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Situation Review

Final Report

Egypt Power Pool Project

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Acronyms and Abbreviations

AC	Alternating current
Acc.	Accountant
AGC	Automatic generation control
BCC	Backup Control Center
BOOT	Build-own-operate-transfer
CO2	Carbon dioxide
DC	Direct current
DSM	Demand side management
EC	Electricity Company
EEA	Egyptian Electricity Authority
EEHC	Egyptian Electricity Holding Company
EETC	Egyptian Electricity Transmission Company
EGEAS	Electricity Generation Expansion Analysis System
EGPC	General Egyptian Petroleum Corporation
EMS	Energy Management System
Eng.	Engineer
GOE	Government of Egypt
GWh	Gigawatt-hour
HV	High voltage
IAS	International accounting standards
IPP	Independent power producer
km	Kilometer
kV	Kilovolt
kWh	Kilowatt-hour
LAN	Local area network
LE	Egyptian pound (currency)
LOLP	Loss of load probability
LRMC	Long run marginal cost
M, m	Meter
MIWR	Ministry of Irrigation and Water Resources
MOEE	Ministry of Electricity and Energy
MOF	Ministry of Finance
MOP	Ministry of Petroleum
MVA	Megavolt-ampere
MVAR	Megavolt-ampere reactive
MW	Megawatt

MWh	Megawatt-hour
NECC	National Energy Control Center
NOx	Nitrogen oxides
NREA	New And Renewable Energy Authority
PC	Personal computer
PSDN	Packet switching data network
PSSE	Power System Simulator for Engineering
PTI	Power Technologies Incorporated
RCC	Regional Control Center
REA	Rural Electricity Authority
RFP	Request for proposals
R&D	Research and development
RTU	Remote terminal unit
SCADA	System control and data acquisition
SO2	Sulfur dioxide
UHV	Ultra high voltage
UPS	Unified Power System
USAID	United States Agency for International Development
VAR	Volt-ampere reactive

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Executive Summary

ES.1 INTRODUCTION

The Egyptian Electricity Holding Company (EEHC, formerly the Egyptian Electricity Authority, or EEA) has requested technical assistance to assist EEHC in formulating and implementing a power pooling mechanism in Egypt. The United States Agency for International Development (USAID) and EEHC have selected Nexant to provide this assistance to EEHC.

The Egypt Power Pool Project was planned to be conducted in four phases:

- Phase I - Situation Review. Conduct a detailed review of current conditions in the power sector in order to obtain a comprehensive understanding of the present situation.
- Phase II - Awareness And Training. Provide workshops, study tours, and other activities to assist key personnel first in understanding power pools in general, and then in developing the skills to implement and operate the Egyptian Power Pool.
- Phase III - Planning The Appropriate Power Pool Framework. First, outline the key features of various power pools to provide a basis for the selection of the overall power pool structure. Then develop a detailed design for the power pool, addressing all the important functions.
- Phase IV - Action Plan. Based on the pool design of Phase III, develop a practical action plan for establishing and implementing the power pool. In effect this will be a transition plan for moving from the current situation to a fully functional Egyptian Power Pool.

The draft and final Situation Review Reports are the main Phase I deliverables.

The main work started in August, 2000. The estimated completion date is 15 January, 2002. It was originally expected that Phases I, III, and IV would be undertaken approximately in sequence, with the activities of Phase II spanning the duration of the Project.

However, in order to accommodate EEHC's need to complete certain urgent activities within the first six months, some of the Phase III activities were undertaken immediately upon the commencement of the work, along with the Phase I activities. Specifically we focused on steps leading to the selection of the overall power pool framework as soon as possible. Based on our presentations addressing this issue, EEHC agreed, on 29 October 2000, that the Single Buyer structure would be the basis for the power pool. The Single Buyer will be the sole organization which purchases power from generators, and the sole organization which sells power to Distribution Companies.

This early selection of overall power pool framework permitted us to address EEHC's key objective of having draft agreements for the generators and distributors available within the first six months.

With the selection of overall power pool framework having been made, the remainder of this Executive Summary will provide a high level summary of the results of the Situation Review, with a focus on the aspects that contributed to that decision.

ES.2 TECHNICAL

The existing power sector appears to be essentially sound technically.

- Loads and resources are in balance.
- The generating plants operate at reasonably high average efficiency and availability.
- The transmission system is adequate to serve the existing loads and operates with reasonable losses.
- The distribution system serves the loads adequately. Its losses are somewhat higher than would be desirable. The split between technical and non-technical losses is not known with any accuracy.
- The system is well operated, with reliability and efficiency.
- The system is well planned, having been able to serve rapidly growing loads over the past 10 years and with plans being implemented to serve still rapidly growing loads over the next 10 years. It would be worthwhile to review some of the policy-driven planning constraints, including choice of new plant technology.
- The planning and operations functions have up-to-date software and hardware in place to support their activities.

ES.3 FINANCIAL AND COMMERCIAL

There are noteworthy financial and commercial problems in the power sector.

- Most of the financial ratios of EEHC and the ECs are outside the desirable range. Profit margin, return on equity, return on assets, receivable turnover, inventory turnover, and interest coverage ratios are all too low. Debt to equity ratio is too high.
- If financial results were restated according to International Accounting Standards, the power sector as a whole would probably be unprofitable.
- The recent trend in profitability is not favorable - net operating income fell substantially between the last two fiscal years.
- The high level of non-payment creates liquidity problems throughout the power sector. The average collection period is over two years for EEHC and averages about 16 months for the ECs.
- To provide the facilities needed to meet the planned growth over the next ten years will require capital investments equivalent to many billions of dollars.
- The only existing important formal contracts in the power sector are those between EEHC and the BOOTs. These contracts are not an important constraint on pool design.

These problems have not yet had a significant effect on the technical performance of the power sector. However, given the problems and the trends, failure to address them may well lead to deterioration in the technical and commercial performance.

ES.4 POLICY

To the best of our knowledge the items listed in the bullet lists below represent the GOE's policies, or more precisely in some cases their implementation, and are crucial factors that influence the design of a power pool for Egypt.

The following bullet points relate to the commercial aspects of power sector businesses.

- Tariffs are not set high enough to provide reasonable profit to the Electricity Companies.
- There is a single uniform national electricity tariff schedule.
- The tariff schedule includes large cross subsidies among some classes of electricity users.
- There is a significant problem with non- or late payment of bills.
- There will be no subsidies to the power sector from the Government of Egypt, except to the extent that fuel prices to the generators represent a subsidy.
- The benefits of low-cost hydro are to be shared across the country.

There are plans to make some changes to the structure of the power sector, and to retain some of the existing aspects, corresponding to policies in those areas, as noted in the bullet points below:

- Generation and distribution will be separated into four thermal and one hydro Generation Companies, and seven Distribution Companies.
- EEHC's existing transmission and central dispatch functions will be separated from EEHC and form a new Egyptian Electricity Transmission Company (EETC).
- The newly formed companies should all be profitable.
- The seven Distribution and four thermal Generation Companies will sell shares to private investors, with up to 49% private ownership.
- End-use customers and generators do not have access to the transmission and distribution grids, and cannot use the grid for power transactions between themselves. EEHC is the only organization empowered to buy power from generators.

ES.5 POOL DESIGN IMPLICATIONS

The factors noted in the subsections above, especially the policies, have important implications on power pool design.

- When the functions of generation, transmission, and distribution are separated and all performed in separate companies, then utility power pools which are based on the assumption that members are most or all vertically integrated monopolies are not feasible, because no such organizations exist.

- Competition for generation among the Distribution Companies is not feasible because it would interfere with spreading the benefits of low-cost hydro around the country, increase the overall cost of generation, and make it impossible for all firms to be profitable.
- Competition for generation among end-use customers is not feasible because they do not have access to the grid, and if they did the tariff schedule could not sustain the large cross-subsidies that exist today (among other reasons).
- Distribution Companies with high costs and/or low revenues due to the uniform national tariff schedule will need some form of subsidy, which must come from elsewhere in the power sector.
- A Single Buyer structure and power pool can meet all the constraints.
- Given the distortions caused by the tariff and non-payment issues, mechanisms must be incorporated in the power pool design to address them.

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Section 1 Introduction

1.1 BACKGROUND

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- Phase III - Planning The Appropriate Power Pool Framework. First, outline the key features of various power pools to provide a basis for the selection of the overall power pool structure. Then develop a detailed design for the power pool, addressing all the important functions.
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The draft and final Situation Review Reports are the main Phase I deliverables.

The main work started in August, 2000. The estimated completion date is 15 January, 2002. It was originally expected that Phases I , III, and IV would be undertaken approximately in sequence, with the activities of Phase II spanning the duration of the Project.

However, in order to accommodate EEHC's need to complete certain urgent activities within the first six months, some of the Phase III activities were undertaken immediately upon the commencement of the work, along with the Phase I activities. Specifically we focused on steps leading to the selection of the overall power pool framework as soon as possible. Based on our presentations addressing this issue, EEHC agreed, on 29 October 2000, that the Single Buyer structure would be the basis for the power pool. The Single Buyer will be the sole organization which purchases power from generators, and the sole organization which sells power to Distribution Companies.

This early selection of overall power pool framework permitted us to address EEHC's key objective of having draft agreements for the generators and distributors available within the first six months.

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1.2 OBJECTIVES

As a result of this revised approach to the sequence of the work, the focus of this report is primarily on simply describing the conditions as we found them. Their implications on power pool selection and design have already been presented to USAID and EEHC, and will be briefly summarized in this document.

1.3 APPROACH

The general approach to conducting the work leading to this report was to identify the key areas to review and analyze, meet with the knowledgeable people in EEHC and other organizations and discuss the issues with them, and identify, locate, and review the relevant documents in each area.

EEHC comprises a central organization which performs planning, directs the operation of the bulk electrical system, owns and operates the high voltage transmission system, and undertakes other administrative and headquarters functions. EEHC also is the sole owner of seven regional Electricity Companies (ECs) which are responsible for the generation and distribution of power in their areas. In order to obtain a wide range of perspectives and sources of information, we met with representatives from most of EEHC's main departments, and with representatives from both the generation and distribution functions in most of the ECs.

The representatives of EEHC and the Electricity Companies were uniformly cooperative and helpful. Many of them gave hours of their time and provided us with highly relevant documents. We wish to thank them for their assistance and hospitality.

1.4 ORGANIZATION OF REST OF REPORT

The remainder of this report is organized according to the key areas for investigation:

- Section 2 describes the policy, legal, and regulatory framework.
- Sections 3, 4, and 5 outline the organizational structure of the power sector in general and EEHC in particular, and any planned changes to these structures.
- Sections 6, 7, and 8 summarize the physical system and its planning and operation.
- Section 10 describes the financial issues related to EEHC and the ECs.
- Section 9 covers the existing contractual relationships in the sector, and Section 11 covers two miscellaneous issues (ecological impact of the generating units and fuel mix considerations).
- Appendix A provides details regarding the financial issues.

Section 2

Policy, Legal, And Regulatory Framework

Section 2 Policy, Legal, and Regulatory Framework

2.1 POLICY

Power pool development in Egypt takes place in the context of overall reforms in the power sector. In some countries power sector reform rests upon a policy foundation documented in "white papers" or similar documents approved by the government, and is enabled by specific legislation designed to implement the comprehensive program outlined in the white paper. Typical objectives for seeking reform include a desire to improve poorly performing power sectors, to attract needed investment, to create more competitive power sector businesses, and to raise money from the sale of government-owned assets. All of these motives appear to exist to some extent in Egypt today.

We are aware of no such white paper or other comprehensive policy foundation in Egypt, yet it is clear that the desire for reform is present, as indicated by the Government of Egypt (GOE) taking steps such as:

- Introducing privately financed independent power producer (IPP) projects, contracted for through competitive tenders and under development on a build-own-operate-transfer (BOOT) basis.
- Planning to unbundle the existing ECs into separate Generation Companies and Distribution Companies.
- Establishing "The Electric Utility and Consumer Protection Regulatory Agency" and appointing some of its initial members.
- Transforming the former EEA into the EEHC.

Nevertheless, to the best of our knowledge the items listed in the subsections below do represent the GOE's policies, or more precisely in some cases their implementation, and are crucial factors that influence the design of a power pool for Egypt.

2.1.1 Tariffs and Commercial Issues

The following bullet points relate to the commercial aspects of power sector businesses.

- The Cabinet sets tariffs, which reflect political objectives and are not directly cost-based.
- Tariffs are not set high enough to provide reasonable profit to the Electricity Companies.
- There is a single uniform national electricity tariff schedule.
- The tariff schedule includes large cross subsidies among some classes of electricity users.
- There is a significant problem with non- or late payment of bills.
- There will be no subsidies to the power sector from the Government of Egypt, except to the extent that fuel prices to the generators represent a subsidy.

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- The benefits of low-cost hydro are to be shared across the country.

These policies are quite typical of those in countries starting a transition from a generally socialist economy and a power sector consisting of a state-owned vertically integrated monopoly to an economy with more private ownership and a power sector which includes private ownership, competition, and the "unbundling" of the functions of generation, transmission, and distribution into separate, independent organizations. Although such policies can be effective in achieving social welfare and economic development goals, they mean that the benefits of private ownership and competition are not available, and the pricing distortions impair economic efficiency. There is also a real danger of progressive deterioration of the financial strength of the monopoly as conditions change, and resulting deterioration in the physical system and electrical service.

The policies noted above have the following implications:

- Tariffs set with a significant political influence concern potential private investors.
- Private investors in the Distribution and Generation Companies need assurance that they will be treated fairly and will have a reasonable chance of making adequate profits if they invest and operate well.
- A uniform national tariff covering seven separate Distribution Companies does not necessarily preclude private investment in the affected firms, but it reduces the potential scope of privatization, complicates their finances, and reduces their attractiveness.
- If cross subsidies are too severe, customers who have choices may leave the system (self-generate or buy from others).
- Privately owned firms cannot tolerate such high levels of non- or late payment of bills.
- If subsidies of some firms are needed, they must come from within the power sector.
- It is a policy choice of the GOE how much of the benefit of low-cost hydro should go to electric customers and how much to the GOE for other uses.

2.1.2 Structural

There are planned changes to the structure of the power sector, corresponding to policies in those areas, as noted in the bullet points below:

- A new regulatory body is being formed but is not yet fully operational.
- Generation and distribution will be separated into four thermal and one hydro Generation Companies, and seven Distribution Companies.
- EEHC's existing transmission and central dispatch functions will be separated from EEHC and form a new Egyptian Electricity Transmission Company (EETC).
- The seven Distribution and four thermal Generation Companies will sell shares, with up to 49% private ownership.

These structural changes represent significant steps towards a more open, competitive power sector with much greater private ownership. These steps have some important implications:

- The power pool will need to abide by whatever regulations are developed, will be subject to regulation itself, and will need to coordinate closely with the regulatory body.
- There will be no longer be any vertically integrated utilities in Egypt, therefore a power pool will be required.
- The needs of the new companies' private investors will have to be considered.

In addition to the changes, some existing structural features will be retained:

- The hydro Generation Company, the Egyptian Electricity Transmission Company, and EEHC will remain 100% government owned.
- Retaining government ownership in some or all of the critical central functions, and hydro generation, is commonly done in power sectors in the process of restructuring, but is a policy choice rather than a necessity. The overall financial arrangements must provide for recovery of these costs.
- End-use customers and generators do not have access to the transmission and distribution grids, and cannot use the grid for power transactions between themselves. EEHC is the only organization empowered to buy power from generators.

These are factors that enable cross-subsidies to be maintained. A change in law would be required to overcome this.

2.2 LEGAL

This summary of key legal issues is based upon an initial trip taken to Cairo in December 2000, a brief response from EEHC's legal advisor in February to questions put in writing and left with him in December, and a review of a number of the most pertinent laws relating to the electricity sector. From this initial investigation it appears there are no major legal issues that will adversely affect the creation of a power pool.

However, there will be major legal and related efforts required for the GOE to address the many legal and institutional issues that will arise among the new sectoral entities once EEHC is unbundled (i.e., separated) into separate generation, transmission, and distribution companies. For example, each legal entity should be represented by its own legal counsel during the unbundling process. Where the resources to support this activity will come from is unclear.

There is also an acute need to insure that following unbundling there are legal procedures in place to insure that all transactions are at arm's length and are transparent in nature. It is important for all parties involved in the unbundled companies to recognize that the legal/institutional relationships that will govern day-to-day interaction among the unbundled entities are not purely technical issues that can be worked out easily given the close relationships that will exist among the key officials from their days working together within EEHC. Once EEHC is unbundled, the responsibility of these officials will be only to their Generation or Distribution Company and not to EEHC.

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2.2.1 Legal Background

The basic law governing the production and utilization of electric power in Egypt is Law No. 12 of 1976, which established the EEA. Under the 1976 Law, EEA was established as a public company with the right to create affiliated companies or joint stock companies either by itself or with third parties. The EEA was from the outset given a special budget outside the general state budget as long as it acted in accordance with Law No. 129 of 1947, which concerned the granting of public utility concessions for a period not to exceed thirty years.

Law No. 100 of 1996 amended Law No. 12 to allow public utility concessions for electricity generation to be granted to local and foreign investors for ninety years notwithstanding the provisions of Law No.129 and Law No. 61of 1958 relating to the granting of concessions connected with investments in natural resources and public utilities. It also seems to have extended EEA's authority to regulate the movement of electricity loads on the networks of the distribution companies.

Law No. 18 of 1998 further modified the structure of the electricity industry by bringing all the assets of the seven electrical distribution companies back into the EEA, effectively creating seven vertically integrated utilities within the EEA. Under the terms of Law 18, the workers in the seven distribution zones are effectively transferred to the EEA without any change in their ranks, salaries, and financial privileges and rights. In addition, the capital assets of each of the companies was increased by the amount of the net value of the generating stations and transfer networks added to the distribution companies following verification of the size of these capital assets per Law No. 59 of 1981 concerning corporate companies. Under Law 18, the Board of the EEA takes on the legal function of the general assembly for each of the seven companies giving it the top legal authority for all decisions relating to the merged organizations. Law 18 also modified certain provisions of Law No. 12.

The structure of the Egyptian power sector was further modified by the passage of Law No. 164 of 2000 which transformed the EEA into an Egyptian Joint Stock Company renamed the Egyptian Electricity Holding Company subject to the provisions of the Law on Joint Stock Companies, Partnerships Limited by Shares and Limited Liability Companies as contained in Law No. 159 of 1981 and the Capital Market Law as promulgated in Law No. 95 of 1992. The new law vested the EEHC with a juridical personality which effectively makes the Holding Company a private legal entity.

The institutional structure of the Egyptian power sector was further modified by Presidential decree No. 339 of 2000, which superceded Presidential Decree No. 326 of 1997, creating a new regulatory institution responsible for oversight of the power sector. The new institution, named the Electricity Utility and Consumer Protection Regulatory Agency, has juridical status and is attached to the Ministry of Electricity and Energy (MOEE). The mandate of the institution is broad and encompasses the regulating, monitoring, and control over all matters relating to electric generation, transmission, distribution, and consumption to ensure availability and continuity of supply. This includes satisfying demand with suitable prices, environmental protection, and providing for lawful competition and avoiding any monopolization within the electric power industry.

Finally, also in 2000, the EEHC's Chairman, Dr. Swidan, enacted Administrative Decree 32 to standardize the commercial statutes of all the companies under EEHC.

2.2.2 Unresolved Issues

When unbundling occurs there will need to be a number of commercial arrangements developed which in turn will have to be formalized in contractual/institutional/legal and regulatory arrangements. For the purpose of this "preliminary" analysis, the broad types of arrangements are noted below. (Some of these issues will be addressed in the later work of this project.) Considering the role of the Single Buyer, it will of course have to have agreements for the purchase and sale of electricity.

In addition, as the owner of the transmission system, following the unbundling of its generation and distribution assets EEHC will need to establish transmission connection agreements and transmission use of system agreements with all the Generation and Distribution Companies as well as with ultra high voltage (UHV) and high voltage (HV) direct customers. While primarily technical in nature, these agreements also will need to include financial and economic clauses relating to penalties that may occur to one or more parties in the event of a breakdown in the transmission system.

2.2.2.1 Electricity Purchase Agreement

As the "Single Buyer" of generation services, a restructured EEHC will need to have electricity purchase agreements with each of its former generation companies Ideally, even before any assets are actually sold to investors, these electricity purchase agreements should be structured as legal documents with rights and obligations and in the event of a dispute over the contract's provisions there should be clear provisions for dispute resolution.

An electricity purchase agreement is a complicated document and involves a clear delineation between the buyer and the seller on issues relating to (1) points where metering will occur, (2) dispatch terms and conditions, (3) how power will be transmitted between buyer and seller and, (4) any agreements between the two parties to buy or sell ancillary services. It must also address services provided under the contract, the terms of the contract, the quantity and obligation to supply and how to modify supply obligations if necessary, the quality of supply, and agreements relating to scheduling and dispatch. Further concerns relate to the price of electricity (including availability and energy charges, price changes and indexation and taxes), billing and payment terms, criteria for determining quality, provisions for billing adjustments, dispute resolution procedures, force majeure clauses, what happens in event of default, limitation of liabilities, contract termination clauses, and confidentiality of information provided between the parties.

Other provisions the electricity purchase agreement may need to incorporate include how to comply with demands for regulatory review of contracts, measures to insure compliance with all codes and laws, what law governs in the event of a dispute, what happens in the event of changes in the governing law as well as a host of miscellaneous provisions.

2.2.2.2 Electricity Sales Agreement

As in the case above, as the single seller of electricity to the Distribution Companies and perhaps to UHV and HV customers, EEHC should have separate sales agreements with each

customer highlighting the commercial and technical terms of the sales, as well as outlining procedures for dispute resolution. To insure non discriminatory contract provisions, these contracts in many nations are subject to regulatory review which again means that all parties to the contract must have their own legal counsels and the Regulatory Body must have the institutional capacity to understand the complexities of such contracts and to be able to make a judgment on whether particular contract provisions were met. It will be necessary for all the involved parties to understand the economic and financial dimensions of such contracts.

In an Electricity Sales Agreement there must be clearly defined contractual arrangements between the buyer and seller regarding (among other things) the metering of power, the terms of service provided under the contract, the term of the agreement, the quantity of power provided (including minimum and maximum volumes, supply obligations, and terms for modification of supply volumes) as well as the quality of power to be provided.

The Agreement must specify price conditions regarding the availability of power and how to treat fluctuations in energy prices, conditions for billing and payment, measures to determine power quality, and procedures to adjust disputed invoices. There must be provisions for hearing and settling disputes, measures to be taken in the event of a default by either contracting party, limitations on liabilities, contract termination provisions and contract clauses on confidentiality of information.

There also must be provisions for regulatory review of contracts if demanded by the regulator, provisions for compliance with all codes and laws, a clear statement of the governing law of the contract, which is especially important if foreign companies are one of the parties to the contract, provisions for changes in law and a number of minor miscellaneous provisions.

2.2.2.3 Transmission Connection Agreements

In Transmission Connection Agreements between EEHC and the proposed five generation companies and seven distribution companies there need to be separate agreements stating (1) that the terms of the agreement are static, (2) the process for requests for connection, (3) the terms of ownership of connection facilities, (4) the terms for maintenance of connection facilities, (5) the terms for improvements to connection facilities, and (6) the terms of payment for connection facilities. A Transmission Connection agreement needs to comply with all laws and codes and there must be clearly delineated terms for terminating such agreements as well as procedures relating how to deal with disputes and how to resolve them.

