or together with other holding companies, public entities or public sector banks, shall be managed by a Board of Directors to be appointed for renewable term of three years.

The Board of Directors shall meet at least once every month upon a call by its Chairman, and in his absence the Chairman of the General Assembly shall delegate a Board director to preside the meeting.

The Board shall consist of an odd number of Directors, not less than five and not more than nine including the Board Chairman as follows:

(a) A part-time Chairman having experience, to be appointed by the General Assembly of the company based upon a nomination by the Board of Directors of the holding company.

(b) Part-time members, to be appointed by the Board of Directors of the holding company from among those who have experience, representing the entities participating in the company, and shall form 50 percent of the number of the Board members.

(c) A number of members equal to the number of members who have experience, to be elected from the employees of the company in accordance with the provisions of Law regulating this matter.

(d) The Chairman of the (Trade Union) Committee, who shall not be counted in the vote and in case the company has more than one Trade Union Committee, the General Trade Union shall select one of the Chairmen of these committees.

The General Assembly shall determine the membership remunerations to be received by the Chairman and members of the Board referred to in item (a) and (b) of the preceding paragraph, and the company's statutes shall specify their annual remuneration subject to the provision of Article 34 of this Law.

The General Assembly shall determine the meeting attendance allowance to be received by the Board members, and the annual remuneration of the elected members at an amount not exceeding the annual basic salary.

The holding company's Board of Directors shall elect from among the appointed members set forth in item (b) one or more Managing Directors on full-time basis for management of the company, and shall set the salary to be paid to him in addition to the amounts which he is entitled to under paragraph 4 of this Article.

The Board shall specify who is to replace the Managing Director in case of his absence, if his office becomes vacant or his removal.

The Board may entrust its Chairman with the duties of the Managing Director provided that he shall work full time, and in his case the Board shall determine the salary to be paid to him in addition to the amount, which he is entitled to under paragraph 4 of this Article.

ARTICLE 22:

Subject to the provisions of Article 4 of this Law, a company whose capital is participating in by individuals or artificial persons of the private sector, shall be managed by a Board of Directors to be appointed for a renewable term of three years, and shall consist of an odd number of Directors; not less than five and not more than nine including the Chairman of the Board, as follows:

(a) A part-time Chairman from those having experience, to be appointed by the Chairman of the General Assembly of the company based upon a nomination by the Board of Directors of the holding company.

(b) Part-time members from those having experience, to be selected by the Board of Directors of the holding company, representing the parties participating in the company.

(c) Part-time members in proportion to what is owned by the artificial persons of the private sector or individuals participating in the company, to be selected by the representatives of these parties in the General Assembly.

(d) Part-time members to be elected from the employees of the company in accordance with the Law regulating this matter, and their number shall be equal to the number of the Board members under items (b) and (c).

(e) The Chairman of the Trade Union Committee who shall not be counted in the vote, and in case of having more than one union committee in the company, the General Trade Union shall select one of the Chairmen of these committees.

The General Assembly shall determine the membership remuneration to be received by the Board Chairman and members referred to in items a, b, and c. The company's statutes shall specify the annual remuneration which they are entitled to subject to the provision of Article 34 of this Law.

The General Assembly shall determine the meeting attendance allowance to be paid to Board members, and the annual remuneration which the elected Board members are entitled at an amount not exceeding the annual basic salary.

The Board of Directors of the holding company shall select from among the members set forth in item b, a managing director who shall work on full-time basis and the Board shall specify who is to replace him in case of his absence, if his office becomes vacant or his removal.

The Board of Directors may entrust the duties of the Managing Director to the Chairman in which case he shall work full-time for the management.

The provisions of the preceding Article shall apply to the entitlements of the managing director or the Chairman who works full-time for management.

ARTICLE 23:

The Managing Director shall have all the authorities related to management of the company and shall undertake all actions necessary for the accomplishment of its purpose, with the exception of that which is assigned to the General Assembly and the Board of Directors under the provisions of this Law and its Executive Regulations and the statutes of the company.

ARTICLE 24:

The Managing Director shall represent the company before the courts and in its dealings with others.

CHAPTER 2
SUBSIDIARY COMPANIES
OF THE HOLDING COMPANY

SECTION 4
THE GENERAL ASSEMBLY

ARTICLE 25:

The General Assembly of the company whose capital is fully owned by the holding company alone or jointly with other holding companies, or with public artificial entities or public sector banks, shall be formed as follows:

(1) The Chairman of the Board of Directors of the holding company, or whoever replaces him in his absence, shall be President of the General Assembly.

(2) Members of the Board of Directors of the holding company to which the company is affiliated.

(3) Members from those who have experience whose number shall not be more than four to be selected by the General Assembly of the holding company which shall set the attendance allowance to be paid to them.

(4) Two members to be selected by the union committee, and the meetings of the General Assembly shall be attended by the Chairman and members of the Board of Directors of the company and the auditors from the Central Agency for Auditing, who however, shall not be counted in the votes.

The General Assembly's resolutions shall be passed by a majority of votes of the attendees except in the case where the Executive Regulations or the company's statutes require a special majority.

The Executive Regulations shall set forth the conditions required for the validity of convocation of the General Assembly and the system of voting on the matters presented to it whether at ordinary or extraordinary meetings.

ARTICLE 26:

The General Assembly of the company whose capital is jointly owned, together with the holding company, by individuals or artificial persons of the public sector, shall be formed as follows:

(1) The Chairman of the holding company, or whoever replaces him in his absence, shall be President.

(2) Members of the Board of Directors of the holding company to which the company is affiliated.

(3) Shareholding individuals and artificial persons of the private sector, and they shall have the right to attend the General Assembly in person or by proxy provided that the proxy be established by a written power of attorney and the proxy should be a shareholder, unless the company's statutes required holding a certain number of shares to qualify for attendance. However, each shareholder who holds at least ten shares shall have the right to attend even though the company's statutes stipulate otherwise.

The right to voting of the representatives of the holding company, the public artificial persons, the public sector banks, the private sector artificial persons or individuals, shall be proportionate to the capital share of each in accordance with the voting quorum required by the company's statutes.

Resolutions of the General Assembly shall be passed by a majority of votes of the representatives of capital shares present, except in the cases where the Executive Regulations or the statutes of the company require a special majority.

The meetings of the General Assembly shall be attended by the Chairman and members of the Board of the company and the auditors of the Central Agency for Auditing, who, however, shall not be counted in the votes.

The Executive Regulations shall set forth the conditions required for the validity of convocation of the General Assembly and the method of voting on the matters presented to it.