2.2.2.4 Transmission Use of System Agreement

Just as the term implies, a Transmission Use of System Agreement between contracting parties specifies the term of the contract, the services to be provided, the obligations of the Transmission Owner (including provisions on how service will be provided and expanded if requested) and the quantity of service. The Agreement specifies the price (including the wheeling charge as well as provisions for price changes, indexation of fuel prices and taxes), billing and payment provisions, determination of quantity and procedures for adjusting invoices between the parties. A Transmission Use of System Agreement also includes procedures for dispute resolution, force majeure events, default events, limitation of liabilities between the contracting parties, contract termination provisions and provisions for confidentiality of information. A Transmission Use of System agreement includes provisions

for contract review by the regulatory authorities, provisions for compliance with all codes and laws, a delineation of the governing law for the contract and provisions for how changes in law affect the contract.

2.2.2.5 *Ancillary Services*

Ancillary services are services such as reserves which are necessary for the reliable operation of the electrical system. Depending on the overall design of the power pool, there may be a need for ancillary services purchase agreements and/or ancillary services sale agreements between EEHC and the Generation Companies, between EEHC and the Distribution Companies, and between EEHC and UHV and HV customers.

Ancillary Service Purchase Agreements relate to providing reserves (instantaneous, operating and backup), frequency control, voltage support, and black start. Some of these services can be provided by Generation Companies, some by Distribution Companies, and some by UHV and HV customers. The contractual terms for these services are very similar to the contractual provisions of electricity purchase agreements.

2.2.2.6 *Supporting Technical Codes*

In order for the industry to evolve, it is also essential that EEHC and the Generation and Distribution Companies, following unbundling, establish a Grid Code, a Distribution Code, and set Performance Standards for relationships with customers which could be used by the Regulator as a benchmark to be included in generation and distribution licenses. The preparation of these documents will involve the participation of technical, legal, financial and economic experts representing each of the parties in an arms length transaction to insure that the interests of all parties are equally represented.

2.2.3 Specific Legal Issues Related to the Regulatory Agency

EEHC provided responses, summarized below, to questions posed in the draft version of this report, most of which dealt with potential conflicts between Presidential Decree 339 and Laws 18, 100, and 164.

- According to Article VIII (2) of Presidential Decree 339, contracts signed under Law 100 will not be affected by the Regulatory Agency.
- The Regulatory Agency will issue licenses for electric power production, transmission, distribution, and consumption, and will review the plans associated with these same functions.
- EEHC will propose pricing for energy exchanges among generation, transmission, and distribution companies, but the Regulatory Agency has the right to review these prices.
- According to Article VII (6) of Presidential Decree 339, the Regulatory Agency will approve decisions related to the settlement of disputes among entities in the power sector, or between entities and consumers. Parties who do not agree with such decisions can appeal to the courts.
- The Regulatory Agency will issue licenses to existing as well as new companies in the power sector.

- The Regulatory Agency has the authority to monitor and ensure compliance with license conditions during the first five years of the license's term as well as after five years.

2.3 REGULATORY

As noted above, Presidential Decree No. 339 of 2000 created a new regulatory institution responsible for oversight of the power sector. The new institution, named the Electricity Utility and Consumer Protection Regulatory Agency, has juridical status and is attached to the MOEE.

The Regulatory Agency will perform the following duties as stated in the Decree's Article 3:

1. Ensure that the electric power generation, transmission, distribution and selling activities are all fulfilled within the context of abiding by the laws and statutes in force in the Arab Republic of Egypt, in particular those connected with environmental protection.

2. Verify periodically the plans of electric power consumption, production, transmission and distribution, including the investments necessary therefore, to ensure its availability for the different uses, in agreement with the policy of the State in this field.

3. Set the controls to insure legitimate competition in electric power production and distribution activities to secure consumer's interests.

4. Ascertain that the cost of production, transmission, exchange and distribution of electric power will secure the interests of all parties concerned with the activity.

5. Ascertain that a fair yield is realized for the Electricity Utility to guarantee the continuance of its activity and its sound financial situation.

6. Verify the rules of work at the National Center for Control of the Unified Power Grid, with the aim of ascertaining the application of optimal criteria of operation and technical performance levels in coordination with the Egyptian Electricity Holding Company, within the context of interests of all parties to the Electricity Utility.

7. Monitor the availability of technical, financial and economic efficiency of the Electricity Utility.

8. Ensure the quality of technical and administrative services level as provided by the Electricity Utility to consumers.

9. Publish the information, reports and recommendations that would assist the Electricity Utility and the consumers in knowing their rights and obligations, and in acquainting them with the nature of the role played by the Electricity Utility Agency, within the context of complete transparency.

10. Study the subscribers, complaints in a way securing the protection of their interests and settling the disputes that might arise between the different parties concerned with the activity.

11. Granting licenses (see Article 8 for details) for the establishment, management, operation and maintenance of electric power generation, transmission, transmission, distribution, and selling functions.

The Minister of Electricity and Energy shall submit to the Cabinet of Ministers the recommendations and proposals of the Agency requiring the issue of decrees from a higher authority, to take whatever decisions it chooses in respect thereof. The Minister of Electricity and Energy shall also issue the organizational decrees necessary for enforcing the present decree.

The Board of the Regulatory Agency has been formed under the Chairmanship of the Minister of Electricity and Energy. Table 2-1 presents the members of the board, which has met twice by the time of the writing of this document (3 March 2001). The first meeting was more of an introductory one where administrative, legal, and other functionality issues were discussed. The second time the board discussed the candidates for the position of the Executive Director and selected Dr. Mohammed El Sobki from Cairo University.

The Executive Director will work under the general directions of the Chairman and will be responsible for directing the agency and supervising the activities of its different departments.

The MOEE has assigned and is preparing the Regulatory Agency's proposed location, which is the new building for the Rural Electrification Authority in Nasr City.

Table 2-1 Regulatory Agency Board Members

NAME	REPRESENTING
Minister Ali El Said, Chairman	MOEE
Dr. Mustafa Swidan	Electricity sector
Dr. Hassan Younes	Electricity sector
Eng. Fawzia Abu Neima	Electricity sector
Eng. Ahmed Ezz	Industrial customers
Ambassador Moushira Khattab	Public/residential customers
Eng. Saad Nassar	Government and Agricultural
Dr. Farouk Ismael	Institutional and Commercial
Dr. Emad Sharkawie	Expert on ELECTRICITY
Mr. M. El Zawarieh	Expert on LEGAL
Mr. Amr Mohammed	Expert on ECONOMICS

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Section 3

Existing Power Sector Structure

3.1 OVERVIEW

In this section we describe the main organizations which comprise or significantly affect the power sector. The power sector in Egypt is dominated by organizations which are part of or controlled by the GOE, although the trend is in the direction of increasing private sector participation.

In the following subsections we will discuss first the main Ministries and other GOE groups affecting the power sector, then provide more detail on the MOEE, and finally discuss the situation regarding power sector tariffs.

3.2 GOVERNMENT OF EGYPT

Several branches of the GOE play important roles in the power sector, as illustrated in Figure 3-1. "Other Ministries" play less important roles which will not be discussed further. The GOE also has an important role in the development of the BOOTs - it is the ultimate guarantor of payments to them.

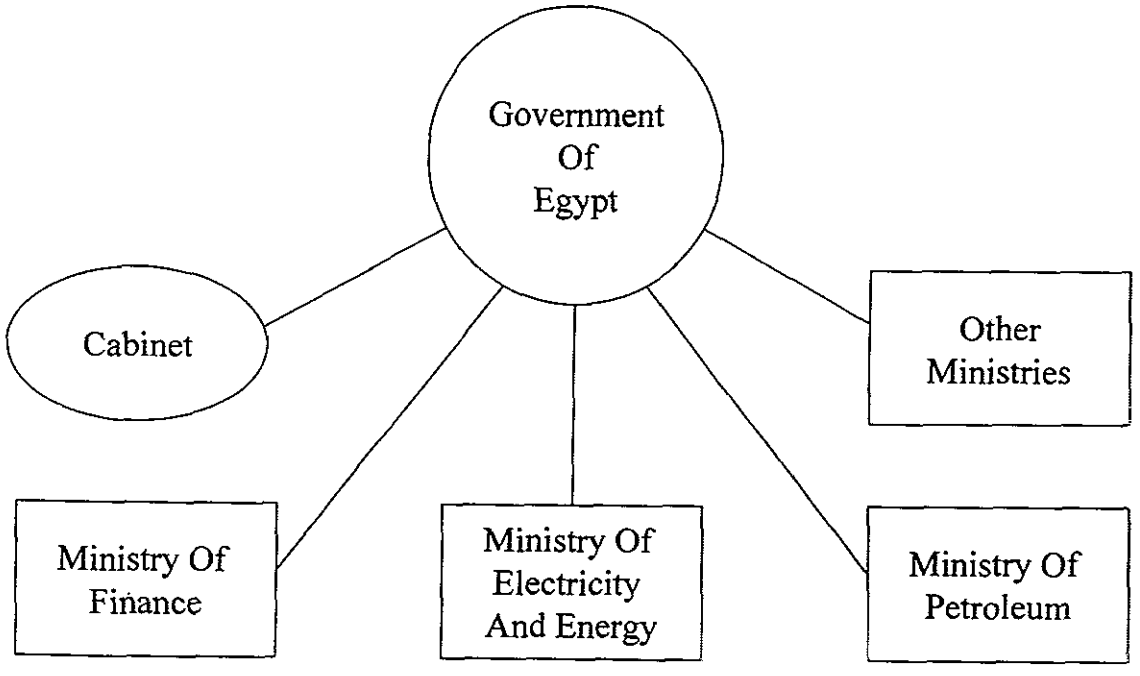

Figure 3-1 Government of Egypt Roles

3.2.1 Cabinet

In addition to its advisory role, the Cabinet plays a crucial role in the power sector through its authority to approve the tariff schedules that apply throughout the power sector. Especially as private investment becomes a more important part of the power sector, and GOE subsidies are removed. the balanced use of this power will be vital to the future financial strength of power sector organizations and ultimately their technical and commercial performance.

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3.2.2 Ministry of Finance

The Ministry of Finance (MOF) serves as general financial advisor within the GOE. In addition, it has several direct interactions with the power sector:

- Each of the seven ECs has its own individual debt obligations to the MOF.
- The interest payments on this debt are current, but full payments for principal are not being made.
- At 30 June 2000, the 1.7 billion Egyptian pounds (LE) owed by the EEHC to the MOF was cancelled and became part of the capitalization of the EEHC, offsetting a corresponding amount of money owed EEHC by other GOE entities.
- After separation of the ECs into Generation and Distribution Companies, plans are that all such Companies will make payments directly to the MOF.
- The money owed to EEHC and the ECs by branches of the GOE and by GOE-owned organizations may be subject to future debt-for-debt swaps, but there are barriers to such swaps.

3.2.3 Ministry of Petroleum

The Ministry of Petroleum (MOP) is responsible for setting up and monitoring the implementation of energy polices related to petroleum sector activities. A main authority under the MOP is the General Egyptian Petroleum Corporation (EGPC).

EGPC is responsible for crude oil and natural gases activities in Egypt, including exploration, production, conversion and processing, transportation, and distribution. It owns fully or partly a number of refineries and companies in the petroleum sector including joint venture companies for oil and gas production. The ECs' generating plants all receive their fuel directly or indirectly from EGPC.

3.3 MINISTRY OF ELECTRICITY AND ENERGY

The MOEE has primary ministerial responsibility for the generation, transmission, and distribution of power. Figure 3-2 illustrates its organization. EEHC, which is the main organization actually providing the generation, transmission, and distribution of power, is described in Section 4.

3.3.1 Electric Utility And Consumer Protection Regulatory Agency

The Electric Utility And Consumer Protection Regulatory Agency has responsibility for oversight of the power sector. The mandate of the Regulatory Agency is broad and encompasses the reorganizing, monitoring and control of all aspects of the power sector including electricity production, transmission, distribution, and consumption, the control of price, environmental protection, and the fostering of "legitimate" competition to avoid monopolistic control of any aspect of the industry. It is discussed in more detail in Section 2, which addresses the power sector's policy, legal, and regulatory framework.

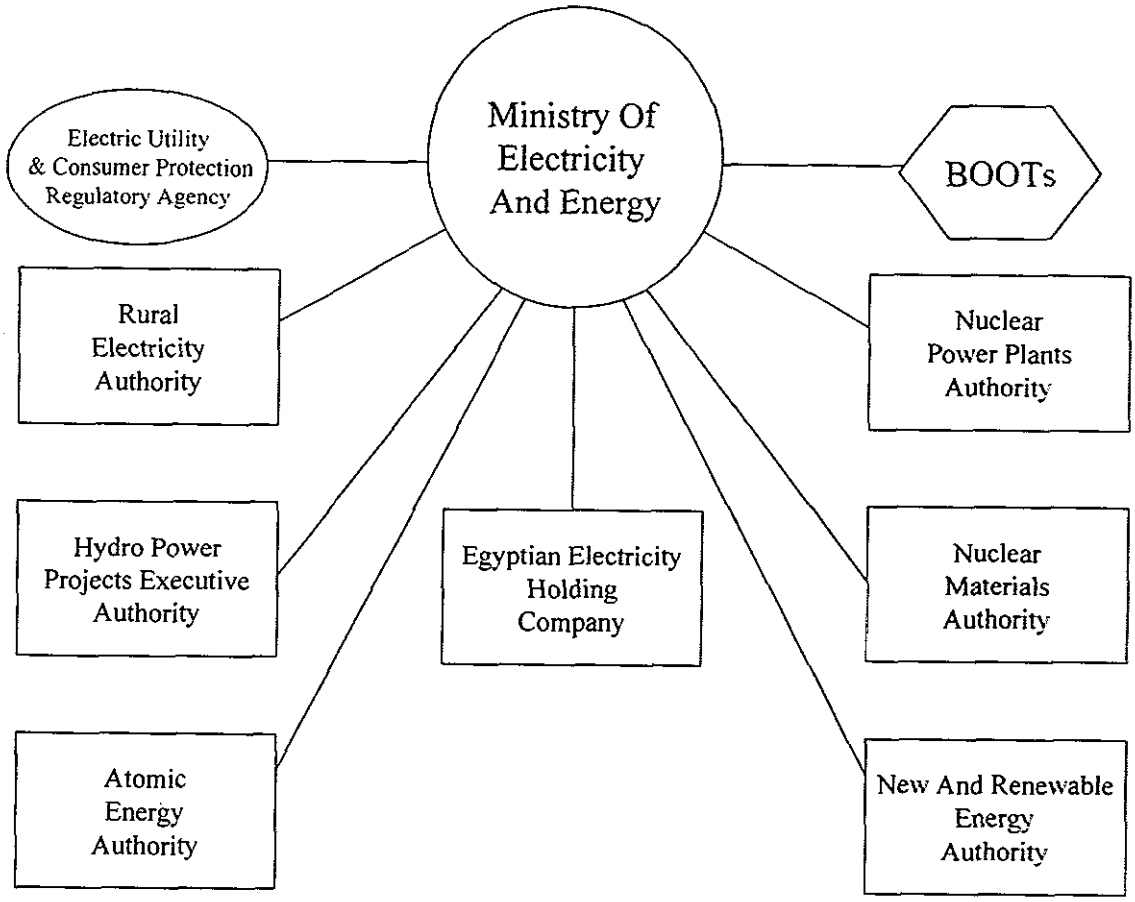

Figure 3-2 Ministry of Electricity and Energy

3.3.2 Rural Electricity Authority

The Rural Electricity Authority (REA) is responsible for the planning and construction of the high, medium, and low voltage distribution networks in the rural towns and villages. The number of electrified main villages and large settlements has reached about 6,100, and the electrified small settlements (of less than 1,000 inhabitants) numbers about 23,000.

3.3.3 Hydropower Power Projects Executive Authority

The Hydropower Power Projects Executive Authority is responsible for the study, design, and construction of hydropower plants projects.

3.3.4 Nuclear Power Plants Authority

The Nuclear Power Plants Authority is responsible for all aspects of nuclear power plant projects. Its work to date has been involved:

- Studies of sites and appropriate types of plants.
- Preparing tender documents for the first nuclear power plant.
- Bidding and negotiation associated with the first nuclear power plant.

This project was cancelled after the Chernobyl accident. Currently the generation expansion plan for the next ten years includes the 600 MW El Dabaa nuclear power plant in 2010.

3.3.5 New And Renewable Energy Authority

The New And Renewable Energy Authority (NREA) is responsible for:

- Identifying and evaluating new and renewable energy resources
- Planning for their development
- Carrying out technical, economic, and environmental studies needed for renewable energy development
- Implementing new and renewable energy projects through its own means or co-operation with others
- Implementing demonstration and field-testing projects for renewable energy technologies.

Renewable energy concepts have appeared in the national energy plan since 1980, but NREA activity began with the establishment of the New And Renewable Energy Authority in 1986 through law 102/1986. NREA's focus was to be on solar, wind, and biomass resources.

3.3.6 Atomic Energy Authority

The Atomic Energy Authority is responsible for conducting research on different peaceful applications of atomic energy to fields of interest such as medicine, agriculture, radiation technology, control of radiation levels, regulatory procedures, and training of personnel.

3.3.7 Nuclear Materials Authority

The Nuclear Materials Authority is responsible for studies to determine the potential for nuclear fuel materials in the country, and ultimately the processing of these nuclear materials.

3.3.8 BOOTs

BOOT projects have been chosen for several power plants under construction, and at one time it was planned that all or nearly all major new generation projects would be done on a BOOT basis. A project's technology, primary fuel, location, etc., can be mandated by EEHC, as it deems appropriate.

The projects offer the advantage of reducing the ECs' need for debt and equity capital to support the investment requirements of costly large projects. Part of the objective also is to obtain the price benefits of competition and the investment and operating efficiency benefits of private ownership.

We understand that the signed contracts to date are between the BOOT owners and EEHC, but we also understand that they include payment guarantees from the GOE, as represented here by the MOEE.

BOOTs provide an opportunity for the power sector, but raise issues that are not easy to resolve:

- What fraction of new plant capacity should be acquired through BOOT projects?
- What needs to be done to make the BOOT projects feasible without GOE payment guarantees?

- Eventually it may be necessary to have much more flexible dispatch provisions in the contracts. At what point will it be necessary to negotiate for that?
- GOE payment guarantees suggest that the power sector itself is viewed as not being a sufficiently reliable business partner. Would it be better to address the fundamental commercial problems so that such guarantees would not be needed?

3.4 POWER SECTOR TARIFFS

Table 3-1 presents the current tariff schedule. The history leading up to this schedule, and the schedule itself, includes the following elements, among others.

- Around 1990 there was pressure from the World Bank to increase tariffs to reach long run marginal cost (LRMC), from a starting point of about 40% of LRMC. As a result of a series of increases and the redefinition of LRMC based on natural gas cost, the claim can be made that the levels approached LRMC.
- Actual current costs are higher than the hypothetical LRMC.
- Tariffs are virtually unchanged since 1992. In 1994 only the Public Lighting category increased. In 1996 the rates for small agricultural customers were decreased.
- EEHC does cost of service for five classes: residential, commercial, and three levels of high voltage industrial. Tariff rates also vary according to the level of usage.
- The tariff schedule includes increasing block rates and very large cross subsidies among customer classes.
- The tariff structure (i.e., cross subsidies, overall level) is set by the Cabinet with due consideration of social and political objectives.
- Costs have increased since 1992,with no corresponding increase in the tariff schedule.
- Merrill Lynch recommended that tariffs increase yearly according to fuel cost increases. No action was taken.

The financial analysis presented in Section 10 shows that revenues to EEHC and the ECs under this tariff schedule are not sufficient to provide a reasonable level of profit for all the firms. If the negative impact of the high level of non-payment were incorporated, then the situation would be even worse.

When all the main power sector organizations are owned by the government, and it limits customers' ability to seek other suppliers, it can be feasible to have a tariff schedule with large cross subsidies and which provides inadequate profit levels. This may be desirable to achieve national policy goals such as industrial competitiveness, rural electrification, affordable electricity to poor households, and so on. The financial and technical strength of the power sector can be maintained through direct or indirect subsidies from the government, or from donors. However, this approach becomes progressively less feasible when the government's ability or willingness to provide subsidies decreases and/or donors' contributions decrease. Ultimately, the money to build and operate the power sector must come from somewhere. If the customers do not provide it, some one else must, or power sector will begin to deteriorate.

Table 3-1 Current Tariff Schedule

Customer Class	Energy Rate, Piasters/kWh	Demand Rate, Egyptian Pounds per kW-month
1 UHV		
Kima	4.7	
Other consumers	6.8	
2 HV		
All consumers	11.34	
3 Housing Companies	10.7	
4 MV & LV		
4.1 More than 500 kW		
All Consumers	15.35	7.3
4.2 Less than 500 kW		
Agriculture	7	
Other Consumers	18	
5 Residential		
0- 50 kWh/month	5	
51 - 200 kWh/month	8.3	
201 - 350 kWh/month	11	
351 - 650 kWh/month	15	
650 - 1,000 kWh/month	21	
More than 1,000 kWh/month	25	
6 Commercial		
0- 100 kWh/month	18	
100 - 250 kWh/month	26	
251 - 600 kWh/month	32.2	
601 - 1,000 kWh/month	41	
More than 1,000 kWh/month	43	
7 Public Lighting	30	

Section 4

EEHC Structure And Organization

Section 4 EEHC Structure and Organization

4.1 BACKGROUND

EEHC and its subsidiaries are responsible for providing nearly all of the electrical generation, transmission, and distribution in Egypt today. The structure of the power sector has undergone several changes in the past ten years, and more changes are planned (see Section 5). Its current structure and organization are a product of this history.

- Law No. 12 of 1976 established EEA, which had direct responsibility for all electrical generation, transmission, and distribution in Egypt.
- In addition to its headquarters functions, EEA eventually came to include many generation plants, seven distribution zones selling to lower voltage customers, and the transmission and dispatch organizations. It sold directly from the higher voltage grids to large customers that amounted to about 25% of total demand in 1998.
- Non-EEA generation was permitted from 1984 for industrial facilities building power plants for their own use, and from 1996 for privately owned and operated independent power producers (IPPs) which could sell only to EEA.
- In 1992 the seven distribution zones were separated from EEA and transformed into separate companies. The state Holding Company for Electricity Distribution was the formal owner of those companies, with the hope that they could be privatized.
- In 1998 those Distribution Companies were brought back into EEA. The generating plants within their geographic areas were transferred to their ownership, creating the seven current ECs.
- In 2000 EEA itself was transformed into EEHC, still owner of the ECs but then also effectively a private company, owned by the MOEE.

4.2 GENERAL DESCRIPTION

Figure 4-1 illustrates EEHC's organizational structure prior to any of the proposed changes and the separation of generation and distribution. Its Board of Directors governs EEHC, which as of March 19, 2001 has 15 members. The current Chairman of the Board is the newly appointed Dr. Hassan Younes.

EEHC has three main kinds of organizational elements. The Electricity Companies are separate companies, wholly owned by EEHC. What Figure 1 shows as "Departments" are EEHC's headquarters organizations, nearly all located in or near Cairo, including the group (within Operations) that performs the central dispatch function. The Transmission organizations are also part of EEHC itself, but they are responsible for operating and maintaining the 500, 220, and 132 kV transmission network and substations. They are operating organizations which cover the entire country.

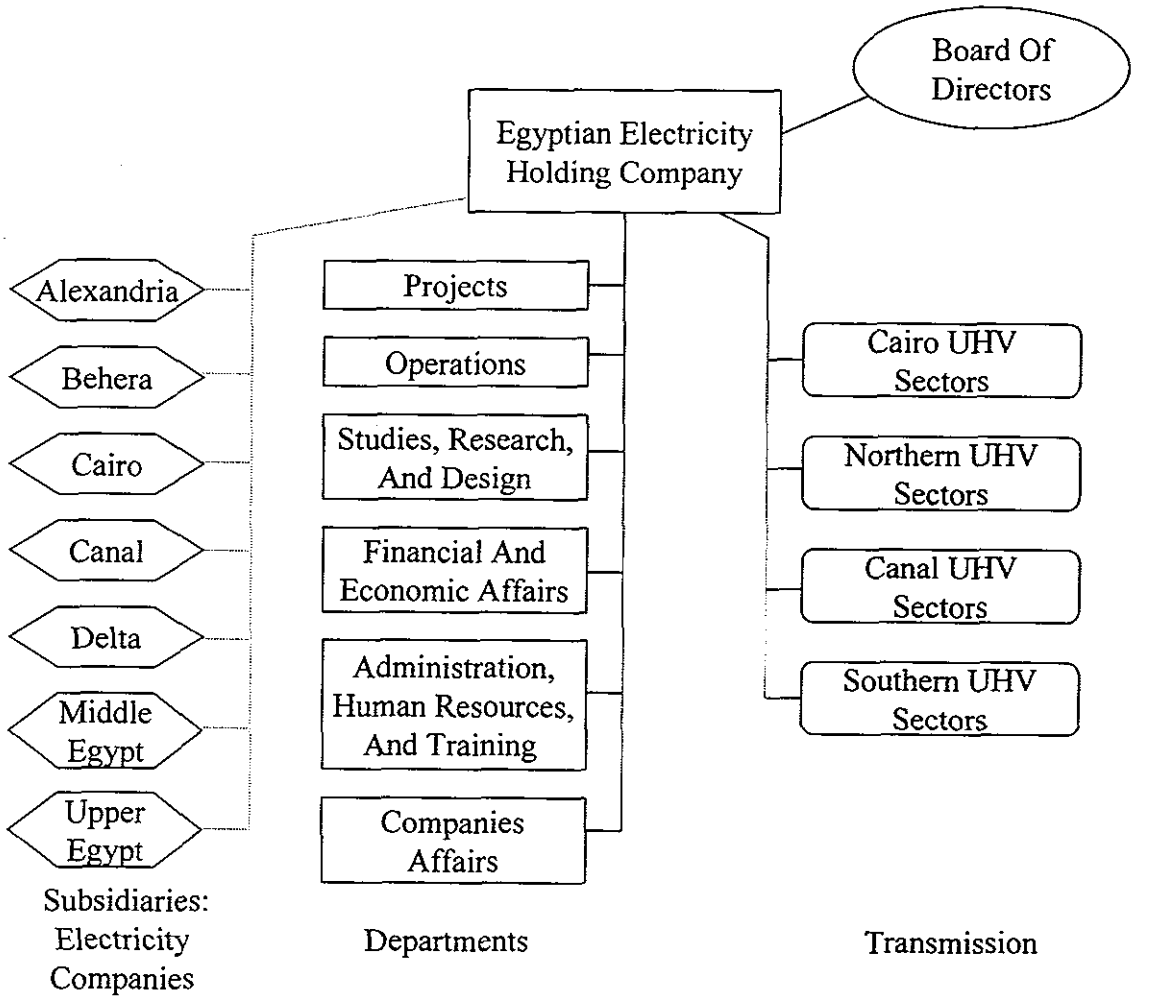

Figure 4-1 EEHC Organizational Structure

4.3 SUBSIDIARIES

Each of the seven ECs owns some generating plants, the lower voltage networks, and related support facilities. Each of ECs has its own Board of Directors. Certain Vice-Chairmen from EEHC also serve on the governing body for each of the ECs. Other Sections of this report provide data on their loads, generation, and financial situation.

Reflecting their creation as a combination of previously existing generation and distribution organizations, each EC has a Chairman from either the distribution or generation function. The Vice-Chairman is from the other function.

The ECs serve all of the customers connected to their networks. In sparsely populated areas, the ECs own small "remote" generators and serve local customers on isolated grids not connected to the national grid. Each EC provides basically the same services. The subsections below describe some noteworthy points regarding the different ECs.

4.3.1 Alexandria

Alexandria EC is the second largest of the ECs. The Chairman is Eng. Ahmed El Mofty, responsible for the distribution function. The Vice-Chairman is Eng. Samir Zazouh who

leads the generation and electricity production function. It has about 17,000 employees. Alexandria EC used to have the smallest generation capacity, but with the addition of Sidi Krir 1 and 2, which are on line, and the future BOOT plant Sidi Krir 3 and 4 (expected to be on line in early 2002) it will no longer be the smallest.

In the year 1999/2000 its sales of 5.19 billion kWh were divided among a total of 1.42 million customers, of which 1.33 million were residential, 87,902 commercial, and 110,000 industrial. The average selling price was 13.88 piasters/kWh. Its collection ratio is about 85%.

4.3.2 Behera

This company is sandwiched between the Alexandria, Cairo, and Delta ECs. The Chairman is Eng. Mokhtar Fadel, responsible for distribution. The Vice-Chairman is Eng. Hosni El Kholy, responsible for the generation side of the company. Behera has about 11,000 employees and is the smallest EC in terms of number of employees and number of customers. In year 2000 it generated 6.6 billion kWh and was a net exporter of energy.

In the year 1999/2000 the Behera EC had a total of 963,637 million customers of which 948,040 were residential, 34,000 commercial, and 62,480 industrial. The average selling price was 13.14 piasters/kWh.

4.3.3 Cairo

Cairo EC is the largest of the ECs. The Chairman is Eng. Abdel Hamid Ismail, responsible for distribution; the Vice-Chairman is Eng. Mohammed Said Abdel Monem, responsible for generation.

Cairo EC serves approximately 5.02 million customers or approximately 40% of the national total. In year 1999/2000 it sold 19.44 Billion kWh, of which it generated over 17 billion, with the rest imported. The Cairo EC employs almost 24,000 people, of which approximately 8,000 work in generation and the rest in distribution. Of the 5.02 million customers, approximately 4.19 million are residential, 516,319 commercial, and 304,438 are industrial. The average selling was 13.9 piasters/kWh

The Cairo EC serves about 95% of all the government ministries, offices, embassies, hotels, hospitals, and other key customers who have special requirements for very high reliability (most of these must have two separate feeders to ensure redundancy and reliability).

4.3.4 Canal

The Canal EC has the largest geographical area. The Chairman is Eng. Hegazay Ali Ayad, responsible for generation; the Vice-Chairman is Eng. Ismael Ibrahim Hilal, responsible for distribution. The company has 19,045 employees.

The Canal company had approximately 1.97 millions customers in 1999/2000, mostly on the Suez Canal cities from Port Said to Ain El Sokna. Of these 1.33 million are residential, 87,906 are commercial, and 38,919 industrial. The average selling price was 14.84 piasters/kWh. They also service all of Sinai, where much growth is expected in the next ten

years. The second and third BOOT projects will dramatically increase generation in their geographic area, at Suez and Port Said.

The Canal EC was one of the first to switch accounting systems and has started to use International Accounting Standards. They also have a highly computerized operation.

The largest new and renewable energy generation in the country is in Canal, with wind farms capable of generating up to 30 MW already installed. In year 2002 they will start work on a 100 MW hybrid solar (sun-energy) and combined cycle gas power plant. Due to its hybrid developmental nature, the World Bank will offer this project a 50 million grant. To maintain private sector involvement, this project is expected to also be offered on a BOOT basis for the remainder of the financing.

4.3.5 Delta

The Delta EC used to be divided into North And South Delta; however, in 1998 they combined all their distribution (North and South) and also all the generation (from Middle and West Delta). The Chairman is Eng. Ahmed Mohammed Abdulla El Husseiny, responsible for distribution and the Vice-Chairman is Eng. Samir Ezz El Arab from generation. The company has over 21,000 employees.

The Delta EC had during 1999/2000 approximately 3.89 million customers, of which 3.34 millions were residential and agricultural (consequently most are subsidized due to the tariff structure), and 186,682 were industrial. In the same year it generated the second most thermal energy after Cairo, approximately 11 billion kWh or about 20% of all thermal energy generated that year in Egypt.

4.3.6 Middle Egypt

The Middle Egypt EC is geographically between Cairo and Upper Egypt. It covers five govern rates: Beni Suef, Menya, Assuit, Fayoum, and the New Valley.

The Chairman is Eng. Mohammed El Sayed Ibrahim, responsible for generation and the Vice-Chairman is Eng. Mahmoud El Sayed Ghali, responsible for distribution. The company has almost 12,000 employees. In the current energy transfer pricing policy Middle Egypt is the biggest winner in that it in effect buys low cost hydro-energy from Upper Egypt and sells it to Cairo at a profit. The main 500KV transmission lines go from one end of its geographical border (south) to the other (north). The transmission lines belong to the EEHC, and they too get their margin for transmitting the energy from its source at the hydro stations to its use mostly in Cairo.

The Middle Egypt Company has the largest and most advanced research and development (R&D) group. With a budget of approximately one million L.E., they have developed their own SCADA components and sell their R&D services such as those for sizing correction of reactive power compensation units. In year 2000 Middle Egypt generated about 8 billion kWh of thermal energy or about 15% of national consumption.

In the year 1999/2000 the Middle Egypt Company had a total 1.90 million customers of which 1.83 were residential, 74,433 were commercial and only 58,930 industrial. The average selling price of electricity was 12.95 piasters/kWh.

4.3.7 Upper Egypt

The Upper Egypt EC is home to all the hydro power plants projects, the details of which are discussed in another section of this report. The Chairman is Eng. Hamdi El Shafee, responsible for generation, and the Vice-Chairman is Eng. Hassab Allah Ibrahim Abdel Ella, responsible for distribution. The company has over 11,000 employees. The Upper Egypt EC has the highest cost of distribution per customer in Egypt. This is due to the many social benefits that the company provides to many of the communities around the hydro power plants. It is also has the lowest cost of generation per kWh because the hydro units require no fuel.

In the year 1999/2000 the Upper Egypt EC had 1.63 million customers, of which 1.43 million were residential, 141,000 commercial, and 81,500 industrial.

4.4 DEPARTMENTS

4.4.1 Projects

The Vice Chairman is Eng. Abd El Magid Radwan. The functions of this group are to provide overall project management and construction management to all the new projects that EEHC undertakes. In some cases the group actually executes the projects using EEHC staff, but in most cases the new projects are contracted out, in which case supervisory services are provided. The responsibilities of the group are divided into projects of distribution, transmission, and generation.

- For distribution projects the group manages the civil works, network construction, and plant installation.
- The group manages all transmission projects, including towers and poles, cables for high and ultra high voltages, and substations.
- For the generation projects, the group selects the site and manages the contractors assigned to build or renovate the power plant.

4.4.2 Operations

The Vice-Chairman for Operations is Dr. Hassan Younes. The responsibilities of this group are:

- The National Energy Control Center (NECC), from which all dispatch functions take place and all the 500kv, 220kv, 132kv and some of the 66kv networks and transmission systems are monitored and managed.
- The Chemical researches and tests labs, in which all the oils and fuels are studied and evaluated for the operation of the generation plants.
- Operation and maintenance for all electrical and communications networks is coordinated with the field personnel who actually perform the tasks.
- The regional control centers, from which all the 66kv networks are coordinated.
- Protection and metering for the high voltage network.
- The communication systems for the high voltage networks and the generation plants, including all the telecommunication and fiber optic networks and SCADA systems.

4.4.3 Studies, Research, and Design

The Vice-Chairman is Dr. Mohammed Awad. The functions of this group are:

- Load forecasting
- Generation expansion planning
- Transmission expansion planning
- High voltage lab and other electrical testing and research
- High voltage distribution planning
- System wide economic studies (for each component as well as for the various network systems)
- Future design for substations, generation plants, and distribution and transmission networks

4.4.4 Financial and Economic Affairs

The Vice-Chairman is Acc. Mahmoud Abou Rehab. The responsibility of this group is to provide overall financial and economic support for the management of EEHC. The group is divided into four major areas:

- Financial affairs
- Economic affairs
- Budgets for the whole organization
- Financial transactions and communication with banks, and with the central auditors of the government

The group is responsible for providing both future budget statements for forward management as well as all the historical reports such as income statements, cash flow, and profit and loss.

4.4.5 Administration, Human Resources, and Training

The Vice-Chairman is Eng. Zinab Abd El Azim. The function of this group is to provide overall administrative and human research support to all of EEHC's central functions (not including the ECs).

In addition this group coordinates training provided by other. They also plan for and provide training for other public and private Egyptian companies and training services to several Arab and International Institutions.

4.4.6 Companies Affairs

The Vice-Chairman is Eng. Fawzia Neima. This group many functions and responsibilities as it coordinates all the technical as well as economic affairs of the seven ECs. In addition it also serves to provide internal regulatory functions such as monitoring tariffs and providing studies and input to the MOEE for re-structuring the organization and preparing it for privatization.

The economic component of the group has responsibility for collecting and consolidating the financial statements for the ECs. They also collect all the cost and energy flow information for the energy transfers between the seven companies, and calculate the transfer prices.

The technical component of the group has the responsibility to monitor the technical performance of the ECs and try to bring them to the same level of performance

Both groups provide much input for planning and studies, especially of tariffs and other reform issues. They also provide much of both the technical and commercial input in the development of the BOOT contracts, before and after award.

4.5 TRANSMISSION

There are four groups responsible for transmission operations and maintenance. These are divided into four geographical zones covering all the transmission lines and substations installed across the country. The overall responsibility of each of theses is to perform both planned and preventative maintenance as well as quick recovery of any downed lines due to weather or any other source of outage.

The planned maintenance is very closely coordinated with the National Energy Control Center (NECC) as they monitor line loadings, system protection relays, other planned or unplanned outages, and other data in order to transfer power reliably and without damage to equipment. This is done so that each component is brought out of service for its regular maintenance in a safe and orderly manner. Although NECC has the capability to take lines in and out of service automatically, they do not do that. They only act as supervisors, coordinating with the transmission field groups from each of the four companies. It is the field people who actually open breakers and perform all the required maintenance on transmission lines, substations, transformers, and other equipment for the entire network. Once maintenance or repair is complete, they also are the ones who actually put all the various components back into operation.

4.5.1 Cairo

Eng. Ahmed Rafaat directs the Cairo UHV sector, which has 2,126 employees. Cairo has 2,250 transformers of 500 kV, 5,740 transformers of 220 kV and almost 1,100 kilometers of high voltage transmission lines.

4.5.2 Northern

Eng. Abd El Latif El Arian directs the Northern UHV sector, which has 3,275 employees. The Northern sector has 8,565 transformers of 220 kV and 4,275 kilometers of high voltage transmission lines.

4.5.3 Canal

Eng. Ahmed Abd El Gawad directs the Canal UHV sector, which has 1,181 employees. The Canal sector has 2,250 transformers of 500 kV, 3,535 of 220 kV transformers, and about 3,700 kilometers of high voltage transmission lines.

4.5.4 Southern

Eng. Ezat Mehrez directs the Southern UHV sector, which has 4,920 employees. The Southern sector has 5,655 transformers of 500 kV, 2,970 transformers of 220 kV, 3,222 transformers of 132 kV, and 7,632 kilometers of high voltage transmission lines.

Section 5

Planned Structural Changes

Section 5 Planned Structural Changes

The last ten years have brought a series of major changes to the power sector. There is every indication that the process of restructuring and reform will continue, as additional major changes are planned in several areas. The government has issued laws and decrees to support liberalization of and private sector participation in the power sector. Based on this framework, the following key changes are planned.

- Regulation: To form and put into operation a Regulatory Agency.
- Unbundling: To separate generation from distribution.
- Corporatization: To create new, independent firms providing only generation or distribution.
- Privatization: To sell shares in the new firms to private investors.
- BOOTs: To obtain some or all future generation from privately developed and owned build - own - operate - transfer projects similar to the projects already under contract and construction.
- Power pool: To link the to-be-separated generation and distribution firms.

5.1 REGULATORY AGENCY

Although a regulatory body was authorized through Presidential Decree 326 in 1997, no concrete steps were taken to implement it. Presidential Decree 330 of 2000, which superceded the earlier Decree, provides for the Electricity Utility and Consumer Protection Regulatory Agency, which is in the process of implementation.

Section 2 discusses the Regulatory Agency in more detail. Its broad but general mandate includes, among others, duties that would permit it to address the commercial problems that exist in the power sector today. If it exercises those duties forcefully, and its recommendations are approved and implemented, it could have a major impact on resolving those problems and putting the power sector on a sound financial and commercial footing. There is no history yet to use as a guide to how it will undertake its responsibilities, but the pace of its early stages suggests the possibility of an active role.

5.2 UNBUNDLING AND CORPORATIZATION

EEHC is a joint stock company which also is the sole owner of the seven Electricity Companies. Each is a vertically integrated monopoly in its region, with both generation and distribution assets and responsibilities. EEHC is responsible for the central power sector functions such as transmission and national dispatch, and also central administrative and headquarters functions.

EEHC plans major restructuring of both itself and the ECs. We understand that EEHC has decided upon the following changes, as illustrated in Figure 5-1:

- Separate the generation functions from the existing ECs, leaving them as seven Distribution Companies.

- Create four thermal and one hydro Generation Companies from the separated generation assets.
- Separate the transmission and NECC functions from EEHC and create a new Transmission and Dispatching Company, the Egyptian Electricity Transmission Company.
- Create three categories of non - regulated (i.e., not subject to the Regulatory Agency's oversight) companies: Project Services, Communications, and Affiliated.

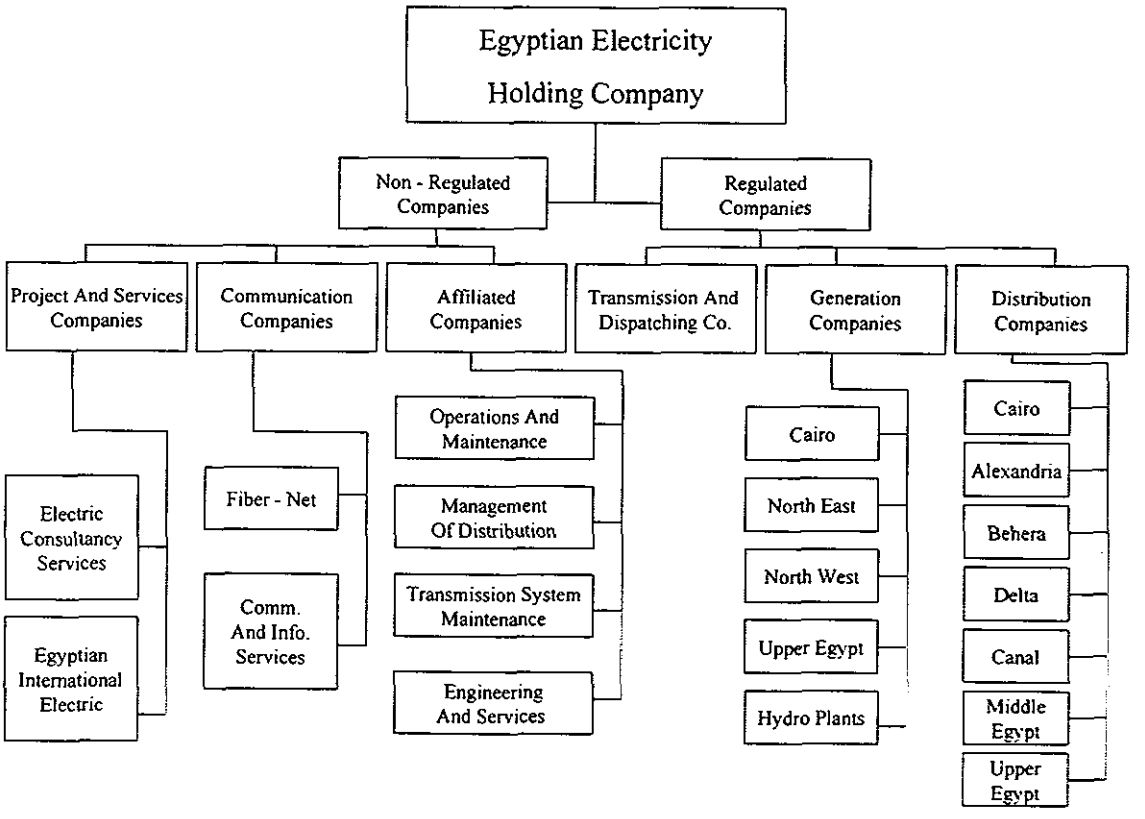

Figure 5-1 Planned EEHC Organizational Structure

5.3 PRIVATIZATION

Current law permits sale to private investors of up to 49% of the shares in the to-be-formed Generation and Distribution Companies. Most of the debt in the power sector is associated with the generating units, and will be assigned to the Generation Companies, making them less attractive to private investors. Therefore, the Distribution Companies will probably be the first to seek such sales, possibly with an initial offering of 10% to 20% of one of them, leading up to 49%. The Generation Companies' shares would be offered later.

Several critical issues must be addressed to attract private investment to the Distribution and Generation Companies:

- Excessive debt, both that EEHC and the ECs owe to Government of Egypt and that the GOE owes to EEHC and the ECs.

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- The uniform national tariff.
- The overall level of prices in the current tariff schedule.
- The amount of late and non-payment of electricity bills by consumers, especially branches of the GOE and GOE - owned industry.

The pace and effectiveness of resolution of these matters will dictate the tempo of electricity sector privatization.

Merrill Lynch, a US-based investment bank was assigned to assist in the privatization effort. Merrill Lynch is advising the government on the formation of the Distribution Companies.

5.4 BOOTS

Obtaining new generating units through independent power producers offer several advantages over having EEHC build and finance them:

- Brings new sources of investment into the power sector and permits projects to proceed for which GOE funding might not have been available.
- The procurement process provides the benefits of competition.
- Private ownership brings improved efficiency in investment and operations, and some of these benefits flow to the purchaser (EEHC).
- Because the power sector is still centrally controlled, the GOE can maintain many of its policies (technology, fuel supply, etc.) even though the plants are privately owned.
- Using the BOOT approach, at little cost EEHC will gain ownership of the plants while they probably will have years of economic operation still left.

Until recently there has been virtually no private investment in the power sector. This situation is changing rapidly. At present several BOOT contracts have been signed and the projects are under construction. At one time MOEE policy was for all future major generation additions to be BOOTs. Now a mix of BOOTs and EEHC financed projects is planned, but nevertheless the current plan shows BOOTs totaling more than half the installed capacity of generation additions through the year 2010.

5.5 POWER POOL

This Egypt Power Pool Project is providing assistance to EEHC in formulating and implementing a power pooling mechanism for Egypt. The Egypt Power Pool will represent a significant change to power sector structure, involving new functions and new relationships. Although the pool design is an output from the Project rather than an input, based on work to date we believe the power pool will involve the following key features:

- The most prominent new function will be what we refer to as the Single Buyer. The Single Buyer will be the sole organization which purchases power from generators, and the sole organization which sells power to Distribution Companies.
- These purchase and sale relationships will be covered by contacts or contract-like documents. The Distribution Companies will make payments to the Single Buyer, which in turn will make payments to the Generation Companies and other generators

for the power they deliver, and to other power sector organizations for the services they provide.

- Within the framework of these contracts NECC will direct the operation of the generators and the high voltage transmission system. It is planned that NEEC and the existing Transmission organization will be joined and transformed into a single company.

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Section 6

Description of the Physical System

Egypt's interconnected power system is also known as the Unified Power System (UPS) of Egypt and it serves the entire country, which has a land area of 1.002 million square kilometers and a population of about 64 million. The UHV transmission system consists of 500 kV and 220 kV transmission lines that form the backbone of the network and an older 132 kV transmission network. At the distribution level, the power system consists of 66 kV, 33 kV, 22 kV, 11 kV and 0.38 kV power lines that are owned and operated by the seven regional ECs. The generation of power is predominantly hydro in Upper Egypt and mainly steam in other parts of Egypt. The major load center, Cairo, consumes over one third of all the electric power produced in the entire country. The UPS recorded a peak load of 11,736 MW in the fiscal year ending 2000 with a total energy consumption of 70,623 GWh. A peak load of 12,600 MW was observed in September 2000.