ARTICLE 27:

Subject to the provisions of this Law and its Executive Regulations and the statutes, the General Assembly shall:

(a) Approve the balance sheet and profit and loss account.

(b) Approve the Board of Directors' report on the company's activity, and release (discharge) the Board from responsibility.

(c) Approve the profits distribution.

(d) Approve the continuance of the Chairman and Directors of the Board in office for another term or remove them, by silent vote.

(e) Consider whatever the President of the General Assembly of the company, the Chairman of the Board of Directors of the holding company, the Board of Directors of its subsidiary company, or the shareholding artificial persons to the private sector or individuals who own 10% of the capital deem necessary to be presented to the General Assembly.

ARTICLE 28:

The statutes of the company may not be amended except with approval of the extraordinary General Assembly and in accordance with the provisions of the Executive Regulations.

ARTICLE 29:

The President of the General Assembly may call the Assembly for an extraordinary meeting to consider the removal of the Chairman and all or part of the members of the Board of Directors of the company during their term of office.

In this case the President of the General Assembly should give notice to the General Assembly and to the Board Directors to be removed stating his view and the reasons on which it is based at least ten days prior to the convocation of the General Assembly, Board Members to whom the notice has been addressed may discuss its contents in a memorandum to be placed with the Secretariat of the General Assembly at least three days before its convocation. The President of the General Assembly shall read the memorandum to the General Assembly, and the member who presented the memorandum may appear before the General Assembly before it makes its decision to refute the reasons of his removal.

The General Assembly shall make its decision by secret ballot, and the removal resolution shall not be valid unless it be passed by a majority of two thirds of the shares represented in the meeting.

A member who is removed by a resolution of the General Assembly shall be deprived of his salary, remunerations and any amounts he used to receive from the company as of the date of issuance of the Resolution.

In all events, the Chairman and Directors of the Board of the company should not attend the meetings of the General Assembly if its agenda includes the removal of the whole Board or some of its members or the Chairman.

In case of removal of the whole Board, the extraordinary General Assembly shall issue a resolution appointing one or more commissioners (mandators) to manage the company on temporary basis until a new Board is formed in accordance with the provisions of this Law within three months from the date of issuance of the removal resolution.

But if the removal be confined to the Chairman or the managing director or some members of the Board, the Board shall be completed in accordance with the provisions of this Law, and the new member shall complete the term of office of his predecessor.

ARTICLE 30:

Without prejudice to the provisions of this Law, the provisions or Articles 59 through 76 of Law 159 of 1981 referred to shall apply to the General Assemblies of companies owned by the holding company jointly with artificial persons of the private sector or individuals.

CHAPTER 2
SUBSIDIARY COMPANIES
OF THE HOLDING COMPANY

SECTION 5
FINANCIAL SYSTEM AND
AUDITING OF THE ACCOUNTS OF THE COMPANY

ARTICLE 31:

The statutes shall specify the beginning and end of the financial year of the company giving regard to the fiscal year of the holding company to which it is affiliated.

ARTICLE 32:

Net profits are the profits resulting from operations undertaken by the company after deduction of all costs necessary for the realization of these profits and after calculating and earmarking all depreciation and provisions as required by accounting standards prior to distribution of profits in any form whatsoever.

The Board of Directors shall earmark at least 5% (five percent) of the profits referred to in the preceding paragraph to form a legal reserve. The General Assembly of the company may stop earmarking this reserve or may reduce its percentage if it has reached 50% (fifty percent) of the capital.

Legal reserve may be used to cover the company's losses and to increase capital.

The company's statutes may stipulate for earmarking a specific percentage of the net profits to form a regular reserve.

If the regular reserve is not allocated for specific purposes set forth in the statutes of the company, the General Assembly, upon a proposal by the Board of Directors, may resolve to use it in whatever may be of benefit to the company or to the shareholders.

The General Assembly, upon a proposal by the Board of Directors, may from other reserves.

The Executive Regulations shall set forth the rules and conditions of distributing distributable (dividends) profits.

ARTICLE 33:

Company employees shall have a share of the profits resolved to be distributed, which shall be determined by the General Assembly based on a proposal by the Board of Directors and which shall be not less than 10% (ten percent) of these profits.

Profits paid to employees in cash shall not exceed the total amount of their basic annual wages.

The Executive Regulations shall set forth the method of allocating profits in excess of total annual wages to services that would be of benefit to the employees of the company.

ARTICLE 34:

The company's statutes shall set forth the method of setting and distributing the remuneration of the members of the Board of Directors. The remuneration of the Board may not be more than 5% (five percent) of distributable profits after the allocation of an amount of profits not less than 5% (five percent) of capital as a prime share for shareholders and employees.

ARTICLE 35:

The Central Agency for Auditing shall audit the accounts of the company and evaluate its performance in accordance with its Law.

CHAPTER 3
GENERAL PROVISIONS

SECTION 1
AMALGAMATION, DIVISION, (TERMINATION) DISSOLUTION AND LIQUIDATION OF HOLDING COMPANIES AND THEIR SUBSIDIARY COMPANIES

ARTICLE 36:

Holding companies may be divided and amalgamated by a decree of the Prime Minister upon a proposal by the concerned Minister, and their subsidiary companies may also be divided and amalgamated by a resolution of the Board of Directors of the company or of holding companies and with the approval of the General Assembly of the merged-in or divided company as the case may be.

Every company created through amalgamation or division shall have an independent artificial entity with the ensuing legal implications.

Subject to the provisions of this Law and its Executive Regulations, the provisions of Articles 130 through 135 of Law 159 of 1981 referred to shall apply to amalgamation cases.

ARTICLE 37:

The committee set forth in Article 19 of this Law shall undertake valuation of net assets of companies in cases of amalgamation and division. The committee's resolutions with regard to holding companies should be approved by the concerned Minister, and the resolutions regarding subsidiary companies should be approved by the General Assembly of the merged and the merged-in company or of the divided company as the case may be.

ARTICLE 38:

If the company's losses reach half the issued capital, the Board of Directors should immediately call the extraordinary General Assembly to consider dissolution or continuance of the company.

ARTICLE 39:

The company shall terminate at any of the following events:

(1) Dissolution of the company.

(2) Expiration of the specified duration in the company's statutes.

(3) Completion of the purpose for which the company has been established.

(4) Amalgamation or division.

The terminated company shall be in a state of liquidation and the provisions of Articles 137 through 154 of Law 159 of 1981 referred to and its Executive Regulations shall apply to it.