The UPS is interconnected to the Jordanian and Libyan power systems. It is also linked to the Syrian power system through the Jordanian interconnection. This interconnection was placed in service in January 2001. During the year ending 2000 Egypt imported power from Libya and exported power to Jordan.

6.1 GENERATION

The UPS has several types of power generation based on the type of fuel used. The UPS has a total of 188 generating units located throughout the country in 38 generating plants. Figure 6.1 shows the percentage and the actual generation capacities by generation type. Steam and hydro generation account for over 75% of the total installed generation capacity of 14,582 MW. Recently, 19 MW of installed capacity due to wind generation was constructed in the Canal EC. Trends show that the EEHC has been adding significant steam generation capacity over the last five years.

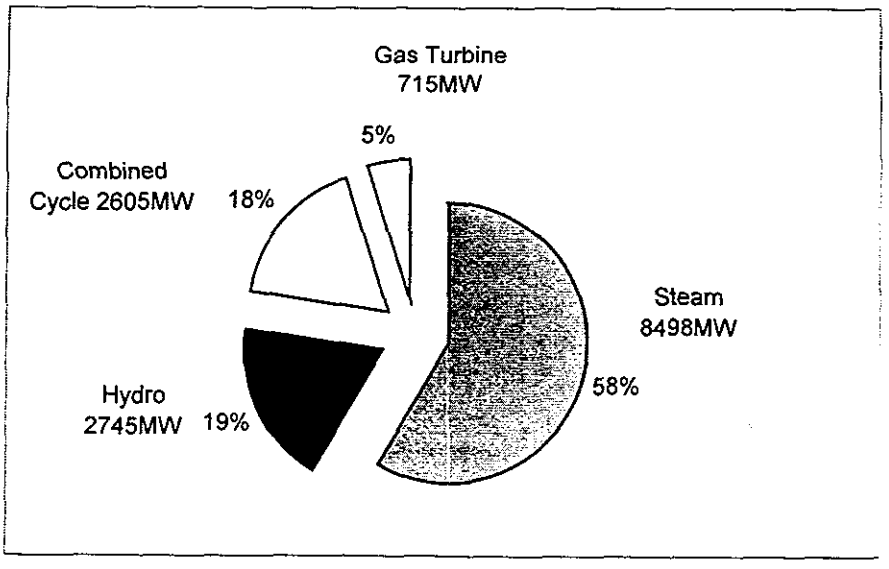

Figure 6-1 Total Installed Capacity By Generation Type

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The seven ECs own this total installed capacity as shown in figure 6.2. Cairo EC has the largest installed capacity while Alexandria EC has the smallest.

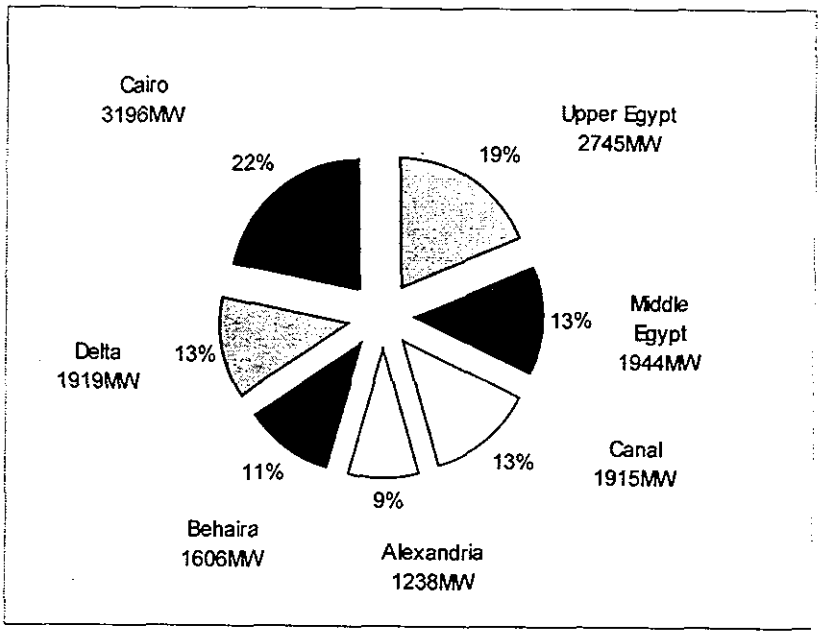

Figure 6-2 Installed Capacity By Electric Company

Table 6.1 shows that all the generation in Upper Egypt EC is hydro and all the generation in Middle Egypt EC is steam based. All other ECs have a combination of steam, combined cycle, and gas turbine type of power generation.

Table 6-1 Type Of Installed Generation Capacity (%) By Electricity Company

	Upper Egypt	Middle Egypt	Canal	Alex.	Behera	Delta	Cairo
Steam	0	100	91.4	81.8	60.1	26.6	72.4
Hydro	100	0	0	0	0	0	0
Combined Cycle	0	0	0	0	28.7	73.4	23
Gas Turbine	0	0	8.6	18.2	11.2	0	4.6

Hydro generation plays a significant role in the power production. It represents about 19% of the total installed capacity. Fuels used for power generation include heavy fuel oil, special light oil, light fuel oil and natural gas. Table 6.2 shows the amount of fuel consumed for the year ending 2000 by type and EC. Cairo EC consumed the most fuel while Behera EC consumed the least. In recent years natural gas has provided about 65 - 75% of the total fuel used for power generation.

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Table 6-2 Fuel Consumed By Electricity Company (1999-2000)

	Middle Egypt	Canal	Alex.	Behera	Delta	Cairo
Heavy Fuel Oil (Kilo-Ton)	921	579	83	350	165	1,242
Special Light Fuel Oil (Ton)	-	126	-	504	751	764
Light Fuel Oil (Ton)	2557	851	713	961	606	1,332
Natural Gas (Million M^3)	1,002	1,764	2,520	1,320	1,587	3,063

Generation efficiency is in the range of 82-91% for hydro generation and 21-48% for steam generation based on individual plant data. For the UPS as a whole, average thermal generation efficiency was 39%.

6.2 TRANSMISSION

The primary transmission network of the UPS consists of transmission lines at 500, 220, and 132 kV voltage levels. The 500 and 220 kV network is considered as the backbone of the UPS network. There is one 400 kV transmission tie line from the UPS to the Jordanian power system, which is connected to the Syrian power system. The UPS is directly connected to the Libyan power system by a 220kV transmission line.

Table 6.3 shows the total capacity of all substations in each of the different transmission areas by voltage level. Table 6.4 shows the lengths of the electric circuits for each transmission area by voltage level. The southern sectors have very large capacities at all voltage levels and the entire older 132 kV transmission network.

Table 6-3 Sub-station Capacities (MVA) By Voltage Level

Area	500 kV	220 kV	132 kV
Cairo	2,250	5,740	0
Canal	2,250	3,535	0
Northern Sectors	0	8,565	0
Southern Sectors	5,655	2,970	3,222
Total	10,155	20,810	3,222

The bulk of the transmission is done at the 220 kV voltage level. The 400 kV transmission line shown in Table 6.4 is the tie line from the UPS to the Jordanian power system. There are plans to convert this AC tie line to a DC line in order to increase the power transfer capability. During the course of the last five years, the UPS has grown both in transmission line lengths and transmission capacity at the 220 kV level most significantly. There has been no significant increase in the 500 kV transmission capacity during the last three years. The

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132 kV network is old and there are no plans to expand the transmission network at this voltage level by either adding new transmission lines or building new substations.

Table 6-4 Length Of Electric Circuits (Km)

Area	500 kV	400 kV	220 kV	132 kV
Cairo	211	0	877	0
Canal	385	20	3,314	0
Northern Sectors	0	0	4,275	0
Southern Sectors	1,653	0	3,443	2,536
Total	2,249	20	11,909	2,536

Figure 6.3 shows the cumulative energy flows in the UPS in GWh for the fiscal year ending 2000. Figure 6.3 also shows a net import from the Libyan power system into the UPS and a net export of power from the UPS to the Jordanian power system.

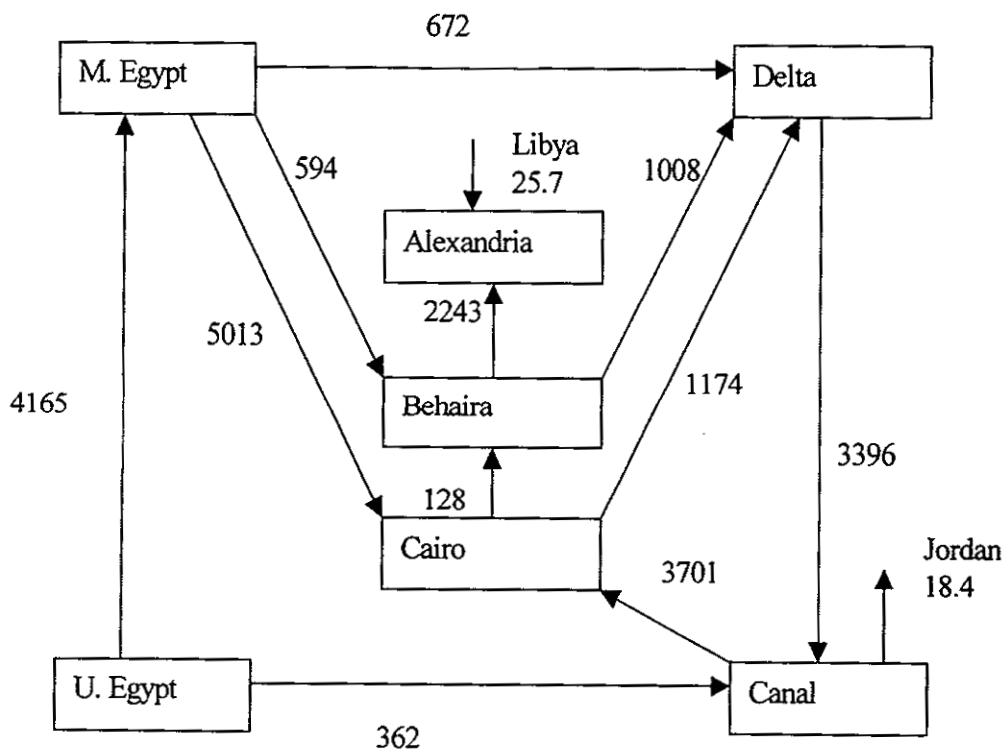

Figure 6-3 Cumulative Power Flows In The Egyptian Power Network (GWh)

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Figure 6.4 shows that Cairo and Alexandria ECs are major importers of energy from the other Electric Companies. Canal EC is a small importer of energy from its neighbors. Upper Egypt, Middle Egypt and Behera ECs are the main exporters of electrical energy.

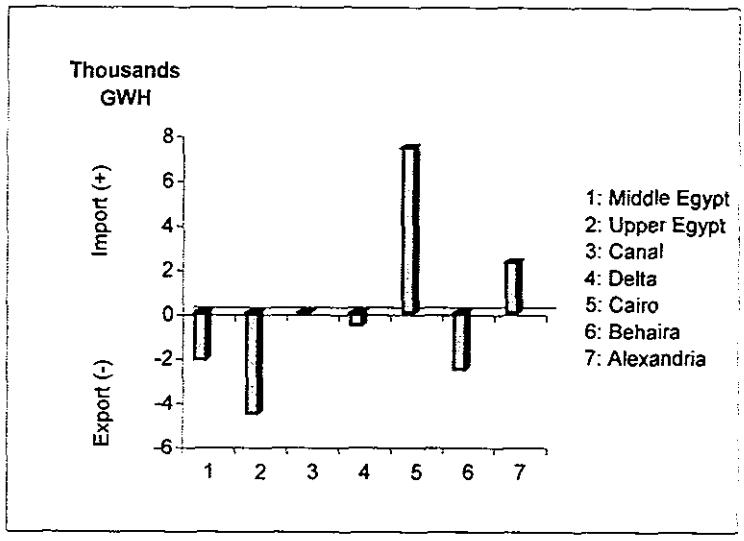

Figure 6-4 Cumulative Net Energy Exchange By Electricity Company

The bulk high voltage transmission system currently has shunt reactors only. This is because the transmission lines provide the required reactive power support during peak load and shunt reactors are needed to reduce over voltages during light load conditions. However, planners at EEHC have noted that this situation will change in the near future and are envisioning the installation of capacitor banks at the 220 kV level to support the system during heavy loading conditions.

The Egyptian UPS is an extremely stable network. The system can withstand a major fault at the 500 kV voltage level for 8 cycles without losing stability. This stability can be attributed to the following factors:

1. Most of the transmission lines are relatively short. The problems of having much of the generation in Upper Egypt and the major load in Cairo have been resolved by construction of major generation facilities in the Cairo area and increased load growth in Upper Egypt area.

2. Generation facilities are distributed throughout the power system network.

3. A 500 kV multiply fed transmission ring has been constructed around the Cairo metropolitan area.

6.3 SYSTEM LOADS AND ENERGY BALANCE

Based on statistics for the fiscal year ending 2000, net energy delivered into the system (equivalently, total consumption including transmission and distribution losses and non-technical losses) was 70,623 GWh. Imports and exports were negligible in comparison. Figure 6.5 shows the net deliveries into each EC. This consumption includes the loads and associated losses of the direct service UHV customers in each EC's region, which are not part

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of the loads served directly by the ECs. The Cairo metropolitan area accounts for more than a third of the total energy consumed in the entire power system. Behera and Middle Egypt ECs each account for less than 10% of the total energy consumption.

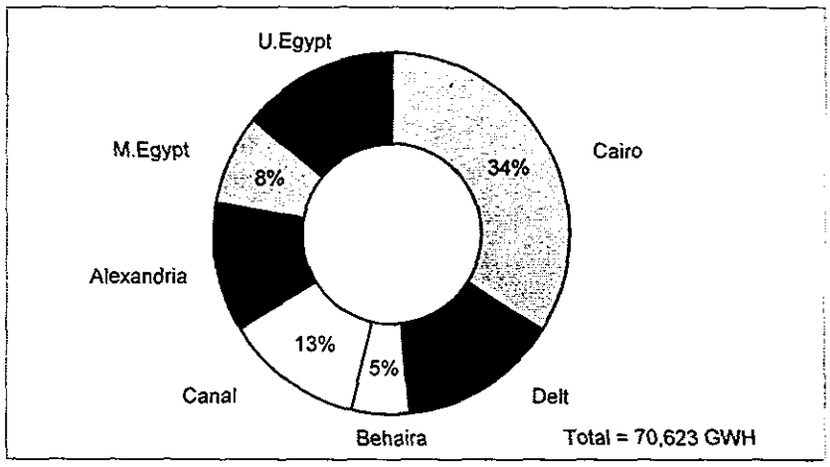

Figure 6-5 Net Energy Deliveries (GWh) Into Electricity Company Regions

Figure 6.6 shows the total energy generated for the fiscal year ending 2000, which was 73,374 GWh. Power plant auxiliaries and account for the difference compared to the total energy deliveries of 70,623 GWh shown in Figure 6.5.

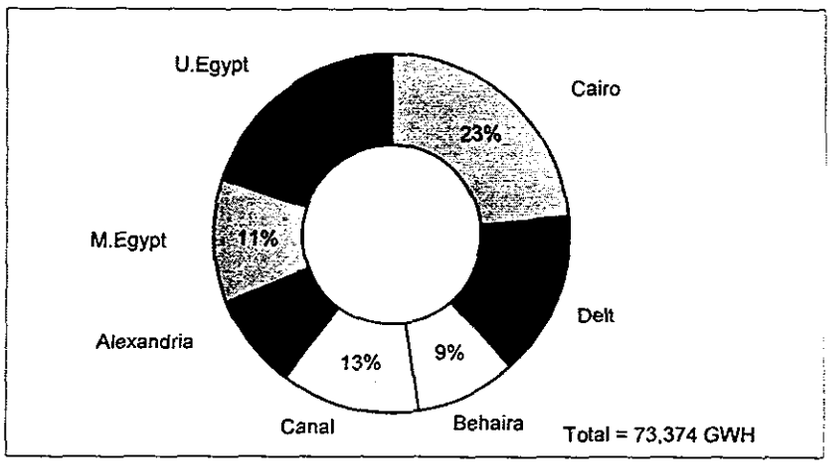

Figure 6-6 Energy Generation (GWh) by Electricity Company

Figure 6.7 shows the total amount of energy sold for the fiscal year ending 2000. This total energy of 60,863 GWh was sold to the seven ECs and to 17 large UHV customers, which consumed a total of 8,975 GWh. The difference between the total energy delivered into the system and the total amount of energy that was sold is 9,766 GWh. This represents the total technical losses associated with the transmission and distribution grids, and non-technical losses such as theft.

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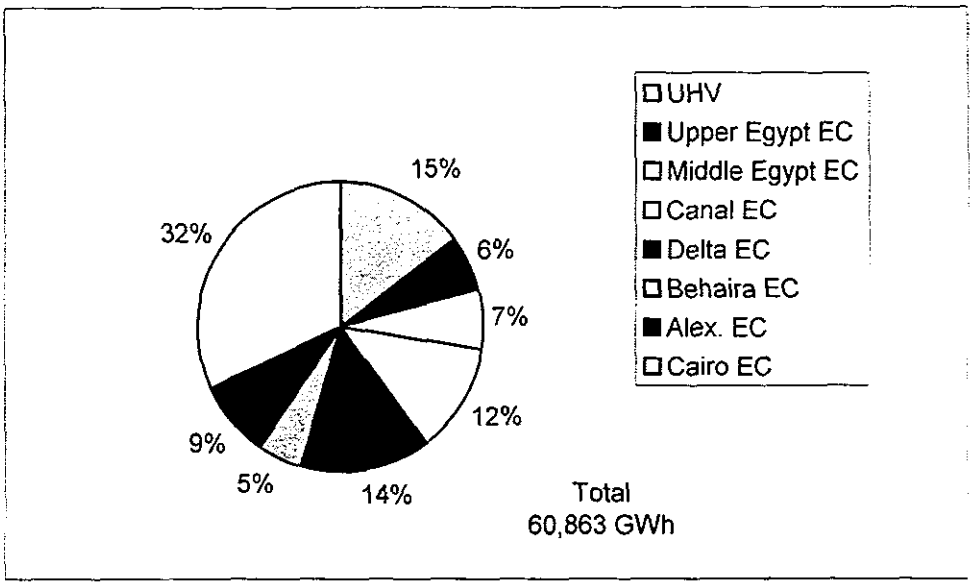

Figure 6-7 Energy Sold to ECs and UHV Customers

Figure 6.8 shows energy sales by load category for the year ending 2000. The largest increase in energy sold over the last seven years has been for the industrial sector followed by residential sales. Agricultural sales have been fairly constant over the same time period.

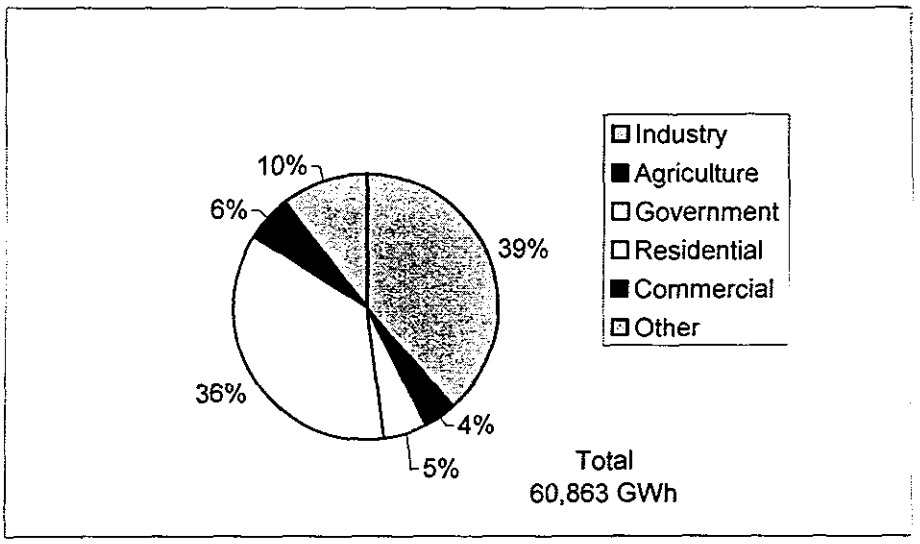

Figure 6-8 Energy Sold by Load Category

Figure 6.9 shows the peak and light load conditions for each of the seven ECs for the year ending 2000, including the loads of the UHV customers in their region. The sum of the individual peaks was 12,538 MW compared to an system peak of 11,736 MW, indicating a relative diversity of 94%. Over the past year, there was a 7.5% increase in the overall peak loading. The largest increase (23%) was in the Canal EC.

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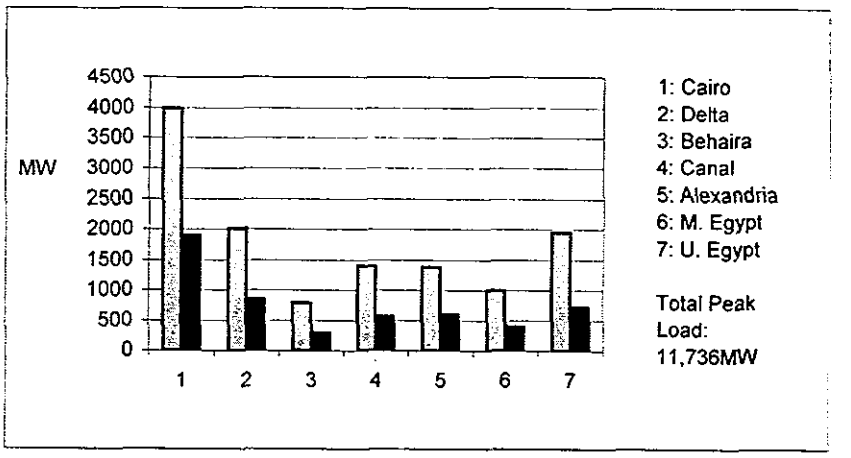

Figure 6-9 Maximum and Minimum Loads by Electricity Company

The system peak load has grown from 7,004 MW in 1990 to 11,736MW in the year 2000 as shown in figure 6.10. This corresponds to an average growth rate of 7% over the last decade. A peak load of 12,600 MW was observed in September 2000, another increase of 7% over the previous year.

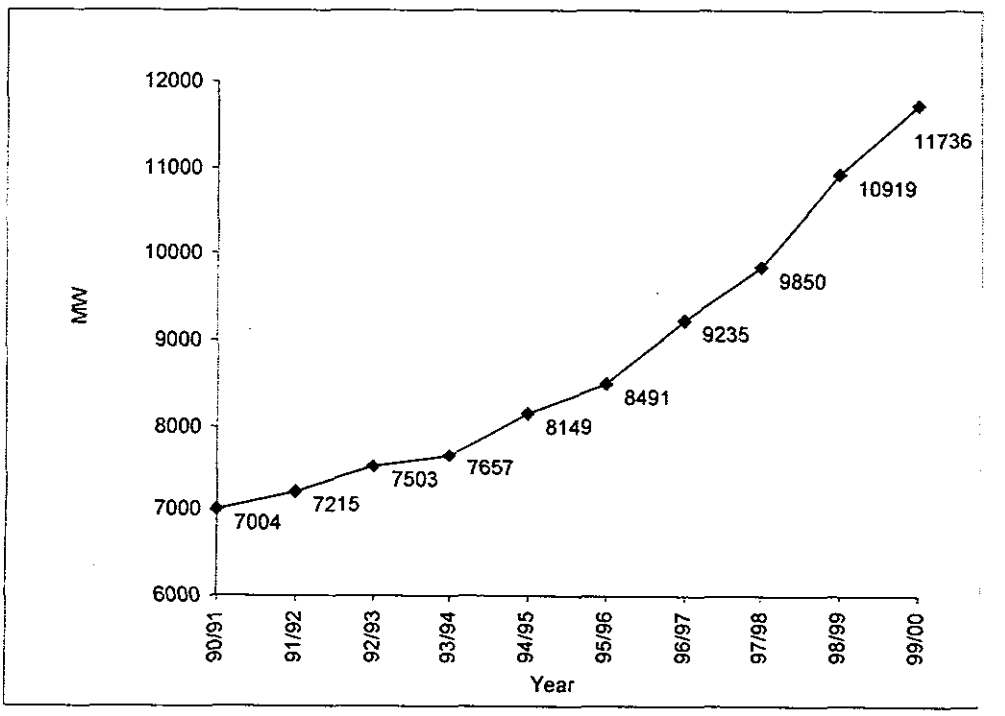

Figure 6-10 Growth of Peak Load (MW)

6.4 INFORMATION TECHNOLOGY

NECC, located close to Cairo, is the primary energy control center. A smaller Backup Control Center (BCC) is also available to assist under emergency operating conditions. Each of these control centers conduct power system operations using state-of-the-art Energy Management System (EMS) software provided by GE-Harris. The BCC is capable of performing standard

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system control and data acquisition (SCADA) and dispatch operations. The primary control center has eight main application processors and five consoles each equipped with one color monitor. There is also an impressive video wall that can project information from the chief dispatcher's console including one-line diagrams of the power system in real time. Four printers installed in the computer room allow the system operator to log and report alarms and events.