CHAPTER 3
GENERAL PROVISIONS

SECTION 2
ARBITRATION

ARTICLE 40:

Arbitration may be requested to settle disputes arising between the companies governed by the provisions of this Law, or between them and public or private sector artificial persons, or individuals, whether local or foreigners, and in this connection, the provisions of the Third Chapter of the Third Book of the Law of Civil and Commercial Proceedings shall apply.

ARTICLE 41:

Requests for arbitration between public sector companies or between them and a central or local governmental body, a general or a public sector authority or a general organization submitted before the date of this Law's coming into force, and disputes on execution of rulings issued with regard thereto shall continue to be heard before the Arbitration Boards formed in accordance with the provisions of the public sector organizations and companies Law promulgated by Law 97 of 1983 and in accordance with the provisions and procedures set forth therein.

CHAPTER 3
GENERAL PROVISIONS

SECTION 3
ON PERSONNEL (SYSTEM) POLICY IN HOLDING COMPANIES AND THEIR SUBSIDIARY COMPANIES

ARTICLE 42:

The company in conjunction with the concerned General Trade Union shall lay out the regulations relating to its personnel policy. These regulations shall include in particular wages, increments, allowances and leaves policy in accordance with each company's organization and these regulations shall be approved by the concerned Minister.

The company, in conjunction with the Lawyers General Syndicate, shall lay down the regulations relating to its legal department observing their respective classification of enrollment on the Lawyers listings, their allowances, the rules and procedures of measuring their performance, their duties and disciplinary procedures with regard to them. Until such regulations are issued, the provisions of the Law concerning legal departments of general authorities and public organizations and their affiliated units promulgated by Law 47 of 1973 shall be applicable to them.

These regulations shall be issued by a decree of the Prime Minister upon a presentation by the concerned Minister.

ARTICLE 43:

The following shall be observed in laying down the rules regulating personnel affairs:

First: Every company shall have an organizational structure and a table of positions compatible with the nature of the company's activities and objectives.

Second: The wages system should comply with the minimum prescribed by Law.

Third: Linking wages, incentives, allowances, bonuses and other compensations and monetary benefits of the employees to the production or turnover achieved by the company and the profits realized.

ARTICLE 44:

The provisions of Articles 78, 79, 80, 81, 82, 83, 85, 86, 87, 91, 92 and 93 of the Law of Personnel Employment in the Public Sector promulgated by the Law 48 of 1978 and the provisions of Law 117 of 1958 concerning the regulation of Administrative Prosecution and Disciplinary Tribunals and the Provisions of the State Council No. 47 of 1972 referred to shall apply with the respect to the duties of employees in holding companies, their interrogations and disciplinary procedures.

ARTICLE 45:

The service of an employee shall terminate for any of the following reasons:

(1) Loss of Egyptian nationality or absence of reciprocal condition for subjects of other countries.

(2) Reaching the age of sixty subject to the provisions of the Social Security Law promulgated by Law 79 of 1975.

(3) Medically unfitted for service.

The provisions of Chapter 5 of the said Law shall apply to Occupational Safety and Health.

The provisions of the Labour Law shall apply to the company's employees where no specific provision is made in this Law or in the regulations issued in implementation thereof.

CHAPTER 3
GENERAL PROVISIONS

SECTION 4
PENALTIES

ARTICLE 49:

Without prejudice to any severer penalty or legal description set forth in the Penal Code or in any other Law, any person who commits any of the following acts shall be publishable by a term of imprisonment not less than two years and a fine not less than two thousand pounds (2,000) and not more than ten thousand pounds (10,000) or either of these two penalties:

(1) Any person who intentionally tampers with the company's statutes, prospectus or any other company documents, or recording therein incorrect information, or in violation of the provisions of this Law or joint stock companies Law (referred to), and any person who knowingly signs or distributes these documents.

(2) Any person who maliciously overvaluates in-kind shares presented by the partners, at more than its true value.

(3) Any manager of member of the Board of Directors who distributes to shareholders or to others profits or interests contrary to the provisions of this Law or the company's statutes, and any auditor who approves this distribution.

(4) Any manager, member of the Board of Directors or liquidator who intentionally states incorrect information in the balance sheet or in the profit and loss account or who intentionally ignores to mention essential facts in these documents.

(5) Any auditor who intentionally makes an incorrect report on the result of his audit or who intentionally conceals essential facts in this report.

(6) Any manager, member of the Board of Directors or auditor or assistant or employee thereof, and any person entrusted with inspection of the company, who divulges any of the company's secrets that he ex-officio has access to, or who uses these as secrets to obtain benefit for himself or for others.

(7) Any person appointed by the competent administrative authority to inspect the company who intentionally states in his report on the result of inspection false events or who intentionally ignores to mention in his report essential facts that would affect the result of inspection.

ARTICLE 50:

Without prejudice to any severer penalty set forth in the Penal Code or any other Law, any person issuing or offering for negotiation shares, stocks, debentures, subscription receipts or temporary certificates contrary to the provisions set forth in this Law, shall be punishable by a fine of not less than five hundred (500) pounds and not more than five thousand (5,000) pounds.

ARTICLE 51:

In case of recurrence, the minimum and maximum fines set forth in the two preceding Articles shall be doubled.

ARTICLE 52:

Funds of companies governed by the provisions of this Law shall be deemed as public funds and those in charge of their management, and their employees shall be considered as public servants with respect to the application of the provisions of Chapters 3 and 4 of the Second Book of the Penal Code.

ARTICLE 53:

Criminal proceedings may not be initiated in the crimes referred to in Articles 116 bis, 116 bis (a) and 116 bis (b) of the Penal Code with regard to members of the Board of Directors of companies governed by the provisions of this Law except upon an order by the Public Prosecutor, the Assistant Public Prosecutor or the First Public Attorney.

ARTICLE 54:

Those charged with verification of the crimes committed in violation of the provisions of this Law and the decrees issued implementation thereof, and who shall be specified by a decree of the Minister of justice in conjunction with the competent Minister, shall have the right to pursue all the records and books of the holding company or its affiliated companies. The Chairman, members of the Board of Directors, the managing director, the auditor and all employees of these companies should present to them all information, data, papers, documents, records and books which they require to perform their duty.

ARTICLE 55:

Without prejudice to the provisions of the preceding Article, no supervising authority of the State, except for the Central Agency for Auditing, may exercise any act of supervision in the head office or branch offices of any of the companies governed by the provisions of this Law unless a permission to do so is obtained from the competent Minister or the Chairman of the Board of Directors of the holding company.