The facilities at the BCC are more modest, although functionally they are the same as those of NECC. Three application processors and two consoles power the backup control center. There is a conventional map board that uses lamps to display real-time information. Three printers enable the operators to record events and log alarms

The Regional Control Centers (RCCs) are fully equipped with SCADA equipment. At many of the RCCs new state-of-the-art SCADA hardware and software is being installed. These allow the operators at the RCCs to monitor the distribution system.

Stand-alone Personal Computers (PCs) are available for use of high-level officers and engineers at both NECC and the RCCs. However, there is no corporate Local Area Network (LAN) or enterprise system that links all the PCs. Therefore data flow and information flow is essentially through conventional means: paper, fax or telephone.

6.4.1 Communication Systems

A recently installed upgraded communications network provides integrated voice data and communication between the NECC, the BCC, the RCCs, the generating stations, and all major substations. This system is comprised of digital microwave, fiber optics, and power line carrier links, all connected to form a highly sophisticated communication network. Small telephone switches (PABX) located at NECC, BCC, the RCCs and major locations form part of the voice communication network. Communication to the generating plants from NECC is through a sophisticated X.25 data network.

The communications system is comprised of about 50% digital microwave and 50% power line carrier links. It covers 81 sites and contains 24 new digital microwave links, 17 existing links, 81 new remote terminal units and 61 digital telephone switches. There is also a fiber optics system installed as part of the 500 kV transmission network. The communication system uses X.25 packet switching data network (PSDN) for data collection and WSSC/ICCP protocols for interconnection between NECC and the RCCs. Primary and backup routes are used for data transmission through a loop arrangement.

6.5 METERING SYSTEMS

Metering is provided at several levels in the UPS. All generators, all international tie lines, major tie lines at all voltage levels, all transformers that connect different voltage levels within the high voltage network, and all transformers that connect different voltage levels between the high voltage network and the distribution level network are metered. In most cases, the meters measure MW, MVAR and energy flow (class 0.5 energy meters). Most of these meters are electromechanical and there is no automation involved in meter reading as such. However, there is a major effort to computerize the process of meter reading so that the process of metering may be synchronous, accurate, efficient and more robust. A recent order

to purchase 3000 meters has been placed and the UPS is in a transitional phase as the old meters are being replaced. Implementation of a computerized metering scheme will be a key point in the design of the Egyptian Power Pool. This is because it would facilitate the settlement process for both inter-regional flows and for international flows.

At present, each RCC has a metering committee consisting of members who perform the jobs of meter reading and meter calibration. All meter reading is manual and done on a periodic basis. The meter readings are used for calculation of net power flows between ECs, and for the calculation of losses. Readings from each EC are sent off to the EEHC, who compiles meter readings from all the ECs and computes inter-company flows, losses, and provides settlement.

At the residential and distribution level, the process of meter reading is mostly a manual process requiring a large group of meter readers each averaging reading about 150 meters a day. ECs are looking at providing these meter readers with hand-held computer devices. This would clearly improve the efficiency and accuracy of the process. A significant problem that meter readers face is the lack of accessibility to meters that are located inside customer premises, especially when these customers are absent. New meters are being installed in publicly accessible areas to facilitate the meter reading process.

6.6 PROTECTION SYSTEM

The protection system of the UPS of Egypt is a complex system that monitors, controls, and coordinates power system protection efforts at all voltage levels of the high voltage transmission network. Speed and selectivity of the relays and protection equipment play a vital role in ensuring the stability and reliability of the power system network. Consequently all power system equipment (generators, transmission lines, transformers) is protected by reliable protection schemes such as differential protection, phase/directional comparison, distance protection, over-current protection, and over/under voltage/frequency protection.

The 500 and 220 kV transmission lines have two protection schemes. The primary is distance protection; one of its steps is used in a directional comparison scheme. The backup is a directional scheme based on ground fault current. In addition to this, each transmission line has three auto reclosers. Fault recorders, event recorders and fault locators, which are used for disturbance analysis, monitor the protective relays in the UPS, thus minimizing maintenance time and providing better evaluation of relay performance. There is a major effort to replace the old electromechanical relays and breakers by new digital and static switches. There is also a major project to undertake central coordination of all protection in the UPS. The project aims to achieve coordination by automating the process of protection beginning with the use of digital relays in the field, data acquisition, and computer analysis of data.

Section 7
System Planning

7.1 ORGANIZATIONS AND RESPONSIBILITIES

Power system planning within EEHC is carried out within the Department for Studies, Research, and Design, which includes a load forecasting group, a generation planning group, and a transmission planning group. The planning department at EEHC concerns itself with the design and planning of the high voltage network and generation only, and the 66 kV network in Cairo and Alexandria ECs.

At the distribution level, each EC carries out the process of planning based on the projected growth and load requirements of each load zone that falls within the responsibility of the corresponding Branch office. In some cases, where the EC does not support a planning department, the REA conducts the planning. All distribution level expansion is conducted by each EC or by REA depending on the availability of a planning department at that EC.

7.2 DEMAND FORECASTS

The process of long term power system planning begins with the load forecasting group in the planning department of the EEHC. Using econometric forecasts by sector (agriculture, high voltage industry, commercial, etc.), they develop high, low, and medium load growth forecasts. These projections are done on a national basis and include transmission, distribution, and non-technical losses. Forecast load factors are used to obtain peak demand forecasts consistent with future energy requirements. The scope of EEHC's planning department is limited to the planning of the high voltage network and system generation only.

Figure 7-1 shows the projected peak demand for the next ten years and Figure 7-2 shows the projected energy demand. Each grows at an average rate of 5.5% - 6% per year throughout the period

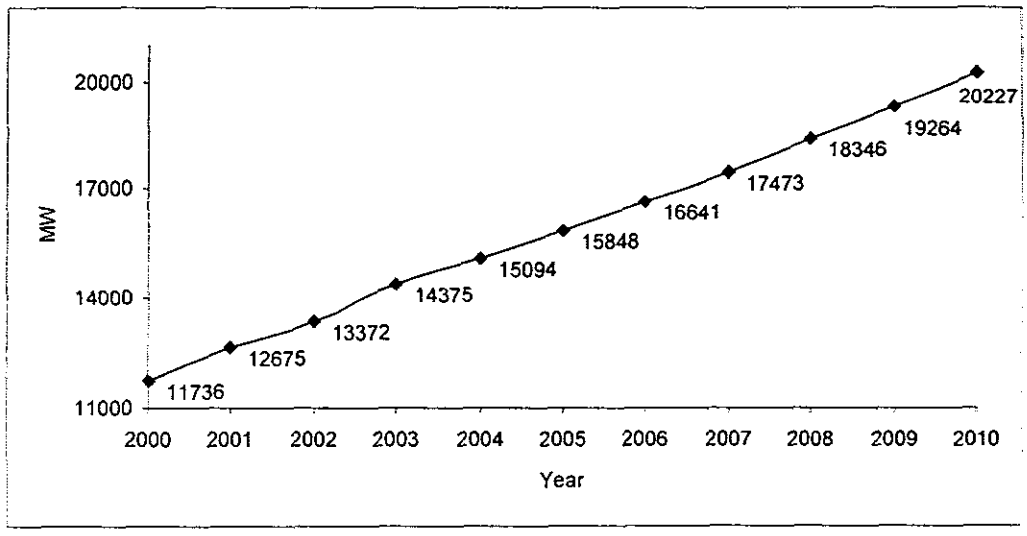

Figure 7-1 Projected Growth of Peak Demand (MW)

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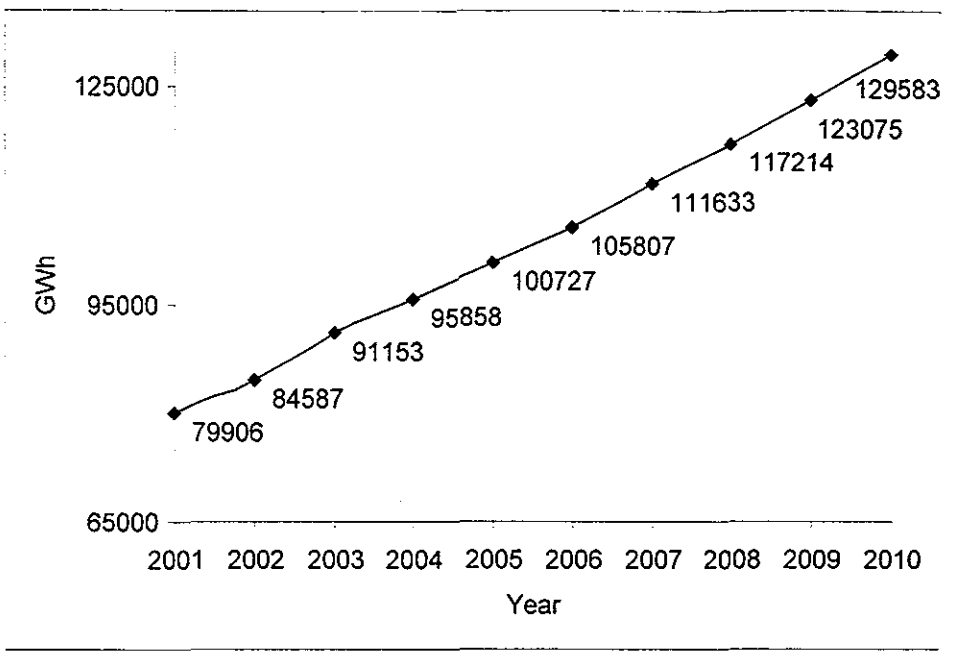

Figure 7-2 Projected Growth of Energy Demand (GWh)

Load data to be used for purposes of long-term load forecasting are available at NECC, which stores all operational data through its storage system for a period of up to five years

7.3 GENERATION PLANNING

The generation planning group is responsible for creating expansion plans for the planning period. It also assists in developing Request for Proposals (RPF) soliciting vendors to bid BOOT projects.

The generation planning group uses two basic criteria to govern its planning:

- Loss of load probability (LOLP) less than or equal to 1 day in three years.
- Minimum reserve margin of 15%.

These criteria, a description of the existing system, and the load forecast are key inputs to their basic planning tool, a software package developed by the Electric Power Research Institute called Electricity Generation Expansion Analysis System (EGEAS). EGEAS develops optimum expansion plans in terms of present worth of revenue requirements and average system retail rates. These functions can be used to project a life cycle total resource cost or a rate impact measure. EGEAS also accounts for monthly fuel costs, different seasonal patterns for generating unit characteristics in different years, improvements in modeling of duel-fueled units, cost calculations, and provides reporting. Although EGEAS software is capable of calculating emission quantities, this information is not used

The choice of units to be used for generator expansion process is a policy decision made by EEHC, taking into account several factors including concerns about new technology, fuel flexibility, generator efficiency, and use of indigenous components and labor for construction and maintenance of power plants. EEHC has a general guideline that the expansion plan will include 20% hydro, 20% combined cycle, 7% gas turbine, and 53% steam generation. EEHC

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prefers steam generation as it has extensive experience in this type of generation and can use local manufacturers. EEHC also wants units that can use heavier fuels as well as natural gas.

A separate group is charged with the task of determining the sites for the selected plants. This group bases its decisions on logistic considerations such as availability of natural resources, proximity to fuel/gas resources, proximity to loads, power system performance, implementation, maintenance, and use of local resources for construction and maintenance of plants.

Demand side management (DSM) is considered in the planning process. The generation planning group typically prepares more than one generation expansion plan based on different amounts of expected demand relief. EEHC is actively pursuing DSM activities that involve peak shaving techniques, rewarding customers for improved power factors, installing double tariff meters, and promoting usage of energy efficient equipment.

Figure 7-3 shows the total planned installed capacity that is going to be added to the UPS by year for the plan period 2001 through 2010.

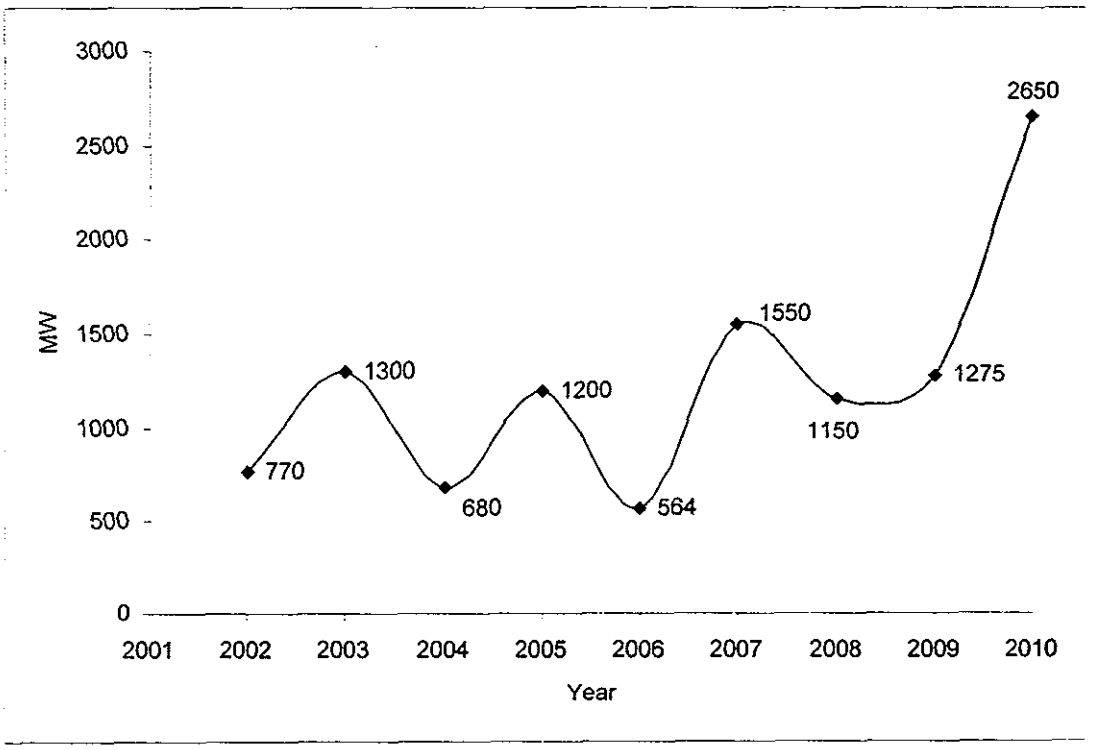

Figure 7-3 Planned Generation Expansion (MW)

Table 7-1 shows additional details of the generation expansion plan that has been developed for the years 2001 through 2010, showing the locations and sizes of each unit that.

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Table 7-1 EEHC Generation Expansion Plan

Location	Technology	Owner-ship	Operation Dates with Size, MW									
			2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sidi Krir 3/4	Steam	BOOT		2x325								
Suez Gulf	Steam	BOOT			2x325							
Pt. Said East	Steam	BOOT			2x325							
Zafarana	Wind	EEHC		120		30	200		100			
El Kureimat	Solar/Gas	EEHC				150						
Nubaria	Comb Cycle	EEHC					500	500				
Cairo North	Comb Cycle	BOOT				500	500					
Nagaa Hamady	Hydro	EEHC						64				
Cairo West	Steam	EEHC							2x325			
Borg El-Arab	Solar/Gas	BOOT							300		300	
El Kuriemat	Steam	EEHC								650		
Sharm El-Sheik	Comb Cycle	BOOT								500		
Safaga	Comb Cycle	BOOT							500			
Ayoun Moussa	Steam	EEHC									2x325	
Toshki	Steam	BOOT									325	325
El Dabaa	Nuclear	BOOT										600
El Walidia	Steam	EEHC										325
Attaka	Pump Storage	EEHC										1400

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7.4 TRANSMISSION PLANNING

Working with the load forecasting and generation planning groups, the transmission planning group's responsibility is to create plans for transmission expansion, conduct feasibility studies on the planned transmission expansion, locate and size the high voltage substations and ensure safety and reliability of the planned transmission system.

The transmission planning process begins with a review of the generation expansion plan and a study of the projected demands in each of the load areas. Having identified the load areas and the sources of available power as per the plans obtained from the generation and load forecasting groups, the transmission planning group decides the best location and sizing of substations and transmission lines to support the load demand. Substation load forecasts are derived from the overall load forecast in the following manner:

1. Using the overall load forecast as the general basis.

2. Obtaining the actual system and substation peak loads from the system operations group.

3. Adjusting loads at individual substations according to information obtained from local ECs and REA.

The transmission planning group uses analytical software from Power Technologies Incorporated (PTI) called Power System Simulator for Engineering (PSSE), which allows the users to perform load flow studies, contingency analysis, optimal power flow and stability analysis. At present, there are no major constraints in the transmission system and the system is very stable.

Typically the transmission planning process considers four base cases; peak load - high water (generation at the Upper Egypt hydro plants), peak load - low water, minimum load - high water, and minimum load - low water. The following criteria are considered in the transmission planning process:

1. Voltages – Bus voltages must be within ±5% of nominal voltage under normal operating conditions and within ±8% of nominal voltage under emergency conditions

2. Line flows – Line flows must be within rated values under normal operating conditions and less than 110% under emergency conditions.

3. Contingency and stability – The power system must be able to withstand a multiple contingency consisting of two lines at the 220kV level or one line at the 500 kV level without loss of stability.

The transmission plan is limited to the expansion of the 220 kV level and higher as there is no plan to expand the older 132 kV network. Although the transmission planning group does not include any formal optimization for losses or costs in their current planning process, they consider practical steps such as calibrating metering for the ECs, reducing usage at EEHC housing, changing conductors in some places of the HV system, washing or changing insulators to reduce corona losses and so on. Studies to use the optimization function in the

suite of PTI software are being conducted to improve the transmission planning process. The transmission planning group would like to obtain software that aids substation planning.

Several new transmission projects are currently under construction and many more are planned over the next ten years. In the next two years several thousand MVA of new transformer capacity is scheduled to become operational, along with hundreds of kilometers of new high voltage lines. These projects include the installation new substations in Upper Egypt and East Cairo to support a new residential housing project, expansion of the airport, and other loads.

In the longer term EEHC is interested in several concepts, including connection of all utilities around the Mediterranean Sea to form the "Mediterranean Ring" and conversion of the existing tie-line between Egypt and Jordan to a DC line to increase power flow capability. Also, a preliminary study has been conducted to investigate the construction of a new 800 kV DC transcontinental transmission line connecting Congo and Algeria to the UPS of Egypt with the intention of tapping the vast hydro resources in the southern part of Africa.

The scope of the transmission planning group at EEHC is limited to the expansion of the high voltage (132kV and above) network, and the 66 kV networks in Cairo and Alexandria. At the distribution level (66 kV and below), power system planning begins once the transmission plan for the high voltage system is approved. Based on the location and sizing of the proposed high voltage substations, the ECs or the REA makes plans for the design and layout of the distribution network. Typically REA plays the role of the planning department at the regional level, when the local EC has no planning department.

7.5 IMPLEMENTATION

Three key steps not yet discussed are approval, financing, and implementation.

The generation and transmission plans are reviewed by EEHC's senior management, revised if necessary, and approved.

For the transmission plan, once it has been approved, financing for near-term projects is sought. When financing is in hand, individual projects are passed on to EEHC's Projects department for implementation

Once the generation plan has been approved, financing for the projects is sought. At the same time the MOEE considers, as a matter of policy in addition to the question of financing, which additional plants and units should be built as BOOTs and which by EEHC. If financing for a particular project is available and the choice is for EEHC to build, then EEHC's Projects department takes over the project for implementation.

If the choice is for the plant to be built as a BOOT, then several departments work together to develop the request for proposals (RFP). Proposals are solicited, eventually a winning proposal selected, and an agreement negotiated. The selection is made based on several criteria including cost, technical competency, and time of implementation. The winner then becomes responsible for project development.

The final approved plans then become the basis for the ECs and REA to conduct their planning of the distribution system, given the planned location of high voltage substations and power plants

Section 8
System Operations

8.1 ORGANIZATIONS AND RELATIONSHIPS

Power system operations are carried out at two distinct levels. At the higher voltage levels, NECC, which is a part of EEHC, directs system operations in the UPS. It is responsible for monitoring and controlling the high voltage transmission network and all system generation. At the lower voltage and distribution levels, RCCs are responsible for monitoring and controlling the power system network.

8.2 GENERAL DESCRIPTION OF SYSTEM OPERATIONS

NECC controls and coordinates the network flows in the 500, 220, and 132 kV voltage levels and dispatches all the generating units according to economic dispatch criteria, which includes coordination of all hydro and thermal generation resources. The dispatch also considers standard operating reserves and stability of the system for major contingencies. NECC is responsible for the following items:

1. To ensure economic and secure operation of the UPS at the 500, 400, 220 and 132 kV voltage levels and all the thermal and hydro generators throughout Egypt.
2. To monitor the UPS in real time to ensure that power system parameters such as frequency, voltage and load are within allowable ranges.
3. To establish operating procedures under normal and emergency conditions.
4. To monitor the network tie line flows between Electric Companies and with neighboring countries.
5. To study and evaluate the performance of the UPS.
6. To coordinate with the RCCs to operate and maintain the 66 kV voltage network, which falls within the responsibility of the RCCs.
7. To schedule maintenance and general operation plans for the high voltage network sectors.
8. To coordinate the scheduling and maintenance of generating plants in coordination with the ECs.
9. To maintain the reliability of the high voltage network and ensure minimum interruption of power delivery.
10. To provide the planning group information about real time operations as the basis for further analysis and planning.

NECC's control of the high voltage system and all generation provides several benefits:

1. Since NECC has a complete picture of the loads, generating resources available, and the conditions in the transmission system, it is the only party with the data available to optimize the operation of the system as a whole.

2. NECC can coordinate and plan maintenance schedules keeping in mind the total load to be served as well as the plans of all ECs for maintenance.

3. Redundancies and overlap in functionality are automatically removed since NECC does all the study and planning for generation and UHV transmission. This leads to removal of any duplication of effort and better coordination of available resources. Thus the efficiency of the operation is enhanced, as the scope of each RCC is restricted to operation and maintenance of the low voltage networks alone.

NECC is a group within the central EEHC organization, so its assigned responsibility and authority over the EEHC-owned high voltage transmission system comes naturally. However, the ECs own the generation, not EEHC directly, and there are no formal written arrangements governing NECC's responsibility and authority over generation. Such arrangements will be necessary when private investors own substantial shares of the firms providing generation (presently the ECs, in the future to be Generation Companies). For example, today EEHC owns 100% of each EC, but the privately owned BOOTs have formal contracts with EEHC governing their dispatch, among other things.