APPENDIX B

DESCRIPTION OF PROJECT TASKS AND PROJECT TEAMS

APPENDIX B

PART A - DESCRIPTION OF PROJECT TASKS

Task I:

The K&M project team shall have a definitional visit with members of the PSED program team to establish final budgets, schedules and any other administrative procedures and contract requirements.

The K&M project team shall prepare a detailed workplan for approval by USAID, (Washington/Cairo Mission) and EEA review: setting forth the sequence of tasks, activities of each team member, and a schedule for attaining critical milestones.

The K&M project team shall perform mobilization activities and contacts with high level Egyptian officials to refine the implementation process and the identification of the MOE resources necessary to successfully carry out the study.

Task II:

The K&M project team shall prepare plan and questionnaires for required information (in Washington).

Task III:

The K&M project team shall assemble documents and information pertaining to:

- legal and regulatory framework in the energy sector;
- Charter and by-laws of EEA;
- Charter and by-law of the eight Distribution Companies and the Electric Distribution Holding company;
- tariffs charged for electric energy sales by customer classification;
- accounting practices;
- balance sheets, income statements and profit and loss statements for EEA and other entities;
- tariff studies already prepared;
- other studies prepared in the last five (5) years for EEA and the Distribution Companies.

Task IV:

The K&M project team shall:

- review EEA's most recent load and energy forecast.
- review EEA's most recent capacity needs' assessment study.
- review present system for generation of electricity, including efficiencies of plants, aging, need for replacement, and evaluation of assets.

Task V:

The K&M project team shall review EEA's most recent long range transmission development plan and integration of isolated systems into the interconnected power system.

The K&M project team shall review transmission by voltage class (i.e., 500 KV, 220 KV, 132 KV), including value of assets, extent of transmission, transmission patterns, transmission losses, transfer price to distribution companies, selling prices to HV customers, sample contracts, and future plans.

Task VI:

The K&M project team shall perform a distribution system study, including review of present system, pricing, collections, losses, and evaluation of assets.

Task VII:

The K&M project team shall review computer systems and computer software applications used in planning.

The K&M project team shall review accounting systems of EEA and distribution companies.

Task VIII:

The K&M project team shall assess profitability and financial work of the different areas of power sector, i.e. generation, transmission, and distribution.

Task IX:

The K&M project team shall review the overall organizational structure of the electric utility organization, including the Ministry of Electricity and Energy's relationship with EEA and the distribution companies.

Task X:

The K&M project team shall prepare a draft final report outlining findings and recommendations. Copies are to be submitted to USAID/Egypt, who will distribute copies to EEA in sufficient time for review before meeting for discussions.

Task XI:

The K&M project team shall meet with EEA, USAID/Egypt, and R&D/EI as requested to answer specific questions and clarify the contents of the draft final report as required.

The K&M project team shall organize and conduct a presentation of the Assessment at the EEA headquarters in Cairo during the twentieth (20th) week of the contract. The presentation will be for representatives of the Ministry of Electricity and Energy, the Egyptian Electricity Authority, other GOE organizations designated by the Ministry of EEA and USAID/Egypt, and other donors designated by USAID/Egypt. The presentation will emphasize the study methodology, major findings and recommendations and long range plans involving policy reforms and institutional development that will allow the Electric Power Sector to grow to meet increased demand, while attaining a degree of financial independence.

The K&M project team shall prepare and conduct briefer presentations for the senior management of the Ministry of Electricity and Energy and USAID/Egypt emphasizing the major conclusions of the assessment, recommendations and the long range plan involving reforms and institutional development.

Task XII:

The K&M project team shall incorporate all appropriate clarifications and suggestions into the Final Report.

The K&M shall provide to USAID/Egypt a camera-ready original copy and fifty (50) paper copies of the Final Report, with annexes, appendices, etc., and two electronic copies adhering to the following software criteria:

1. DOS 3.31 - Disk format on 5 1/4" disks, formatted 1.4 MB, double sided, double density only;
2. Wordperfect 5.51 - for word processing.
3. DBase III+ - for databases;
4. LOTUS 1-2-3 - for spreadsheets; and
5. Harvard Graphics - for charts, graphs, etc.

Three paper copies of the Final report and one electronic copy shall also be provided to R&D/EI.

PART B - K&M PROJECT TEAM

The K&M project team consists of highly qualified personnel to implement the project objective and best serve USAID and EEA's goals. The following is a listing of the specialists involved in Phase I of the project and a brief overview of their experience and background:

Mr. Jerry Geist - Mr. Geist will serve as K&M's Utility Management Specialist. He is the retired Chairman and President of Public Service Company of New Mexico. He retired after thirty years of service, fourteen as its Chief Executive. He is active as a strategy consultant to: NYSE Energy Company, a large multi-national engineering company; two major research laboratories; was chairman of an environmental control manufacturing company; consulted on major, international infrastructure-privatization projects; was instrumental in arranging related financing ($300 M. U.S.$); was a financial consultant for a "multi" state franchise organization, and arranged for its equity and capital resource group; and was a consultant to a large venture capital fund. Mr. Geist is a member of the Advisor Committee of the U.S. Electric Utility for the Federal Energy Administration and the U.S. Department of Labor's Southwestern Regional Manpower Advisory Committee. Mr. Geist has a B.S. degree in Electrical Engineering and received an Outstanding Graduate Award from the University of Colorado, in Boulder. In 1961 he became a Registered Professional Engineer.

Mr. Jose A. Trujillo - Mr. Trujillo is presently vice president for K&M. He is responsible for the overall management and direction of K&M's consulting and business development efforts. He is also the Corporate Director of K&M's Private Sector Energy Development project with USAID. He also was an advisor to the government of the Dominican Republic on matters dealing with privatization and the financing of the electric utility sector. He managed and directed K&M's involvement and participation in privatization projects in Argentina, Poland, and the Caribbean. Mr. Trujillo will be the Policy & Management Specialist. He has over 15 years experience in privatization and management. Prior to joining K&M, he was a consultant providing services in various areas of expertise. He worked on projects that included the potential for implementation of thermal energy efficiency expert systems and evaluation of market and investment conditions. Mr. Trujillo holds a B.S. degree in Marketing and an MBA in Management, from the University of the District of Columbia.

Mr. Ibrahim Khalifa - Mr. Khalifa is presently K&M's Senior Associate. He has participated in various engineering and privatization activities within the company. Throughout his career in industry and management consulting, Mr. Khalifa has dealt extensively with utilities in many countries such as: EGAT in Thailand; Manila Electric in the Philippines; Bombay Electric Supply & Transport; CADAFE in Venezuela; MEW in Kuwait; Electricity Du Liban in Lebanon; the various utilities in Saudi Arabia; and MEW in the Sultanate of Oman. While President of Phelps Dodge Overseas Corporation

and Executive Consultant to Bechtel Power Corporation, Mr. Khalifa has consistently maintained a close working relationship with the Egyptian Electricity Authority. In 1982, he participated in several power generating projects and in the "Organization and Management Enhancement". He has also participated in various studies on tariffs and energy conservation with RCG/Hagler Bailly. Since 1989, he has worked with K&M on various projects including the Kuremat Power Plant Project. Mr. Khalifa started his career as an Electric Power Engineer with the Cairo Electricity and Gas Administration in Egypt and was sent for training with both the Electrite de France, in Paris and the British Electricity Authority, in London. He has over 40 years of worldwide experience in the electric power industry. Mr. Khalifa has a B.S. degree in Electrical Engineering from Cairo University.

Mr. H. John Dunshee - Mr. Dunshee will serve as K&M's Transmission specialist. He has over 30 years of experience in electric utility and transmission operations for Tucson Electric Power Company and Kansas City Power and Light. As Superintendent of Power System Control, he was in charge of energy management, transmission analysis, and dispatching and scheduling. As Principal Distribution Engineer, he was responsible for expansion of 300 distribution circuits and 76 substations. He was also involved in doing load flow studies, short circuit, stability, and relay coordination studies with 345 kV transmission lines. Mr. Dunshee has M.S. and B.S. degrees in Electrical Engineering from the University of Missouri and is a Registered Professional Engineer in Missouri, Arizona, and New Mexico.

Mr. Andrew Ottolenghi - Mr. Ottolenghi is K&M's Director of Utility Operations and will serve as overall technical coordinator and distribution specialist. Throughout almost 40 years of work experience, Mr. Ottolenghi was involved in various aspects of the electric utility field with specialization in its commercial operations and distribution. He was involved in institutionalization of programs to reduce technical and non-technical losses, improvement to the power and load factor of industrial and commercial users, and determination of changes, and its effects, of electric tariffs and metering methods. His experience was gained internationally through work in the U.S., Canada, Dominican Republic, Panama, Egypt, Tanzania, Ecuador, Philippines, and Venezuela. Mr. Ottolenghi has a B.S. degree in Electrical Engineering from the University of Toronto, Canada and also an MBA in Business Administration from McGill University.

Mr. Johannes Peppelaar - Mr. Peppelaar is K&M's Chief Mechanical Engineer and will serve as a steam and fossil power plant specialist. He has over 40 years of work experience in power plant development and maintenance. As Senior Power Plant Engineer for General Electric Corporation, he was responsible for preparation of equipment specifications, equipment and line sizing, and for determination of pre-boiler piping and HRSG's chemical cleaning methods, steam piping, air blowing, etc. for several in-house projects. Mr. Peppelaar has a B.S. degree in Marine Engineering from Scheveningen University in Holland.

Mr. David Wheelock - Mr. Wheelock will serve as Hydro Plant Specialist. He has 13 years of work experience in hydro plant construction and maintenance. Mr. Wheelock's experience includes the design and construction direction of the Upper and Lower Projects, Peterborough Hydro Project, New Hampshire. Additionally, Mr. Wheelock directed the planning and design of numerous pipelines, tunnels, and penstocks, including major waste water interceptors. He also performed hydrologic assessments and energy production determination of the following projects: Wailuku Hydro Project, Hawaii; La Paz Hydro Project, Costa Rica; and Beaver Hydro Project, New York. Mr. Wheelock has a B.S. degree in Civil Engineering from the University of Texas in Austin and an M.S. degree in Water Resources.

Mr. William Lackey - Mr. Lackey will serve as the Utility Accounting Specialist. He has 34 years of utility accounting experience. He served as Vice President, Comptroller, and Chief Accounting Officer of the Public Service Company of New Mexico, New Mexico's public utility. Prior to that, Mr. Lackey was Manager of the Audit Department of Peat, Marwick, Mitchell & Company. He has a B.A. degree in Business Administration, specializing in Accounting, from the University of North Texas.

Dr. William Loehr - Dr. Loehr will serve as Energy Economist. Mr. Loehr has extensive experience in projects dealing with trade problems, payment regimes, credit and financial conditions, and pricing strategies in many developing countries, including: Nicaragua, Kenya, Belize, the Caribbean, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Barbados, and Egypt. He was a participant in the tariff study carried out by RCG/Hagler Bailly for EEA in 1991. Dr. Loehr has a B.S. degree in Economics from the University of Connecticut and a Ph.D. in Economics from the University of Colorado.

Mr. Richard Felak - Mr. Felak will serve as Power Plant Technical Planning Specialist. Mr. Felak, who has over 24 years of work experience in the electric utility industry, worked with General Electric where his responsibility included integrated transmission and generation system modeling and analysis, utility economics, and reliability studies. As Senior International Liaison Engineer, he was responsible for power system planning and engineering studies worldwide.

Mr. Sameh Mobarek - Mr. Mobarek is K&M's Associate in Finance and will serve as Financial Analyst. Mr. Mobarek has worked as Management Information Systems Analyst with Anderson Consulting, developing management systems that control the billing process, metering information, and management reports for Caroline Power and Light. As a Global Energy Markets Analyst for Bechtel Power Corporation, he was involved in the analysis and investigation of the global energy and power markets in the U.S. and abroad, especially in OPEC countries. He has a B.S. degree in Electrical Engineering and Computer Science from George Washington University.

APPENDIX C

STUDIES AND DOCUMENTS REVIEWED FOR EEA

PART A - TECHNICAL DOCUMENTS/GENERATION

(1) Follow-up report January 1993 (Cairo Zone)

(2) Extension of Cairo North Power Plant

(3) Monthly Report for the Unified Electrical Network Operation January 1993

(4) Annual Report of Electric Statistics 1991/1992

(5) EEA Assessment Study Form (Damanhour Power Station 04/20/93)