8.2.1 SCADA and Communication

SCADA at NECC is done using state-of-the-art computer systems and software from GE-Harris. The computer systems utilize GE-Harris XA/21 SCADA software for control and monitoring of the high voltage substations. Real time data is obtained from remote terminal units (RTUs) that are present in each power plant and high voltage transmission substation. The data obtained includes measurements of electrical voltage, current, power (MW and MVAR), and frequency. In addition to these analog measurements, all status measurements are also received at NECC. An on-line system provides archival of SCADA data for a period of up to five years on a rolling basis. This archived data is accessible to advanced applications programs. A video wall displays system one-line diagrams whose status is updated in real-time.

System operators use the information from video wall, which shows the current state of the electrical network, results of the state-estimator, which are also displayed on the same one-line diagrams, and their own knowledge of the power system to conduct operations in a smooth and efficient manner.

Communications between the substations and the Control Centers is provided by Harris Corporation Microwave, Telephone, and Fiber Optic equipment. The communications system uses X.25 protocol, which automatically provides for alternate routings in case of communications equipment failure.

At each RCC, SCADA functionality is limited to the low voltage transmission network that includes 66 kV, 33kV, 22 kV and 11 kV voltage levels. The SCADA hardware and software is being upgraded in each of the RCCs with state-of-the-art systems. Each RCC has a different SCADA vendor; however, care is being taken to make sure that each of these

different systems will be able to communicate with the SCADA system at NECC. Currently supervisory control may be exercised on all distribution capacitor banks at the RCC level to maintain the power factor within acceptable limits.

8.2.2 Generation Dispatch

The process of generation dispatch is carried out by NECC in three distinct steps that involve load forecasting, unit commitment, and economic dispatch. NECC is responsible for control and monitoring of all generators in the UPS. In situations where computer-controlled economic dispatch is not possible, units are dispatched based on the system operator's experience.

The complete process of generation dispatch is implemented using the GE-Harris XA-21 EMS software at NECC.

8.2.2.1 Load Forecasting

NECC uses two types of load forecasting techniques in the operations planning and system operations. Both methods can predict the hourly loads and the minimum and maximum loads for a given day in the forecast horizon. For both the forecast horizon is two weeks at hourly resolutions, and both use the current day's loads as key input data for the forecast.

The first, similar day load forecast, is based on similar day load profiles. This method is based on the operator's input of daily projected minimum or maximum load projections and the load profile to be used by the similar day load forecast algorithm. Load forecast results are calculated for each forecast day by scaling the forecast day's load profile based on peak MWh forecast or "Stretch" between peak and minimum MWh forecast. Since this method does not use historical weather data, this method is prone to errors arising out of the fact that load profiles from one day to another may not be similar.

The second method, demand load forecast, is more accurate and is based on five years' worth of historical weather and load data. The data that is used for purposes of load forecasting is obtained from the EMS.

8.2.2.2 Unit Commitment

The unit commitment process schedules generation sufficient to meet the forecast daily peak load plus a reserve margin. NECC has determined that a minimum reserve margin of 250 MW is appropriate for the Egyptian system. Hydro units are first scheduled based on water availability. Thermal units are scheduled in order of their full load energy cost until total scheduled generation (hydro plus thermal) equals at least the forecast peak load plus 250 MW.

The unit commitment program is initialized from the online EMS database and uses data such as:

- Load forecast
- Outage schedules
- Generating unit data such as availability, heat rate curves, ramp rates, start-up and shutdown costs, unit limits, etc.

- Penalty factors.

Program output includes a schedule for generator operation along with the unit outputs for each hour of the plan period.

8.2.2.3 Short-term Hydro Optimization Planning

Short term hydro optimization is used to schedule available hydro resources over the planning period of one week. There is relatively little flexibility in the control of the Egyptian hydro generation system because Ministry of Irrigation and Water Resources (MIWR) directs the flows in the Nile based on irrigation needs.

The main hydro plants are High Dam (12 units, 2,100 MW) and Aswan 1 and 2 (11 units, 550 MW total). The discharge from High Dam flows into Lake Aswan, which feeds the Aswan plants. The MIWR specifies specify the required river level immediately downstream from Aswan, which the plant releases must maintain within 5 centimeters. The plant tries to maintain the target level exactly. Therefore, the plant operates at flat load throughout the course of the day.

The MIWR provides a rolling 10-day schedule of planned water releases from High Dam, updated every day. For the current day, the releases must produce the planned total release for that day. The must also maintain the water level in Lake Aswan within an acceptable range. Within that framework, NECC can direct the operation of the units at High Dam to provide the optimal amount of hour-by-hour energy, reserves, and frequency control.

Several objective functions such as maximization of energy remaining in storage, minimization of water usage, and maximization of overall efficiency of water utilization are considered as part of the optimization process. The output of the short-term hydro optimization process includes hydro unit schedules, spillway discharge, spill gate openings, and the reservoir levels in each interval of the study period.

8.2.2.4 Hydrothermal Coordination

The process of hydrothermal coordination used by NECC is a complex iterative process between unit commitment and short term hydro optimization. By determining the system incremental cost and an equivalent water-energy conversion factor, hydro cost curves are obtained for each hydro unit subject to constraints.

Hydrothermal coordination then takes the form of unit commitment based on these new cost curves. A new system incremental cost is obtained based on unit commitment. Using this new system incremental cost, equivalent water energy conversion factors are recalculated and so on. The iterative process stops when the improvement in water prices is within some pre-defined tolerance or there is no significant improvement in the system cost.

The process of hydrothermal coordination involves the commitment of hydro and thermal generation resources in the cheapest way possible subject to the constraints involved in the operation of hydro and thermal units. Hydro units are committed first because of their low cost and then the remainder of the net energy demand is allocated to the more costly fossil-fueled units.

8.2.2.5 Economic Dispatch

Once NECC has determined the units to be committed, and the hydro operations schedule, least-cost economic dispatch is accomplished by dispatching the units in the order of their marginal costs. NECC's economic dispatch program, in conjunction with its automatic generation control (AGC) program, perform this function as well as maintaining system frequency at 50 Hertz, balancing system generation and load while taking all system interchanges into account.

For units without AGC capability, or whose operation falls outside their AGC operating range, or in the event of a communications failure, dispatch is done manually at the plant level under the direction of NECC. The RCCs have no control whatsoever in the operation of generating units. Currently about 50% of the generators have AGC capability.

The UPS is operated with at least a 250 MW reserve at all times and typically most units are loaded to only about 90% of rated capacity. This is to ensure that frequency control is done primarily by generator action.

8.2.3 Transmission and Network Security

NECC also monitors the security of the high level transmission network in real-time by using advanced applications such as state estimator, contingency analysis, and optimal power flow. These applications enable NECC to monitor and operate the power system in an optimal fashion under various "what-if" scenarios. Using advanced state-of-the-art SCADA, NECC can monitor all tie line flows and compute losses at all levels of the high voltage network in real-time.

Engineers at the NECC are working to fix convergence problems related to the state estimation process. Once this is done, they aim to have the real time sequence including contingency analysis and optimal power flow programs running. There is no closed loop control in the power system.

Using the automatic system trouble shooting analysis software, which is part of the EMS suite of applications, engineers at NECC can perform studies involving short circuit calculations and equipment failure.

In order to provide effective VAR support to the network in times of peak demand, NECC uses an on-line application that is part of the EMS suite of software called voltage and VAR dispatch. This allows NECC to operate under strict voltage limits (±5% of nominal bus voltages under normal operation, ±8% of nominal bus voltages under emergency conditions) and line flow limits (100% of rated under normal conditions, 110% of rated in emergency conditions). The high voltage transmission system contains only shunt reactors. Transmission losses in the high voltage power system average about 3%.

8.2.4 Distribution

Power distribution falls within the responsibility of the RCCs. Each RCC has basic SCADA functionality that enables it to control the distribution level network that predominantly consists of the 66 kV, 33kV, 22 kV and 11 kV networks. All capacitor

banks may be controlled remotely at the RCC to enable on-line power factor correction based on real-time measurements.

8.3 OPERATIONAL PLANNING

The EMS suite of software includes an outage management function, which facilitates operational planning. This function allows the engineers at NECC to include planned outages of power system equipment in a load flow study. The results can help operators evaluate the consequences of the planned outage on the power system performance. In most cases, execution of contingency analysis in conjunction with planned outages may lead to accurate results for systems operations personnel.

Besides the above, engineers at NECC have access to the Electro Magnetic Transients Program, which allows them to simulate power system events such as faults, capacitor switching, lightning, arcing etc. for purposes of study. Working in conjunction with the NECC is EEHC's power system protection group. This group uses Computer Aided Protection Engineering software developed by Electrocon International USA, to perform operational planning and studies related to power system protection.

8.4 SOFTWARE

The NECC has a state-of-the-art EMS provided by GE-Harris. This allows engineers at NECC to perform SCADA and study the real-time network using advanced applications. This system is used primarily to control all the system generation and the high voltage network that consists of 500 kV, 220 kV, 132 kV and some portions of the 66 kV network. Besides having a fully operational SCADA system that supports data archival for a five year period, NECC has a complete suite of advanced applications programs to assist system operations as described in Table 8-1.

Table 8-1 Description Of Software Available At NECC

Name of Function	Functional Description	Status
Automatic Generation Control	Performs dispatch of generators based on frequency, tie-line flows, etc. to maintain balance between load and generation in real-time.	Only about 50% of units have AGC capability.
Economic Dispatch	Aids the AGC function by allowing economic considerations in real time dispatch	Operational
Unit Commitment	Aids in the optimal scheduling of generating units for up to one week in advance	Operational
Load Forecasting	Aids in the prediction of system load. Functions include short-term load forecasting which is based on the use of historical weather and load data and Similar Day Load Forecast which is based on similar day load profiles and patterns.	Operational

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State Estimator	Aids in the estimation of power system quantities such as voltages and power flows using real time telemetry	Operational however convergence is poor at times.
Dispatcher Load Flow	Aids in a study mode analysis of the power system by calculating power flows and bus voltages	Operational
Contingency Analysis	Aids in performing "what-if" conditions based on power system equipment failure	Operational
Optimal Power Flow	Aids in study mode or real time dispatch of generation taking into account network security constraints	No convergence, process is being tuned
Automatic System Trouble shooting Analysis	Aids the system operator in performing fault analysis, short circuit calculations and equipment analysis	Operational
Energy Accounting / Scheduling	Allows the operator to keep track of tie-line flows and manage various EMS energy accounts	Operational
Transient Stability	Allows the operator evaluate the transient stability margin of the power system network	Operational
Dynamic Load Shed	Allows the operator to decide how to optimally shed blocks of loads to alleviate system stress and enhance system reliability	Operational
Dispatcher Training Simulator	Allows simulation of Power System Operations in an interactive way between the instructor and the trainees for Dispatcher training purposes.	Not operational

In order to perform planning and study functions, NECC engineers have access to a highly sophisticated suite of software tools provided by GE power systems which allows engineers at NECC to study the network under different conditions. In addition to the high voltage power system network and all the generators, the power system network model includes the 66 kV distribution network. The suite of software includes study mode versions of nearly all of the programs noted in Table 8-1.

At each RCC, the level of computerization is slowly increasing. New SCADA systems are being installed at each RCC and the level of automation is slowly increasing. There are no real-time advanced applications on-line however. Depending on the sophistication of the RCC, the RCC may have software that includes, a central database for all the distribution network and study mode applications such as Distribution Feeder analysis, Distribution Feeder Optimization and Distribution Fault analysis.

Despite having state-of-the-art software in several small pockets throughout the various departments at EEHC, there is no corporate LAN or server that stores all the information and software centrally so that clients from various departments may freely access the software as needed. Currently all information from one department to another is by conventional mans such as phone, fax or regular inter-office mail. This is true throughout EEHC, the NECC, and all RCCs.

Section 9
Contracts

The primary objective for reviewing existing contracts is to understand what constraints they impose on the design of the Egypt Power Pool. Normally a contract would not impose constraints unless it represented a long-term commitment which would endure into the time period when the pool was operational. Long-term contracts would not necessarily impose constraints, depending on their specific terms.

9.1 EXISTING CONTRACTS

The only formal contracts that we are aware of are those between the BOOTs and EEHC. We have not had access to complete copies of any of the contracts, but we understand that they provide for terms of 15 to 20 years - obviously long term commitments, necessary to support financing of the plants. They also provide for the following:

- Prices for electrical energy competitive with or below the cost of most of the thermal energy generated by the Electricity Companies.
- Payment guarantees by the Government of Egypt.
- Essentially base load operation.

The amount of BOOT generation currently under contract is small enough that such terms will not impose serious constraints on the operation of the current electrical system, nor will they on the design of the power pool. If BOOTs become a large fraction of total installed capacity, it will be necessary to incorporate more flexible terms in their contracts regarding dispatch - not all plants can operate in a base load manner.

The payment guarantees imply that the BOOTs must be paid in cash or equivalent. This drains cash from a power sector which is already short of cash, and will add to the difficulties of managing cash flows throughout the sector when the power pool is implemented. For BOOTs to become a much higher fraction of total installed capacity will require addressing the fundamental problems that cause the need for Government guarantees, or maintaining the guarantees.

9.2 CONTRACT-LIKE RELATIONSHIPS

We understand that the organizations providing fuels to the generating plants do so on the basis of approved tariff schedules. Whether or not incorporated in a formal signed contract, these impose rights and obligations similar to contracts.

We understand that these schedules do not require long-term commitments on the part of the buyers, in which case they do not constrain power pool design.

9.3 INFORMAL RELATIONSHIPS

The lack of contracts does not appear to have a negative effect on the functioning of the existing power sector. EEHC's ownership of the ECs no doubt contributes to this smooth functioning, because all parties know that as the owner EEHC ultimately can require whatever actions are necessary for proper functioning in any event.

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For example, without formal contracts the ECs use the high voltage grid to move their generation from their plants to their loads or other ECs. NECC dispatches the ECs' generators to minimize overall costs without their formal consent.

Even after Distribution and Generation Companies are formed from the existing ECs, such informal arrangements could continue. EEHC ultimately would still be able to control the operation of those companies as long as it had 100% ownership. They would be more issues to address compared to the current situation, because the Generation Companies have no direct source of revenues, whereas the generation-owning ECs now do have direct sources of revenues. However, after the sale of shares in the Distribution and/or Generation Companies to private investors, the interests of the private owners will need to be taken into consideration even if they are minority owners. Formal arrangements will need to be made covering a wide range of issues, including payments among the power sector companies.

The existing informal arrangements do not impose constraints on the future formal arrangements for several reasons:

- They are not formal contracts.
- They are not long term.
- They will be replaced by the new arrangements while all parties are still owned by EEHC.

Section 10
Financial Issues

10.1 INTRODUCTION

10.1.1 Objective

With the impending separation of generation and distribution, it was important for the Nexant team to review metering points, cost allocations, and especially the overall financial structure of the ECs and EEHC. Implementation of the Egypt Power Pool will require addressing issues related to the costs and revenues, and cash needs, of each firm. In addition we must deal with practical matters such as what data will be required for the pool and how to collect and bring the data in from the Generation and Distribution Companies in order to facilitate the power pool billing process.

10.1.2 Areas Reviewed

Consistent with the power pool objectives, the Nexant team reviewed four major areas within the EEHC and the ECs:

- Profitability
- Non-payment
- Accounting (Financial and Cost)
- Miscellaneous (Billings and Collections and Inventory Control)

10.1.3 Organizations Visited

The Nexant team conducted extensive interviews with key personnel responsible for the various functional finance areas from the EEHC, the Alexandria EC, and the Canal EC. Interviewees were encouraged to elaborate on the particular subjects that were relevant to the objectives of the Nexant team. In order to observe how business is conducted, the Nexant team made several site visits that included substations, NECC, RCCs, Supervisory Control Centers, technical and commercial sections in distribution districts, and various distribution points. The interviews were conducted during the period 15 January through 14 February 2001 and included frequent follow-up meetings with interviewees. The expanded report on findings and supporting detail is presented as Appendix A to this report.

10.2 PROFITABILITY

10.2.1 Current Results

We took data from EEHC and EC financial statements and prepared key operating ratios in order to facilitate financial analysis of the EEHC and the ECs. Table 10-1 presents those ratios. The period covered is the year ending 30 June 2000 for the Egyptian firms and the year ending 31 December 1999 for the US comparison.

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Table 10-1 EEHC and EC Financial Results

	US Average	EEHC	ECs Total	Cairo EC	Alex. EC	Behaira EC	Delta EC	Canal EC	Upper Egypt	Middle Egypt
Profit Margin %	7.5	1.6	3.1	2.4	3.6	1.8	4.1	0.4	12.8	1.9
Return on Equity %	10.4	3.3	7.0	7.8	7.3	7.3	8.9	1.2	18.9	2.8
Return on Assets %	3.0	1.1	0.8	0.8	0.8	0.5	0.1	0.1	2.3	0.3
Receivable Turnover	6.7	0.46	0.84	0.78	0.67	0.84	1.06	1.21	0.57	0.93
Inventory Turnover	13.4	1.09	3.38	4.58	2.84	3.23	3.47	2.31	2.26	5.15
Debt to Equity	1.34	2.01	7.88	9.34	8.23	5.86	6.20	8.99	7.35	8.16
Interest Coverage	2.4	1.11	1.35	1.35	1.78	1.22	1.64	1.07	1.84	1.10

LEGEND:

Profit Margin %: Operating Income / Sales — This ratio is designed to give the ECs an accurate idea of how much money the ECs make on their primary business operations

Return on Equity %: Net Income / Total Equity — Shows what ECs earned on EC investment in the business during the accounting period (Also referred to as ROI — return on investment)

Return on Assets %: Net Income / Total Assets — Measures how well the ECs use their assets to produce income

Receivable Turnover: Sales / Accounts Receivable — Ratio will quickly point out cash flow problems related to EC business's accounts receivable. The number of times in each accounting period that a company converts credit sales into cash. A high turnover indicates effective granting of credit and collection from customers by ECs management.

Inventory Turnover: Cost of Goods Sold / Avg. Value of Inv. — Ratio tells how often EC inventory turns over during the course of the year. Because inventories are the least liquid form of asset, a high inventory turnover ratio is generally positive.

Debt to Equity: Total Debt / Owners' Equity — Ratio the degree of financial leverage that the EC uses to enhance EC return. A rising debt-to-equity ratio may signal that further increases in debt caused by purchases of inventory or fixed assets should be restrained

Interest Coverage: Operating Income / Interest Expense — Evaluates how many times EC interest obligations are covered by earnings from operations. The higher the ratio, the bigger the EC cushion

10.2.2 Recent Trends

Table 10-2 presents changes in EEHC and EC revenues and profitability from the year ending 30 June 1999 to the year ending 30 June 2000. Table 10-2 shows that EEHC and EC revenues showed substantial growth from one reporting period to the next, but net operating income declined dramatically for most of the firms and the group as a whole.

Table 10-2 Net Change in EEHC and EC Revenues and Profitability

	EEHC	TOTAL ECs	Cairo EC	Alex. EC	Behaira EC	Delta EC	Canal EC	Upper Egypt EC	Middle Egypt EC
Change in Revenues from Operations, %	+6.0	+8.8	+4.9	+9.0	+7.6	+9.3	+12.2	+9.3	+16.2
Change in Net Operating Income, %	(62.4)	(29.8)	(54.9)	(2.3)	(48.1)	(1.6)	(68.2)	+12.7	(47.3)

10.2.3 Discussion

Analysis of the key ratios in Table 10-1 indicates that the EEHC and ECs:

- Border on unprofitability
- Are not efficient in asset utilization
- Have excess working capital invested in slow moving inventory
- Have a difficult time collecting outstanding and delinquent accounts receivable
- Have excessive debt
- Barely have sufficient income to cover interest payments on current debt

Other than the return on assets ratio, all ratios for the Egyptian companies are significantly inferior compared to the US average. The return on assets of most of the ECs approaches the US average. This is somewhat misleading, because the ECs' equity fraction of total assets is generally much less than for the US firms. A relatively small amount of net income can produce a reasonable return on equity. However, a small increase in costs or decrease in revenues could make the ECs unprofitable, or conversely quite profitable.

The decline in the level of EEHC and EC profitability can generally be attributed to an increase in debt service related interest expense. This probably is associated with the formation of EEHC, and the transfer of debts associated with the generating stations. It should be noted that restating EC Income Statements to International Accounting Standards (IAS) would probably have resulted in a loss for the year ending 30 June 2000 for the EEHC, Cairo Electricity Company, Middle Egypt Electricity Company, Canal Electricity Company, and Behaira Electricity Company.

IAS related unprofitability would result from revaluing uncollected accounts receivable, bad debt expense, depreciation and revaluing inventory. Adjusting pre-operation experiments, research and development, incorporation expenses and advertising campaign expenses to adhere to IAS would further decrease profitability for those ECs that previously capitalized those expenditures.

10.3 NON-PAYMENTS

The cash collection rate for EC residential customers approximates 90%. The greatest amount of non-payments has been identified with the large EEHC and EC non-residential customers. with GOE power customers constituting the highest percentage of EC and EEHC uncollected

accounts. The inability of the EEHC and ECs to collect balances due negatively impacts EC and EEHC cash flows. Since customer receivable accounts are not aged, an accurate understanding of specific delinquent accounts is not readily available.

Table 10-3 shows the amount of time, in days, it takes on average for the EEHC and ECs to convert one Egyptian Pound (LE) in credit sales to cash. A similar ratio expressed in years rather than days is shown in Table 10-1.

Table 10-3 EEHC and EC Accounts Receivable

	EEHC	TOTAL ECs	Cairo EC	Alex. EC	Behera EC	Delta EC	Canal EC	Upper Egypt	Middle Egypt
Average Collection Period	752	481	484	791	466	373	324	738	395

LEGEND:

$$\text{Average Collection Period} = \frac{\text{Current Accounts Receivable Balance}}{\text{Average Daily Sales}}$$

The number of days, on average, that a firm requires for collection of a credit sale. The length of the collection period indicates the effectiveness with which a firm's management grants credit and collects from customers. A short period is desirable because the firm obtains cash more quickly for reinvestment or for paying its own bills. The collection period is calculated by dividing accounts receivable by average daily credit sales.

10.3.1 Discussion

The average collection period measures the length of time it takes to convert EEHC and EC credit sales into cash. This measurement defines the relationship between accounts receivable and cash flows. Both the EEHC and its ECs face very long average collection periods that require a higher investment in accounts receivable. The higher investment in accounts receivable manifests itself in less cash being available for the EEHC and ECs to cover their cash outflows, such as paying liabilities.

To illustrate, according to Table 3, it takes the EEHC an average of 752.2 days after a customer is invoiced for electricity until the payment is received. The average collection period for the ECs is 481 days. In other words, for every kWh of electricity sold by the ECs today, it will take an average of 16 months until cash is collected and available for the ECs' use.

Delinquent customer account balances are not assessed late payment charges or interest charges on overdue balances and delinquent accounts are normally not disconnected for non-payment. (According to EC customer contracts, ECs can cut off power if no payment is received within 60 days. As a practical matter, however, ECs do not cut off power to their customers.) Therefore, there is no compelling mechanism to force customers to pay their account balances in a timely manner.

10.4 ACCOUNTING

There are three types of reports generated internally on a monthly basis by EC finance sectors:

- Cost Reports
- Financial Reports

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- Monthly - Evaluating and comparing performance (actual versus prior year for the same period)
- Quarterly – Actual versus budgeted (with analysis of positive and negative variances)

- Commercial

Transfer of financial statements to the EEHC by the ECs is a problem for the EEHC because there is no standardized format for communication. The received information must be hand-transferred from faxes, etc., to the program files used to consolidate the information. This is a source of possible errors, requires EEHC staff time, and delays the presentation of the information, reducing its timeliness and usefulness.

The consolidated balance sheet is prepared according to Egyptian Accounting Standards following a format developed by the World Bank for the EEHC approximately twenty years ago. The EEHC and its ECs have been following the GOE Unified Accounting System since it was adopted in 1966. At present, the entire accounting system is manual and all data is extracted from manual ledgers.