PART B - TECHNICAL DOCUMENTS/TRANSMISSION - EEA

1. Kureimat 4-300 MW Generation Plant (Feasibility Study) 1988
2. Feasibility Study for 2-300 MW Thermal Plant Ayoun Moussa - 12-91
3. Feasibility Study for 2-300 MW Thermal Plant in Sidi Krir - 10-91
4. Feasibility Study for Expansion of Sidi Krir (2-300 MW) 6.92
5. Transmission Planning Maps (4) Present, 1997/98, 2000, 2010
6. Power System Expansion Program Transmission Lines & Substations by year (6 pages)
7. Sample Load Flow on Peak for 500 and 220 KV Network (2)
8. Typical single line diagrams of 500 and 220, and 66 KV substations (3)
9. EEA Average Daily Load Shapes for Weekdays and Fridays (2)
10. Revised Load Flow for 500 & 200 KV Network with Shoubra 220 KV busses tied together (1)
11. EEA response to CAA'S comments
12. EEA Fixed Assets Summary by Zone
13. Depreciation Schedule for the Entire Power Sector
14. Chart of Accounts from the Unified System of Accounts
15. EEA Actual Costs and Expenses (01/01/93 - 01/31/93)
16. EEA General Financial Department (Actual expenses of wages & salaries 01/01/93 - 01/31/93)
17. EEA Actual Costs and Expenses - Quarterly Report (07/01/92 - 09/30/92)

PART B - TECHNICAL DOCUMENTS/TRANSMISSION - EEA
(Continued)

18. EEA input assumptions for model to forecast foreign exchange, inflation indicators, expenses, and projected balance sheet (computer generated)

19. EEA consolidated balance (06/30/92) (computer generated)

20. EEA Power Sector Study

21. Draft Preliminary Accounting Findings Report.

PART C - ACCOUNTING/CAIRO ZONE

1. Cairo Zone operating expenses (Per power plant and transmission station) for year ending 06/30/92)

2. Cairo Zone income statement (06/30/92)

3. Cairo Zone balance sheet (06/30/92)

4. Cairo Zone

   - Organizational Chart
   - Financial Affairs Organizational Chart
   - Document and Information Flow
   - Cost Centers and Expenses by Power Plant and Transmission Station (06/30/92)

5. Cairo Zone accumulated depreciation per plant (06/30/92)

6. Cairo Zone client energy purchases and payments for 07/92 - 02/93)

PART D - ACCOUNTING/EEA

1. EEA financial status and financial statement for the year ending 06/30/92

2. Modifications to the Unified System of Accounts dealing with accounting for foreign exchange fluctuations (and foreign loan adjustments), imputed interest and rent calculations

3. Summary Description of the Accounting Department and its Various Section (EEA headquarters)

4. EEA Consolidated Balance Sheet (06/30/92)

5. Summary Description of Accounts 2733 and 227

6. EEA Balance Sheets for 1988, 1989, 1990, 1991 and 1992 and Income Statements (computer generated)

7. EEA HQ Balance Sheet for Year ending 06/30/92

8. EEA Long Term Debited (local and foreign) (computer generated)

9. Depreciation Schedules for Generation and Transmission Assets

10. List of Comments included in Central Audit Agency's Report in EEA'S Balance Sheet (06/30/92)

11. EEA Response to CAA'S Comments

12. EEA Fixed Assets Summary by Zone

13. Depreciation Schedule for the Entire Power Sector

14. Chart of Accounts from the Unified System of Accounts

15. EEA actual costs and expenses (01/01/93 - 01/31/93) month of January

16. EEA General Financial Department (actual expenses of wages & salaries 01/01/93 - 01/31/93)

17. EEA actual costs and expenses - Quarterly Report (07/01/92 - 09/30/92)

PART D - ACCOUNTING/EEA
(Continued)

18. EEA input assumptions for model to forecast foreign exchange, inflation indicators, expenses, and projected balance sheet (computer generated)

19. EEA consolidated balance (06/30/92) (computer generated)

PART E - LEGAL FRAMEWORK/EEA

1. Egypt: Reorganization for Electric Power Distribution

2. A.R.E.: Presidential Decree No. 1472 for the Year 1964 establishing the Egyptian General Authority for Production and Transfer of Electrical Energy

3. A.R.E.: Presidential Decree No. 1473 for the Year 1964 establishing the Egyptian General Authority for Distribution of Electrical Energy

4. A.R.E.: Presidential Decree No. 1474 for the Year 1964 establishing the Egyptian General Authority for Executing Electrical Projects

5. A.R.E.: Presidential Decree No. 3726 for the Year 1965 establishing the Egyptian General Authority for Electricity

6. Law No. 12/1976 For the setting up of "Egyptian Electricity Authority"

7. Law No. 13/1976 Establishing the Authority of Nuclear Plants for Generating Electricity

8. Law No. 14/1976 Establishing Authority for Executing Kattara Depression Project

9. Law No. 27/1976 Establishing Rural Electrification Authority

10. Law No. 153/1980 Establishing the A.R.E. National Telecommunications Organization

11. Decree No. 423/1983 by the President of the Arab Republic of Egypt Instituting the Public Sector's Authority for the Distribution of Electric Power

12. Law No. 36/1984 Modifying some articles of Law No. 12/1976 creating the Egyptian Electricity Authority

13. Law No. 12/1976 Establishing the EEA

PART F - LEGAL PLANNING/ECONOMIC

1. The Strategical Generation Alternatives for the Egyptian Unified Power System
2. Electricity Pricing Strategy Study Appendices (Final Report)
3. Electricity Pricing Strategy Study (Final Report)
4. Electricity Pricing Strategy Study (Final Report) Addendum
6. End Use Model
7. RCG Hagler Bailly Study

PART G - MISCELLANEOUS

1. 1981-1990, 10 Years of Achievements of the Ministry of Electricity and Power.

2. Energy Demand in the Developing Countries.

APPENDIX D

USAID COMMENTS TO ADDRESS LEGAL ISSUES

OCTOBER 17, 1993

PART A - THE EGYPTIAN ELECTRICITY AUTHORITY

A.1

The above report described properly the current legal status of the Egyptian Electricity Authority "EEA". This report set forth its legal framework and authorities as a "public Authority" which means that EEA is a governmental entity. The report mentioned also the consequences of this public entity such as the possibility to effect administrative attachment, the enjoyment of exemptions normally granted to governmental bodies e.g., tax exemption and the public status of its employees as a government employees subject to basic rules of the civil service in the State.

A.2

I support the legal facts mentioned in the report, under the first opinion, in order to have EEA operate on a commercial basis. Law 12 of 1976 concerning EEA may be modified or superseded by a new law preserving the government entity of EEA with its government privileges and in the same time allowing commercial operations. Such a law would be very similar to that organizing the Suez Canal Authority. Law 30 of 1973 concerning the Suez Canal Authority states expressly that the authority shall use, without being bound by governmental restriction all appropriate systems of management and exploitation used by commercial basis. It states also that all funds of Suez Canal Authority are considered private funds, its budget is an enterprises. The Suez Canal Authority can set its internal regulations, such as procurement, management and personnel regulations without having to abide by Government regulations.