Although the ECs each prepare monthly financial statements for their own internal use, EC financial statement submissions to the EEHC are on a quarterly basis.

Due to volatility and marginal operating results within the Egyptian electricity sector, the absence of monthly reporting by the ECs to the EEHC is problematic since timely information for proper planning and control is required by EEHC senior management in order for the EEHC to respond effectively to issues facing the consolidated organization.

10.4.1 Financial Accounting

When restating EEHC and EC operating results to IAS, major problems are encountered in reconciling Egyptian standards with IAS in the areas of "reserves" and "estimates".

All ECs follow the EEHC Balance Sheet format. The EEHC Income Statement differs from the Income Statements prepared by the ECs. All ECs, however, follow the same Income Statement format.

Neither the EEHC nor the ECs are audited by an independent outside audit firm.

10.4.2 Cost Accounting

Managers do not have a system available that collects, classifies and stores cost data in such a way that costs can be understood and controlled.

Within the ECs, no formal process exists for cost accounting that is suitable for the control of cost at the plant or distribution district level. The focus is on electricity production with little attention on the accuracy of cost or on the understanding of cost behavior. Depending on the company, cost accounting is either manual or automated.

The Chart of Accounts currently followed by the EEHC and its ECs supports only the minimum level of detail required, so data needed for detailed analysis is not collected. This

has resulted in cost records (both manual and automated) capturing expenditures on a general level rather than a detailed level.

Cost management consists of annual budgets that forecast labor, spare parts, materials and miscellaneous costs but not revenues. Since plant managers are primarily interested in production data, there is a lack of understanding of costs at plant level. This lack of understanding impacts the effective management of capital by the ECs. In addition, cost information flow is one-way from cost centers to the financial sector where total cost is included in reports that summarize overall performance.

10.4.3 Financial Information System Automation

There is a lack of consistency between software platforms adopted for cost accounting at the ECs with the software adopted for the overall accounting system.

Billing functions are automated within the ECs, but their General Ledgers are manual. In general, customer records are difficult to lay hands on. The EEHC's Commercial Department's billing and collections system, on the other hand, is entirely manual.

Although EC Headquarters' central cost accounting functions are fully automated, cost accounting at the branch level is manual.

Not all RCCs are currently automated. The Alexandria EC is fully operational, both Cairo and Canal will be operational within one year, and West Delta is at the specification and tendering stage of system development. For that reason, the visual reading of meter measurements are taken on a monthly basis since it would be impractical to manually read meters on an hourly basis.

10.5 MISCELLANEOUS

10.5.1 Billing and Cash Collections

Although residential and big customer invoice preparation has been outsourced, meter reading (approximately 90% of current meter readings are manual), delivery of invoices, and collection of payments is a manual process.

While new meter installations are in accessible areas, most residential meters are located inside the customer's residence, which affect the meter readers' productivity and efficiency since repeat visits are normally required to obtain meter readings.

Collectors are essential to the EC billing/cash collection cycles and, since labor cost is low, the ECs can employ a significant number of Cash Collectors. EC Cash Collectors are very aggressive since they receive cash bonuses based on a percentage of revenues collected. This has had the effect of speeding up EC cash flows.

10.5.2 Inventory Management

Inventory control is a combination of manual and automated systems. The current systems are not integrated with cost or the General Ledger. There is no accountability for inventory levels (stock level evaluations are only completed annually). Uses of economic order quantity models are not in place. Although a process to dispose of unused or obsolete items is in place

within the ECs, the process is weak and not cost effective. In addition, ad hoc procurement policies unnecessarily increase unit cost and do not result in minimum stock levels that could free up working capital.

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Section 11
Miscellaneous

11.1 ECOLOGICAL IMPACT OF UNITS

The primary ecological impacts of the existing thermal units appears to be through their air emissions and water requirements. The hydro units themselves have relatively little ecological impact, but the presence of the dams on the Nile has potentially very large impacts. For example, eliminating the annual floods may have far-reaching consequences. However, the primary purpose of the dams is to provide a more reliable and larger water supply for the country.

With respect to water requirements, thus far all steam units use once-through cooling. This provides an increase in temperature in the receiving body of water, and may damage organisms that pass through the cooling system, but results in less evaporative losses than a wet cooling tower. Dry cooling would provide much smaller impacts, but would be far more costly in terms of both capital and operating costs, and unit efficiency.

The most important air emissions from the thermal plants include carbon dioxide, carbon monoxide, particulates, NOx, SO2, and unburned hydrocarbons. The primary fuels for the thermal units are fuel oil (mazut) and natural gas. Natural gas produces noticeably less air emissions overall, but slightly more CO2 per unit of electricity produced.

Air emissions can be reduced through direct control of the combustion process, and in addition the following mechanisms, among others:

- Improve unit thermal efficiency
- Take advantage of the efficiency of cogeneration
- Fuel switching / unit conversion to natural gas firing
- Implementing electrical energy conservation and load management programs
- Reducing system technical losses

Egypt has made substantial progress in most of these areas. For example, natural gas use was about 55% of total fossil fuel use for generation in the early 1990s. In recent years it has been in the range 65-75%, in part as a result of the conversion of some existing units to dual fuel capability and building new units with dual fuel capability. In addition, efficient new combined cycle units, with efficiencies up to 48%, have been built.

However, air emissions are not an important factor in power system planning or operations today. The generation planning software used by the Studies, Research, and Design Department has the ability to calculate the total air emissions associated with possible alternative generation expansion plans, but the information is not used in the decision making process. Air emissions considerations also do not affect the operational commitment or dispatch of generating units.

11.2 FUEL MIX

The ECs generating units burn natural gas, heavy fuel oil, light fuel oil, and special light fuel oil.

EEHC is concerned that it might become too reliant on natural gas as the fuel for its thermal units. EEHC's policy is to develop primarily units with dual fuel capability, especially with the ability to burn mazut. This will assist in assuring the reliability of fuel for generation in the event of a disruption in the supply of natural gas. Therefore, its policy is that combined cycles, which can burn natural gas and lighter fuel oils, but not mazut, be about 20% of new resource additions. Without this policy they would be a much higher percentage, because they provide the lowest cost electrical energy. Steam units, which can burn both natural gas and mazut, are over 50% of the new units to be added consistent with this policy.

The system has been planned with attention to enhancing reliability through using a diversified set of fuels. However, the limitation on combined cycle development means that more fuel in general and more natural gas in particular will be used in the short term because the steam units are less efficient, reducing domestic availability in the long term. It is not clear that limiting combined cycle development to 20% represents the best tradeoff, considering the economic benefits of combined cycles and their long term benefits in reducing fuel use.

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Appendix A
Detailed Financial Review

Appendix A Detailed Financial Review

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A.1 MAPPING OF EXISTING PROCESSES AND BUSINESS CYCLES

The Nexant team employed the following methodology in mapping cycles related to the financial functions of both the EEHC and the ECs:

- Determine whether the processes were formally documented for use within the organization;
- Determine whether the organization has a formal organization chart that establishes hierarchical reporting relationships and responsibilities;
- Obtain a fundamental understanding of process cycle activities performed;
- Facilitate communication among organization interviewees;
- Understand the impact of the functional cycles on the organizations' financial situation; and,
- Provide a basis for preparing the Situation Report (i.e., identify constraints and infrastructure needs).

Mapping of targeted process cycles began with interviews of key individuals in the financial functional areas regarding current duties and procedures followed in process cycles. The interviews identified process cycles in which the functional area participated.
In some instances during the course of the interviews, we provided coaching and acted as an expert facilitator to groups of senior managers during the process cycle analysis and interviews.
During the interview phase of the consultancy, since it is recognized that the companies will not be able to discharge people, we did not provide organizations visited with recommendations concerning reorganizations or redefining job functions or staffing levels. In addition, improved efficiency and increased productivity were also not examined.

A.2 FINANCIAL PROCESS CYCLES

The Nexant team reviewed the following process cycles:

- Business and Strategic Planning
- Revenue Requirements
- Cash Management
- Cost Management
- Budgeting
- Debt Management
- Cost Accounting
- Inventory Management
  - Obsolescence
  - Inventory Control

A.3 BACKGROUND

A.3.1 EEHC

EEHC is the central power sector organization. It maintains its own accounting and financial systems. In addition, it collects and consolidates the financial statements from its wholly owned Electricity Company subsidiaries.

A.3.2 Alexandria Electricity Company (AEC)

The AEC distributes electricity to 1.36 million customers and serves a territory encompassing the Alexandria Governorate and the coastal area for 66 kilometers west of Alexandria.

The operation of the HV network is controlled from one central automated Regional Control Center (RCC). The RCC automatically monitors system equipment status and loading and has the capacity for remote control of the 66 kV breakers. Line switching orders is based on telephone communications between the RCC Dispatch and substation operators.

The MV distribution network is monitored via three distribution control centers by the SCC located at the AEC main office.

The capital costs associated with distribution system expansion are passed on directly to new customers who must pay for new service connections in advance. Both Commercial and Residential customers pay for the cost of new service connections plus required system upgrades and connection to distribution lines. In the case of inadequate loads, Commercial customers also pay for the cost of additional equipment required to meet the load (substation transformers and feeders).

A.3.3 Canal Electricity Company (CEC)

Since all ECs are all owned by EEHC, all seven ECs follow the same organizational skeleton and include the same sectors. The major difference between the seven ECs is the degree of automation and technical levels that exists within the various ECs.

The Canal Electricity Company (CEC) is comprised of eight Zones directed from the CEC Ismailia Headquarters for the Medium Voltage and Low Voltage networks. The CEC is responsible for an area that covers the entire Sinai Peninsula, the Eastern Coast of Egypt east of the Nile River from the Mediterranean Sea in the North to the Sudan Border in the South.

The eight CEC Zones include:

- Sharkeya;
- 10th of Ramadan and The New Cities;
- The Read Sea;
- Port Said;
- Ismailia;
- South Sinai;
- Middle Sinai; and,
- North Sinai.

The CEC Commercial Department has a variety of load demands that include big tourist locations (the area covered by the CEC has the largest tourist centers in Egypt), agricultural loads (pumping stations for irrigation), residential and industrial (cement, petrochemical and steel [arc furnace] factories, etc.). The CEC breaks its customers into two classes: Big (industrial customers that start at 1 MV) and Small (residential customers – flats and small shops, etc.).

At present, the CEC Distribution Company has the 11 kV and 22 kV networks (There is no 33 kV network, 33 kV is found in Upper Egypt). The CEC receives 66 kV directly from the network and converts it to 11 kV. There is an 11 kV Supervisory Control Center located at the CEC Headquarters. The Regional Control Center (RCC) has data acquisition and monitoring capabilities but cannot control.

A.3.4 Operations And Organization

The organization charts for the EEHC and ECs are extremely complex. In general there are non-consolidated financial functions existing between the generation, transmission and distribution portions of the various companies. The financial functions were not consolidated when the organizations were combined in 1998.

A.4 GENERAL ACCOUNTING ISSUES

Neither the EEHC nor the ECs are audited by an independent outside audit firm. Central Auditing completes all audits. The Central Audit is the sole auditor of the EEHC and the ECs. Central Audit audits throughout the year and has been provided facilities within the EEHC from which they operate.

All seven ECs as of 30 June 2000 follow the EEHC Balance Sheet format. The EEHC Income Statement, however, differs from the Income Statement prepared by the seven ECs. All seven ECs, however, follow the same Income Statement format and include both Profit and Loss Account data and Credit Account data.

Many private Egyptian firms routinely restate their statutory results (produced under Egyptian standards) to IAS for outside investors. In restating to IAS, the major problem in reconciling Egyptian standards with IAS has been in the areas of "reserves" and "estimates".

The Chart of Accounts (COA) currently in use by the EEHC and ECs is different than the one they will probably use in the near future. The EEHC had completed an analysis of the government's unique COA and the COA used within the private sector and found that the major difference between the two is in the area of depreciation. While International Accounting Standards (IAS) are silent on the issue, the EEHC and ECs use a special fixed percentage rate for depreciation (10% for buildings and plant, 20% for vehicles and 3.2% for the transmission network).

There is no legal obligation for Distribution Companies to follow the government's unique COA and, in fact, they are free to use any COA they prefer. It is a decision that the Distribution Companies will have to take after they examine their available alternatives. In evaluating COA alternatives, Distribution Companies will examine different depreciation schedules in order determine which schedule will most favorably impact their profitability.

Only Distribution Companies would be permitted to change to a new COA. Generation Companies will continue to use the government's unique COA.

A.4.1 Allowance for Doubtful Accounts

For every LE in credit sales by the ECs, unfortunately, not 100% will ultimately be collected and that, based on historical experience, the ECs should analyze their receivable collections versus gross billed revenues and establish an allowance for probable uncollectable accounts.

Although the ECs do not cut-off customers for non-payment, allowance for doubtful accounts have been established by most ECs. The allowance is calculated as a percentage by the Commercial Department. The Commercial Department analyzes every account to determine whether or not it can be collected.

With reference to writing off bad debt, the Sector goes to the Chairman to write off customer accounts and that the approval of the EC Board of Directors is also required.

A.4.2 Classification Of Accounts

A review of the current EEHC and EC balance sheet through the period ending 30 June 2000 indicates that the account classifications generally follow IAS conventions. The EEHC financial statements covered only the HV network and EEHC operations and do not include the operating results of any of the ECs. The EEHC and EC financial year runs from 1 July through 30 June of the following year.

A.5 CURRENT STATUS OF AUTOMATION WITHIN EEHC AND THE ECS

The entire EEHC budgeting process of fully automated. The budgeting process of all sectors and Zones is also fully automated. The EEHC's budgeting software was developed specifically for the EEHC budgeting process and is not based on Excel spreadsheets. All sectors and Zones use the same budgeting software. Although the budgeting process is fully automated, monthly reports comparing actual and budgeted results are not transferred from the Zones over a data link.

The EEHC's Commercial Department's billing and collections system is entirely manual.

The EEHC and ECs use computer models to allocate data for all loans based on their 5-year plan. The seven ECs use a different model than that used by the EEHC.

Although the billing function is automated in the Cairo Electricity Company, the General Ledger is manual. Behaira has developed its own software for billing. All of the other ECs subscribe to a billing service and maintain manual General Ledgers. In general, customer records are difficult to lay hands on. It would be easier, if necessary for analysis, to get a computer printout of customer data and load into a spreadsheet for analysis.

A.5.1 EEHC Financial Affairs Department

An Irish company, ESBI, had undertaken a contract within the EEHC Financial Affairs Department (FAD) to establish a fully automated Financial Management Information System (FMIS). The FMIS is supposed to connect together all sectors belonging to the EEHC.

Although installation of the FMIS has been completed, the system does not work and progress towards automation has completely stopped.

A.5.2 Automation of CEC Accounting Functions

All computers currently in use within the CEC Headquarters are used as stand-alone PCs and that the CEC does not operate a LAN to integrate the accounting functions. Stand-alone DOS based software applications that were developed internally by the CEC include:

- Cost accounting for Big Customers and for Financial Aspects;
- Inventory;
- Purchasing; and,
- Payroll (CEC payroll is done in-house).

A minimum number of EC loan agreements have been computerized. Although CEC Headquarters Central Cost Accounting is fully automated (software developed internally by the CEC), all cost accounting at the branch level is manual. Within the CEC, there is no distribution of labor hours from the payroll module to the cost accounting module because there is no interface between the modules. At present, the CEC is automating the manual daily employee sign in/sign out document (time sheet).

The Canal Electricity Company (CEC) is in the process of automating its financial systems (billings, etc.). The CEC estimates that it will take between 3-5 years for the CEC to complete the process. Financing the changeover to automation is not the problem facing the CEC, rather, it is a CEC personnel issue. It might be necessary to replace existing staff with new staff in order to effect change and move forward. The CEC Headquarters has computers for the inventory and finance functions but that the CEC does have a Local Area Network (LAN). The CEC Technical Affairs Sector has computers that are utilized for the collection of technical data on the distribution network.

A.5.3 Automation of CEC Cost Accounting

Internally developed cost accounting software is DOS based and that the CEC wants to upgrade using ORACLE. The CEC will probably start next month and that the project would last approximately one year. The proposed system configuration for the data link between the CEC and EEHC and the eventual incorporation of four remote sites LANs (Port Said, Sharm El-Shaikh, Ismailia and 10th of Ramadan and The New Cities) as part of the CEC's WAN.

The proposed automation plan will start with the CEC and then expand to CEC Branches. The issue facing the CEC is not the availability of finances but constraints posed to the CEC by current CEC staff. It is the CEC's staffs' capacity to absorb and adapt that hinders CEC advancement in the area of automation.

At present, the CEC inventory is not completely automated. The internally developed inventory control software program does provide minimum and maximum inventory levels, quantities and inventory valuation data.

A.5.4 Automation of the AEC Accounting Functions

The AEC General Ledger is manual and that any computer applications simply duplicate the manual system.

Approximately 3 years ago the AEC cost accounting function was automated. Prior to that, the AEC cost accounting system had been manual. At present, both computerized and manual cost registers are maintained.

AEC Stores has been fully automated for the past 6 years.

A.5.5 Status of Automation Within the RCCs

Not all Regional Control Centers (RCCs) are currently automated. For that reason, the visual reading of meter measurements are taken on a monthly basis since it would be impractical to manually read meters on an hourly basis. The NECC has identified that transducers will be needed and made available in the future at the RCCs as part of the proposed Power Pool.

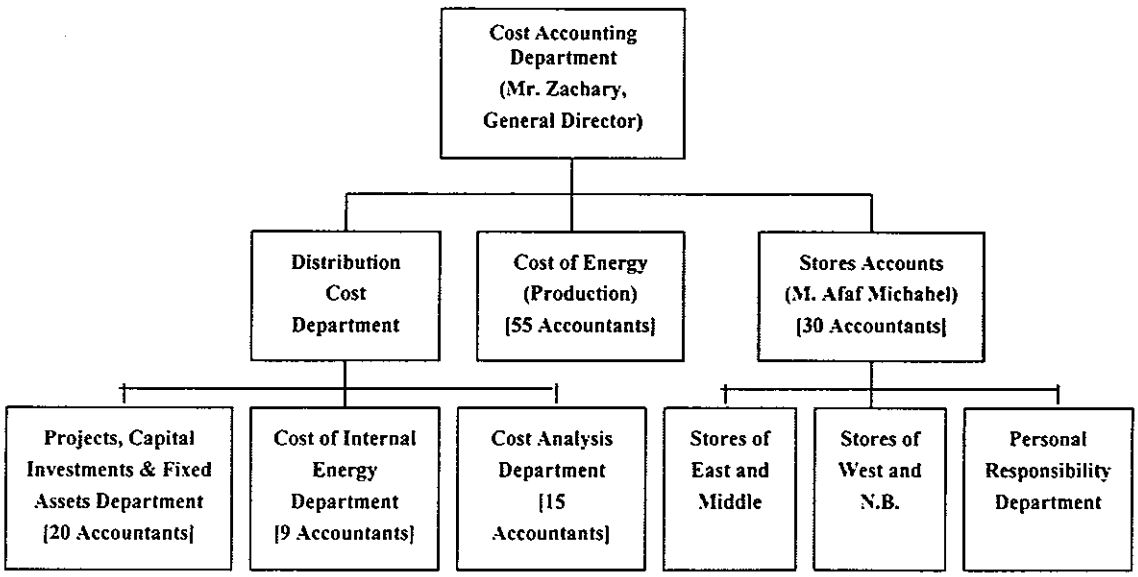
The Alexandria Electric Company is fully operational, both Cairo and Canal will be operational within one year and West Delta is at the specification and tendering stage of system development. Eventually, there will be an automatic data link between the RCCs and the NECC but at present, only the Alexandria Electric Company and the NECC are linked.

A.6 CURRENT STATUS OF EC COST ACCOUNTING PROCESSES

A.6.1 Alexandria Electricity Company Cost Sector

AEC Cost Sector has two Departments. Sector objectives are to account for the cost of each station and calculate the cost of power flows between the ARC, other ECs and the EEHC.

Organization of the AEC Cost Accounting function:



The function of the Cost Analysis Department is to distribute expenditures to the various AEC Cost Centers; the Cost of Energy Department calculates the cost of energy transfers between ECs; and, the Personal Responsibility Department tracks assets assigned to AEC

staff (AEC staff are personally and financially responsible for assets under their control until they receive a release of responsibility from this Department.).

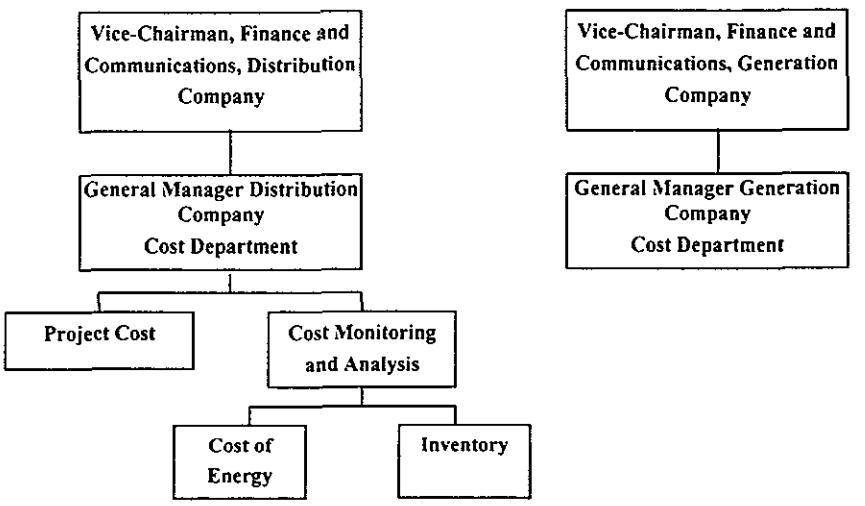
There are five Cost Centers within the AEC:

- Cost of Production Centers;
- Cost of Service for Production Centers;
- Cost of Marketing Centers (The Commercial Sector is responsible for marketing energy);
- Cost of Financing and Management Centers; and,
- Cost of Investments Centers (There is a connection between this Center and projects since salary and any materials utilized in projects is also an investment.).

The allocation of indirect cost is done within the Cost Analyzing Department and all indirect expenditures are distributed.

A.6.2 Canal Electricity Company Cost Sector

The CEC has two separate Cost Sectors, one for generation and one for distribution. Both are under their respective Vice-Chairmen.



Unlike the AEC, where cost is under one department and the AEC's total cost is calculated by the AEC Cost Department for distribution and generation, the CEC cost function is under two separate departments (generation and distribution). Within the CEC, the generation and distribution cost departments forward their cost to the senate committee who, in turn, forward the cost to the CEC Finance Sector for consolidation. CEC total costs are then provided the CEC Vice-Chairman, Finance and Communications.

Because of geographical considerations, there is a Cost Department in each of the nine CEC Branches that report administratively to the Branch but maintain a technical relationship with the Headquarters Cost Department.

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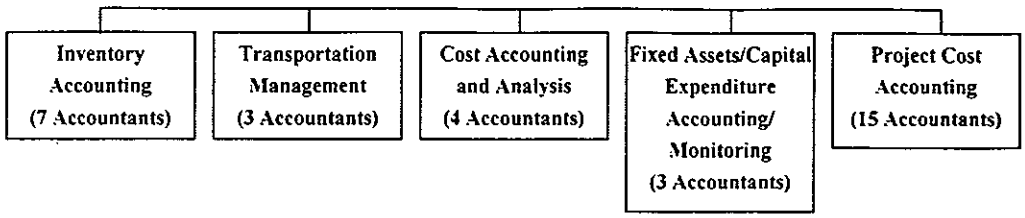
The breakdown of staffing within the CEC cost structure is as follows:



In addition, each of the nine Branches is staffed by 2-3 cost accountants. An additional 5 accountants are assigned to each Branch for inventory accounting.