A.3

I believe that a new law which supersedes the existing EEA law rather than a modification to this existing law, can easily reorganize the new entity of EEA and convert it to a new organization operating on commercial basis pursuant to the new perspective. This new law may adopt appropriate rules which meets the requirements of this sector regarding (1) the degree of autonomy of the new organization (2) the powers of its Board of Directors regarding determination of salaries and incentives to attract and maintain the efficient staff (3) the power to suggest or set, in conjunction with a "Regulatory government or independent Authority", rates and tariffs to cover operation, maintenance and replacement of utilities and facilities and new investments. The new law may set any new rules suitable to the power sector regardless to any other existing laws or regulations. Surely issuing a new law in Egypt normally takes time.

4.A

I approve the legal facts which the report mentioned in its second option, in order to have EEA operate on a commercial basis. Under this option EEA would become the holding company for the generation and transmission of electricity. Promulgating Article 9 of Public Business Sector Companies Law No. 203/1991 states that; any economic authorities, public establishments or public sector companies which have special systems decreed for them, may by a presidential Decree after the Council of Ministers approval, be converted into a holding or affiliated company to be subject to provisions of this law."

4.B

Although some legal interpretation may consider "public Authorities" like EEA are always "Administrative organizations" and they can not be converted to a holders companies, I believe that EEA is considered an "economic authority" and not an "administrative authority" since it performs economic activities in generating and transmitting electricity power. Therefore, it may be transferred to a holding or affiliated company pursuant to promulgating Article No. 9 of Law 203/1991 which allows the conversion of "economic authority" to a holding or affiliated company., This conversion requires the issuance of a presidential decree after approval of the Council of Ministers.

4.C

The report stated that EEA would become the holding company for the generation and transmission of Electricity. This holding company would have several affiliated companies (the number of which to be determined according to a detailed research). The affiliated companies may be privatized pursuant to law 203/1991.

In my opinion this view is correct pursuant to Law 203/1991 and its Regulation. This law is the new law for the Public Sector enacted to free this sector from previous constraints and to enable it to play a prominent role in the process of economic reform in Egypt. Pursuant to Article 1 of this law the capital of the holding company shall be fully owned by the State or by public Judicial persons and the holding company shall have its own artificial entity, take the form of a joint stock company and shall be private judicial person registered in the commercial registry. However, pursuant to Article 2 of this law the holding and it may undertake the investment by itself when needed. Therefore, EEA may be converted to a holding company, this holding company can perform its activities by itself without the creation of affiliated companies. The choice between performing the activities by the holding company itself or through creating affiliated "subsidiary" companies must be determined according to a detailed research taking into consideration the administrative expenses of doing the job in two stages. The first stage is the holding company; the second stage is the affiliated company. It is also important to consider the need to privatize these activities or not, because only the affiliated companies are susceptible to privatization pursuant to this law and its Executive Regulation. The report did not address this choice or the willingness of the Egyptian Government to privatize the

generation and transmission sector but assumed that the holding company will have necessarily affiliated companies.

4.D

It is important to note that, after the conversion of EEA to a holding company, with or without affiliated companies, it will lose its capacity and privileges as a "Public Authority" which are mentioned previously. On the other hand it will gain the advantages of being a private judicial person. It will be vested with all the facilities stated in the new Public Business Sector Law. 203/1991 which are intended to free this sector from constraints. These advantages will enable it to perform its activities on commercial basis within the limits and framework of this law.

4.E

I agree with the report that the second option would be less cumbersome and easer to achieve. The most it would require is a presidential decree after Council of Ministers approval.

4.F

In my view it is important to note that the conversion of EEA to a holding company will release it from the strict ties which relate it to the Minister of Electricity who have the authority to approve or not the decision of its Board of Directors pursuant to Article 1 and 13 of EEA Law No. 203/1991. After the conversion, the holding company will not report to the Sector Law No. 203/1991 the company Board of Directors will exercise all the powers necessary to conduct and run the accomplishment of the company's purpose except for those powers assigned to the general assembly by the company. This General business sector to be appointed by a presidential Decree. The General Assembly shall approve the Board of Director's report on the company's activity, consider discharging the board from responsibility, approve the company's balance sheet and financial statements, consider the continuance or dismissal of the board of directors. The General Assembly also approve profits distribution and approve disposal or sale of production lines assets according to the rules determined by the Executive Regulation.

In my view, although the conversion of EEA to a holding company will release it from the previous strict ties with the Ministry of Electricity, still the Ministry of Electricity and Council of Ministers will retain certain important powers over the company's decisions. Article 10 of the new Public Business Sector Law No. 203/1991 states that the nomination of the minister of the public business sector concerned will not prejudice the administrative and executive powers and authorities with which ministers are vested by laws, regulations and presidential decrees. The power and authorities of Ministry of Electricity and Council of Ministers are stated in EEA Law No. 12/1976. This law provides that EEA Board of Directors recommend the tariff for the distribution and sale of electricity energy to the various users after seeking the opinion of the Central Agency for Accountancy. The Board of EEA proposes the tariffs according to the basis and components of expense (cost) approved by the Higher Council for Electricity Sector and the competent Ministerial Committee. The said tariff will not be enforced unless the Council of Ministers approves it (Article 11 of Law 12/1976).

PART B - THE REGULATORY FRAME WORK

The report recommended that the Egyptian Government would create a regulatory board. This regulatory Board should be organized with the greatest possible independence from GOE. The main function of the Board is to centralize all GOE approvals required by EEA and the EDCOs for issues such as system expansion plans, tariffs, performance standards, etc.

In my view, the creation of this regulatory board with the above organization and authorities requires the issuance of new legislation superseding the existing law No. 12/1976 which confines the power to set tariffs to the competent Ministerial Committee in conjunction with the Higher Council for Electricity Sector and the approval of the Council of Ministers. This ministerial authority to determine the tariffs stated in this law can not be abolished unless a new law annul the aforesaid provisions of law 12/1976. After this legislative nullification, the new Regulatory Board may be established by the appropriate law or Regulation to exercise its authority. The creation of this Regulatory Board primarily depends upon detailed research in the fields of administration, management, economics, finance, etc. to accommodate it with the existing systems after the nullification of Law 12/1976. Also the creation of this new organization raises the question of the expenses related to the creation and functioning of this Regulatory Board and whether it will encumber the sector with a new heavy charge or not. All issues must be surveyed before the establishment of this structure. On the other hand we have to note that the regulatory especially in setting tariffs, would help in the process of fixing tariffs on an equitable basis, responsive to the true cost of operations and services. At the same time it would prevent the abuse of monopoly power within this sector. The independent Regulatory Board may replace the multiple administrative and ministerial committees and bodies in practicing their powers with respect to setting tariffs.

PART C - REPORTS' APPENDICES

There is some confusion and disorder in the report's appendices concerning Laws and Decrees. Certain titles of these laws and Decrees do not relate to respective articles written below. This is the case for Presidential Decrees and Laws in pages A-6 and A-11 in volume 1 and in pages A-6, A-11, A-17, A-24 in volume 2. I consider this confusion due to omissions in the report However, they do not affect the valuable and correct recommendations and results of the report as I mentioned previously.

APPENDIX E

TRAINING AT EGYPTIAN ELECTRICITY AUTHORITY

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TRAINING AT EGYPTIAN ELECTRICITY AUTHORITY

Training is an important investment in human resources and is essential to establishing qualified technical and administrative groups. It also guarantees that performance standards are maintained to support technological development, precision, and security. The training centers are divided in two parts:

Part One

1. Cairo North Electrical and Mechanical Power Training Center

2. Cairo South Electrical Power Training Institution

3. Administrative and Financial Training Center

4. Abukir Training Center/Alexandria Zone

Part Two

1. Fayed Training Center/Canal Zone

2. Talkha Training Center/Central Delta Zone

3. Hydraulic Power Training Center/South Upper Egypt Zone

CAIRO - NORTH TRAINING CENTER

Overview of the Center

The Center was established in 1965 and is one of the oldest training centers.

Location of the Center:

The Center is located in the northern part of Cairo about 8 km from the center of the city, near the electrical power station/Cairo North on Ismalia Canel Street.

Area of the Center:

The total area of the Center is about 9000 sq.m. The building administration and classrooms are 4400 sq.m. The workshops' area is about 2000 sq.m., and the hostel area is about 900 sq.m.

Objective of the Center:

1. To provide skills to technical staff to cope with technological development within their own field of expertise;

2. To supply power stations and modern projects with trained technical staff;

3. To update new EEA employees in the theory and practices of staff activities, information, and training related to EEA's new target technologies.

DEVELOPING STAGES OF THE CENTER

1. The Center was established in 1965 in co-operation with the former USSR.

2. Engineers and technicians were sent to Poland for long and short-term scholarships in different fields.

3. Through co-operation with France's Electricité de France (EDF), some engineers and technicians in the electric sector were trained to examine cables and joints for faults.

4. In 1981, an inclusive agreement was signed with the U.K., represented by the British Cultural Council, to develop all existing sections of the center, including C&I sections.

5. Most of the engineers and technicians were sent to different courses in specialized training centers and institutes. They received practical training in different power stations.

6. The latest agreement was signed with GTZ in 1987, establishing the Center's sections for cable joints workshops and electrical tests. The Center was also provided with documents, training aids, models, and plans for teaching.

   Under this agreement, engineers and technicians are being sent for training in Germany. Experts also come to the Center to offer their experience to improve performance. This agreement increased the Center's training abilities, and it has improved the standards of the staff.

DIFFERENT LABORATORIES AND WORKSHOPS AT THE CENTER

First: Electrical Section

1. Electrical installation workshop
2. Power station workshop
3. Transformers' workshop
4. Electrical lines workshop
5. Cable joining workshop
6. Electrical test lab
7. Electrical extension lab
8. Electrical engineering lab
9. Protection and measurement lab

Second: Mechanical Section

1. Mechanical machinery workshop
2. Fitting workshop
3. Auxiliary power plant workshop
4.
   - Welding workshop
   - Gas welding workshop
   - Argon welding workshop
   - Electrical welding workshop
5. Welding test lab

Third: C&I Section

1. Automatic control lab
2. Electronic lab
3. Mechanic measurement lab
4. Water treatment, gas, and oil analysis lab

Fourth: Auxiliary Workshops

1. Carpentry workshops
2. Forging workshop

- The Center contains a full unit for printing and copying to prepare the necessary printouts and pamphlets.

Fifth: Training aids

1. A library which includes ten thousand books in all fields which serves the Training Center.
2. Audio-visual training aids unit with its motto "a picture is better than a thousand words".
3. Cinema and conference hall for two hundred people.
4. The Center has been provided a video unit.
5. A full-scale copying and printing unit to prepare the necessary printouts and pamphlets.

Sixth: Center Peripherals

1. Trainees' Hostel

It was established in 1989 with a modern system for one hundred people. It contains a video hall, T.V., cafeteria, and kitchen.

2. Sport Club.

It was established in 1984. It provides sporting, social, and cultural activities to provide recreation for and to entertain the employees and the trainees.

SKILLS OF THE CENTER EMPLOYEES

Number	Field	Employees
1	Engineer	38
2	Administrative Development	6
3	Technicians	91
4	Clerks	40
5	Apprenticeship	65
6	Workers	15
Total		**255**

NOTES ON STAFF TRAINING

First: Special Courses

1. Additional courses prepared to suit the technological needs of the recent development of the Center.

2. Various and advanced welding courses to prepare high pressure welding technicians.

3. Staff training courses in methodology, psychology,etc.

4. Electrical courses.

Second: Graduate Classes

According to an agreement with the Ministry of Education, new graduate classes have been developed whereby theory and citizenship are taught in school, while technical and practical training is taught at the EEA Training Centers and at power generation stations.

1. 3-year program in the field of:
   - Electrical Power Station.
   - Power station mechanics.
   - Power stations instrumentation.

2. 5-year program in the field of electrical instruments and control of power stations.

Third: Summer Training

1. Taught by faculties of engineering in different colleges.

2. Industrial education under the 3 and 5-year programs.

TYPES OF TRAINING

Training courses to Improve Technical Standards

A. Electrical Training Programs:

1. Maintenance and operation of measuring and protection equipments
2. Maintenance of Electrical Machines (generators and motors)
3. Establishing and maintaining the transmission lines
4. Maintenance for transformers and distribution panels
5. Maintenance and operation of networks in factories of low and medium voltage
6. Cable joining and testing (low, medium and high voltage)

B. Mechanical Training Courses

1. Operation of steam turbines
2. Operation of steam boilers
3. Maintenance of steam power station auxiliaries
4. Mechanical tools and machinery workshop
5. Courses in gas and electrical welding

C. Training Programs in C&I Section

1. Examination and maintenance of mechanical measurement instruments
2. Automatic control system
3. Water treatment and gas and oil analysis