The CEC is organized into four cost centers:

- Service Cost Center;
- Marketing Cost Center;
- Administration Cost Center; and,
- Financial Cost Center.

The CEC does not differentiate between direct and indirect cost and has not addressed issues such as worker productivity and their effect on CEC costs.

Indirect cost associated with operating the CEC Headquarters is allocated to the cost centers. For example, the Chairman's salary is a direct cost to the Marketing Service Cost Center but an indirect cost the remainder of the CEC. Different indirect cost had different bases for their allocation (i.e. number of staff, number of staff hours, total salaries, etc.). The CEC had a uniform policy for allocating indirect cost and that the CEC followed the same policy year after year.

Treatment of fixed and variable costs within the ECs ignore the particular behavior patterns of cost classifications. For example, the cost of telephones (the basic monthly charge is a fixed cost while the cost of placing telephone calls is variable – some calls are project related (direct variable) while other calls are administrative (indirect variable)). All telephone costs are treated as overhead and allocated to cost centers.

Another example is EC treatment of depreciation costs. To illustrate, if equipment is purchased by an EC that has an estimated useful productive life of 1,000,000 hours over a certain number of years but once the equipment is placed in use and available data indicates that actual hours will exceed 1,200,000, depreciation charges are not adjusted to reflect actual use. All depreciation is straight-line based on a fixed schedule. Variable rates of depreciation are not considered. Depreciation rates on equipment are established based on the manufacturer's specifications provided in the equipment brochure. Once the rate of depreciation is established, it is not changed.

The CEC lacks the capability of calculating the cost of the load per hour during the course of a day (peak load and low load cost). At present, calculation by the CEC of the cost of kWh is performed just once each month based on inputs and outputs. Although it could be possible to compute manually, the CEC lacks the means to perform similar daily high/low calculations.

A.7 OTHER EMPLOYEE RELATED COSTS

In addition to salaries, General Managers and above are provided housing rent free of charge by the CEC as well as cars, drivers and electricity - all at no cost to the employee. In addition, Heads of Sectors are provided furniture by the CEC free of charge to the employee.

A.8 INVENTORY MANAGEMENT WITHIN EEHC AND THE ECS

The Inventory cycle of the EEHC and ECs consist of receiving, storing, retrieving and maintaining inventory records of spare parts and materials at the power plants.

In general, within the EEHC system when materials and spare parts are ordered and shipped they are received and stored at a warehouse facility. Personnel are then able to retrieve parts needs for repairs and maintenance by preparing a request and obtaining necessary approvals. Depending on the Company, inventory control (both physical control inventory cost accounting) varies from completely manual to fully automated. Physical inventories are completed once each year as part of 30 June year-end closing activities.

Stock levels for items are not routinely evaluated. Lack of periodic evaluations on shelf life.

Inventories are valued using the weighted-average method of inventory valuation (All ECs use the weighted-average method of inventory valuation, as mandated by the MOEE.).

If materials cannot be identified to a project, they are treated as current period expenditures.

There are detailed project cost and asset records available within the AEC. For example, vehicle logs books are maintained for each AEC vehicle that detail fuel, oil and maintenance expenditures for that vehicle. Project costs are accumulated as Work-in-Progress until the project is closed out. Then all project cost are transferred to the Fixed Assets section of the AEC Balance Sheet.

Since the AEC inventory is automated, inventory is maintained on the perpetual inventory method. On-hand quantities and prices are updated and available.

While a physical inventory is taken annually as part of the year-end close in June of each year, there is a Stores Inspectorate (which reports directly to the Chairman) that makes monthly inspections of the AEC stores throughout the year. In addition, there is an analysis on stock movements that is prepared annually and submitted to the Chairman for guidance on disposition of slow moving stock.

When distribution and generation were originally separated the CEC production and generation inventories were separated. While the two CEC companies subsequently merged again, CEC inventories remain separate. In addition to the CEC's Central Stores in Ismailia, each of the nine CEC Branches also maintains its own inventories. CEC inventory policy tracks slow moving items in inventory. In general, stocked inventory consists of only essential items that are required by the CEC (Maintenance items such as cables, transformers, circuit breakers, etc.) and consumed during normal operations. Stock levels are based on rate of consumption.

Inventory values are adjusted to reflect the lower of cost or market (if, through obsolescence, items stocked in inventory have a zero market value). The CEC has a committee that reviews stock movement issues (i.e. slow-moving inventory items) and decides if inventory will be liquidated. The present mechanism for inventory liquidations is through public auction. The CEC auction asking price is the average inventory cost calculated. If the auction asking price is not met, the Chairman's approval is required prior to disposing of the item at the highest bid – inventory items are not retained in stock if the auction asking price is not met, they are sold.

Control of physical counts and item movement is under the CEC Purchase Department. Inventory valuation, however, falls under the Cost Department.

The CEC does not normally stock vehicle repair parts. Vehicle repair parts are purchased as required for the repair of a vehicle (for example, replacement vehicle tires are purchased as needed). Vehicle repair part purchases are recorded in the CEC inventory system as simultaneous in and out transactions to provide the CEC with demand history to assist in any future CEC inventory stock level decisions.

There is a special CEC committee that deals with inventory stock issues. The committee reviews future CEC projects and decides what inventory items are required for future consumption. These items are then forwarded to the CEC Purchasing Department for tendering.

A.8.1 Slow Moving Inventory Items

Within the ECs, if an item in inventory does not move during the prior year, a report is prepared by the General Manager for the Chairman. In addition, the GOE's Central Audit (under the Ministry of Energy and Electricity) also reports on inventory movements as part of their year-end audit procedures.

A memorandum is drafted concerning inventory movements and sent to the Chairman at the end of each year. Notice is also sent to other ECs offering slow moving inventory for sale. If other ECs decline to purchase, excess inventory is sold on the open market.

A.8.2 Obsolete Inventory Issues

The AEC previously had a fleet of Russian vehicles and maintained a repair parts inventory for those vehicles. The AEC no longer has the Russian vehicles but still maintains the spare parts inventory for those vehicles. When the AEC tried to sell the Russian vehicle spare parts on the open market, the market price was less than their cost basis on the AEC inventory records. Because the price offered was less that the cost basis, the offer to sell the Russian vehicle repair parts was withdrawn from the market. The Russian spare parts are still included as part of the AEC inventory and are valued at their historical cost.

Since operating units are not operated as profit centers, the cost of maintaining large inventories is not as critical as plant availability and the impact of excessive inventory on plant economics is not apparent.

The process to review the actual amount of annual inventory turnover at each site would provide additional visibility and control.

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Although there are processes in place that routinely dispose of unused or obsolete inventory items that are stored at plants, some companies have spare parts inventories for equipment that had been replaced.

Within the ECs, there are no periodic adjustments to inventory to reflect the lower of cost or changes in market value or year-end adjustments to the cost basis of inventory.

A.9 BUDGETING

The budgeting process for the EEHC has been adopted without modification by all seven ECs.

A.9.1 Overview

Zones and the EEHC Headquarters submit their budget requests to the EEHC Budgeting Department where the requests are then consolidated and submitted to the Board of Directors for review. A monthly report comparing budgeted results with actual results is prepared by the Budget Department (based on input from the Zones) for submission to the EEHC Board of Directors for their review. The monthly report contains an analysis and explanation of both favorable and unfavorable variances.

The EEHC budget preparation cycle begins six months prior to the beginning of the fiscal year to be covered by the budget. The budget cycle for the FY 2002 started in January 2001. The first three months of the budget cycle (January through March) is used by the Zones and the Head Quarters to prepare their supporting schedules and budget requests for submission to the Budget Department.

The period April through June is used by the Budget Department to consolidate Zone requests and submit the consolidated budget request to the EEHC Board of Directors for their review and approval.

The budget is normally approved during June of each year and becomes effective on 1 July for the period covering 1 July through 30 June of the following year.

A.9.2 Steps in Preparing the Annual EEHC Current and Investment Budgets

- **STEP 1.** In January a Budget Committee is formed and the Budget Department explains the budgeting process to the Committee Chairperson and the persons who will prepare the budgets.
- **STEP 2.** The Committee Chairperson receives a financial presentation and an agreement is formalized to establish a Budget Subcommittee.
- **STEP 3.** Letters are sent to the sectors and Zones instructing them to form Budget Subcommittees in each sector and Zone. A Detailed Budget Package containing budget preparation instructions is also provided by the Budget Department to each sector and Zone. The Package includes budget preparation instructions for both the Current and Investment Budgets.
- **STEP 4.** To facilitate the process, the Budget Department sends representatives to each sector and Zone to explain the budget process and assist in the preparation of the budgets. The representatives then bring the completed budget schedules and budget

requests from the sectors and Zones back to the Budget Department where the Zone and sector budget requests are then combined with the EEHC Headquarters budget.

- The Investment Budget is prepared differently. The budget for every project is prepared by the Engineering Department in the Ministry of Electricity. The Investment Budget is then forwarded by the Ministry of Electricity to the Budget Department and is combined by the Budget Department with the Current Budget.

A.9.3 Budget Reporting

The EEHC Financial Department receives reports on Current Operations each month from the Zones, EEHC Headquarters and Hospital (the Hospital is owned by the EEHC). Each reporting unit prepares their own analysis comparing their actual results to their Current Budget and prepares a written report explaining favorable and unfavorable variances.

Monthly report submissions are received by the Budget Department from Zones in the form of written reports. The written reports are then re-entered in the Budget Department's computer for analysis and consolidation. Madame Mary said that the EEHC's budget system is based on the same Chart of Accounts as the EEHC's financial accounting system.

Analyses and reports prepared by the Zones are forwarded to the General Budgeting Department for consolidation. The consolidated monthly report is then sent to the EEHC Board of Directors for review. The exact same process is followed when analyzing and comparing actual expenditures with Investment and Capital Budget. The only difference is that Investment and Capital Budget analyses are prepared on a quarterly basis, not on a monthly basis.

A.10 FREQUENCY OF FINANCIAL REPORTING WITHIN EEHC

No monthly financial statements are prepared. At present, each Zone reports revenue, expense and net income to the EEHC Financial Accounting Department after the first of each month for the prior month. Zones consist of Cairo, Canal, the Hospital, South Zone Upper Egypt Zone (Aswan), North Zone (formally Alexandria) and elements of administration. Accounting within all of the zones is fully automated. Accounting within the EEHC Financial Affairs Department (FAD), however, is entirely manual. Financial data collected each month from the zones is used to prepare a Quarterly Report for the EEHC Board of Directors.

Balance Sheets and Sources and Uses of Fund Statements are prepared only on an annual basis. The FAD periodically prepares reports that analyze the components of EEHC expenditures as required by the Ministry of Finance, Ministry of Planning and EEHC.

The Cost Accounting Department tracks the cost monthly of every kW by hour for the EEHC and all Zones. A Quarterly Report of the total cost of the Zones is prepared for the Board of Directors. In addition, the Department tracks Project Costs and generates a Quarterly Project Cost Report for the EEHC Board of Directors.

A.10.1 EC Financial Reporting

There are three types of reports generated internally on a monthly basis by EC Finance Sectors:

- Cost Reports;
- Financial Reports (Monthly - Evaluating and comparing performance [actual versus prior year for the same period]; and, Quarterly – Actual versus budgeted [with analysis of positive and negative variances]); and,
- Commercial.

Communication of financial statements to the EEHC by the ECs is a problem for the EEHC. At present, each EC computes its own financial statements based on the GOE Chart of Accounts and then submits its financial statements to the EEHC for entry into a spreadsheet. After entry into the spreadsheet, the EEHC then filters the information provided.

Consolidation of the seven ECs is accomplished in an Excel template developed by the EEHC. The format of the EC consolidation shows the balance sheet of all seven ECs side-by-side with an additional column added for consolidation. The consolidated balance sheet is prepared according to Egyptian Accounting Standards following a format developed by the World Bank for the EEHC approximately twenty years ago. The EEHC and its ECs have been following the GOE Unified Accounting System since it was adopted in 1966. At present, the entire accounting system is manual and all data is extracted from manual ledgers.

Although the ECs each prepare monthly financial statements for their own internal use, EC financial statement submissions to the EEHC are on a Quarterly basis. All seven ECs submit their financial statements based on a format developed by the EEHC. Quarterly financial statements from the ECs are submitted to the EEHC using a variety of media: FAX, ***Lotus Notes***, hard-copy printout and, on occasion, on a 3.5" floppy diskette containing the Excel template.

A.10.2 Quarterly Consolidated Financial Statements for the Seven ECs

A Quarterly Report is prepared by the EEHC that contains operating ratios comparing the operations of each EC with each of the other ECs.

The Quarterly Report is distributed to the EEHC Board of Directors. In addition to the Quarterly Report, the seven ECs also submit a written report on their operating results for the previous quarter. The Board of Directors reviews both the EC operating ratios and written reports and tries to solve any problems identified within these documents.

A.11 DEBT MANAGEMENT

Various financial models developed by the USAID Power Sector Support I Project had been previously delivered to the ECs but that they had not been implemented.

A.11.1 Formal Debt Management Plan

The ECs have many loans (both foreign and local) that have maturity dates that extend for the next 25-30 years. The loans usually have generous grace periods of 7-10 years and either nominal or low rates of interest at the front end that increase with the loan repayment period. While the current tariff might cover current EC debt service requirements, the ECs may have a exposure in 2010 where the combination of the end of the grace period and increasing

interest payments prove the tariff inadequate. Now would be the time for the ECs to start to gradually phase in tariff increases for 2010, not in 2009.

An example is presented below to illustrate the above point.

				Interest and Principle Payments by Year					
Loan Description	Loan Amount	Principle Repayment	Interest Rate	2001	2002	→		2029	2030
World Bank Loan dated 1 Jan 2001, maturity in 30 years	200,000,000	0 years 1-5, 1,000,00 per month, years 6-10, 2,500,00 per month years 7-30	.1% per month years 1-5, .5% per month, years 6-10, 1.0% per month years 7-30						
ADB	150,000,000								
Cairo Bank	50,000,000								
TOTAL:	2,800,000,000								

A.11.2 Long Term Debt Management Within EEHC

Since the GOE is the guarantor of all international debt, the EEHC acts in a debt manager capacity for all international debt for both the EEHC and all seven ECs. EC International Long-Term debt is recorded on the General Ledger of the EC incurring the debt. Installment payments (both interest and principle) on international Long-Term debt incurred by the ECs are paid to the EEHC by the ECs. The EEHC, in turn, transmits the installment payment directly to the international creditor. There are no restrictions on the ECs from incurring their own Local Long-Term debt, which the ECs deal directly with local financial institutions and bypass the EEHC.

Since 18 June 2000, the EEHC no longer borrows from international lenders and that all EEHC debt is from local banks. At present, the EEHC borrows from four banks (The National Bank, Cairo Bank, MISR Bank and Alexandria Bank). All international loan obligations were transferred from the EEHC to the seven ECs effective 1 July 2000. Since 1 July 2000 only local debt is reflected on the EEHC balance sheet.

The transfer of foreign debt to the seven ECs was accomplished by relating each individual loan to the specific project financed by the loan (EC by EC).

A debt repayment schedule is prepared for every foreign loan, including interest and amortization. Although the schedule is prepared for only the year covered by the Current Budget, it is calculated for daily, weekly and monthly repayment of loans during the budget year.

The General Budgeting Department does not prepare debt management plans. The Department provides a current year loan repayment schedule to the Cash Management Department and that the Cash Management Department makes loans repayments. The Cash Management Department then furnishes the Budgeting Department with actual loan payments

for budget tracking purposes. There is an International Loan Department under the General Finance Department that is charged with the responsibility for managing international loans.

A.11.3 Long Term Debt Management Within ECs

There is no formal AEC debt management plan currently in place within the AEC. A fundamental problem with AEC debt management is that, since all debt is guaranteed by the GOE, there is really no interest in debt management. In addition, although a Debt Management System had been delivered to the AEC under the previous project, the AEC has delayed implementation since there is an underlying belief within the AEC that the AEC will remain part of the GOE sector.

A minimum number of EC loan agreements have been computerized. In general, only hard copies of the loan documents are available. Since many of the loan agreements specify four or five different currencies, reconciliation is a problem. Although EC debt service has been improving, it still represents a significant liability. With reference to the Ministry of Finance (MOF), obligations to the MOF by the ECs for non-payment of debt in the past are recorded in "Other Liabilities". Although there is a significant amount of old debt still maintained on ECs accounting records, ECs cannot write the debt off because the MOF will not forgive the debt. However, some accounts receivable offsets (based on this debt) have occurred between the ECs and the MOF.

The CEC is currently implementing the debt management system model developed under a previous USAID funded project. The model will manage debt for the next five years (through 2006). The program can be tailored for any period identified (5 years, 10 years, etc.). With reference to debt management system implementation, data had been input for 3 years and that they were trying to complete 5 years.

A.12 DISTRIBUTION

The following Distribution Company cycles were reviewed as part of this consultancy (field work associated with this consultancy included site visits to 66 kV substations with technical and commercial department staff to check connections, installed meters and review of the meter reading cycle):

- Metering;
- Revenue sources
- Billing and Collections;
- Inventory Management; and,
- Control of losses.

A.12.1 Billing and Collection Cycles

Review of the billing cycle included review of activities related to determining electric consumption (meter readings), verification of reading and customer invoicing. Review of the collection cycle included review of collector activities related to obtaining payments from customers and cash management practices.

A.12.2 Metering

Meter reading cycles process within the ECs. The HV sector, transmission network and each of the seven ECs have Meter Reading Committees (MRCs) that are responsible for meter calibration and readings. In addition to the MRCs, there are seven Inspectorates for the total HV transmission network. The function of the MRCs is to take meter readings at control points, analysis data and prepare loss calculations. There are problems with different meter reading times.

There is an EEHC Coordinator in each EC who forwards data to the EEHC. The EEHC then calculates losses for each EC. The loss percent is between 3.2% and 3.3% for the EHV network (500 kV, 220 kV and 132 kV). EEHC Senior Management has a targeted loss percent of 2%, similar to France's loss percentage. If the 66 kV were included in the loss, the loss percentage would be between 6.5% and 6.6%.

The 66 kV system provides real-time data to the Regional Control Centers (RCCs) and, although the capability is currently not available, this data could eventually be transmitted to the NECC for calculation. At present, the RCCs are undergoing an IT building process.

A.12.2.1 Power Plant Data

Although power plant data is of billing quality, data collected is not relied on for billing purposes. Plant meters are currently read once each month and that, although their meters have high accuracy and resolution, it is inconvenient to read the meters more frequently because of their geographical locations. Dispatch currently bills every ½ to 1 hour. In addition to identifying that the NECC will need real-time hourly billing to effectively implement the planned power pool, the issue of how to transmit data, possibly by a modem on the meter, has to be addressed prior to the automation of the RCCs.

A.12.2.2 Sighting of Meters

Previously all ECs were part of Zones. As ECs, meters are set in both the 66 kV sector and the HV sectors. Meters are set between the HV sector and the ECs. On the 500 kV network, both Upper Egypt and Lower Egypt are metered. In addition, there are meters on both sides, at any interchange, between ECs and between Zones. MRCs reconcile discrepancies between ECs on what on EC claims to have sent and what another EC claims to have received.

There is a list available of data points in the field for meters for both the ECs and RCCs for the interfaced companies. The listing provides interchange points with meters, to/from values and specifications for billing quality data.

In addition to Jordan, Libya and Egypt, Syria became the 4th member of the external "Loose Pool" arrangement on 9 January 2001. While a bilateral agreement with Syria has not yet been executed, Syria can request electricity from Egypt and Jordan will then collect the wheeling charges. At present, there have been no transactions between Egypt and Syria.

While end-of-month settlements could be effected in cash, settlements are normally in-kind. The end-of-month settlement process requires that schedules are reviewed, inadvertents are calculated, the interconnection point is added and meters are checked at both ends.

A.12.2.3 Meter Reading Cycle

Although the same meter is used throughout Egypt, the process by which meters are read and data processed varies from EC to EC.

At present, EEHC financial personnel process data received once a month in hard copy format from the ECs. The financial personnel then use the meter at the NECC and calculate the monthly loss.

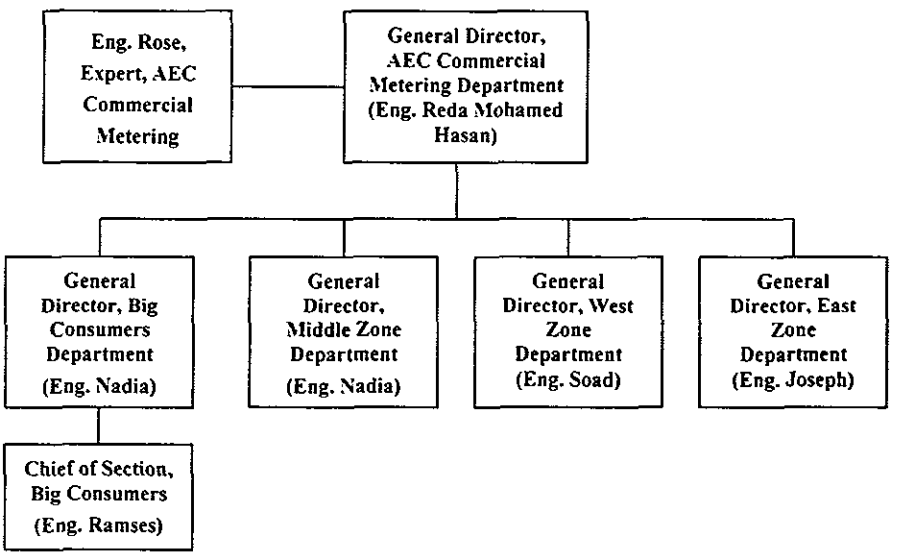
Improvements in IT would save time, improve data quality, synchronize data and provide useful information for management planning and control purposes. Synchronizing data is a continual problem since it is not possible to solve by employing any known manual method.

A.12.3 Alexandria Electricity Company Metering

Approximately 20% of AEC meter readings are now hand-held (more than any other EC). There are only two 220 kV customers (EEHC Direct Customers) in Alexandria. The AEC has approximately 700 big consumers (66 kV and 11 kV). Alexandria is divided into three Zones (hence the three Departments) – East, West and Middle. The AEC Zone Departments are responsible for residential and small company metering.

Residential metering is divided into approximately 18 districts and that each district has a Commercial Department charged with reading the meters of the AEC's 1,300,000 residential customers.

The AEC Commercial Meter Department is organized as follows:

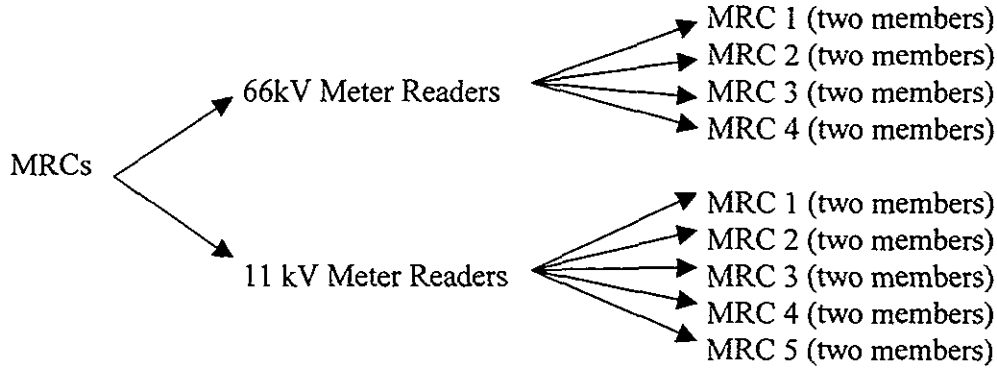


A.12.3.1 AEC Meter Reading Committees

All Meter Reading Committees (MRCs) fall under the AEC Big Consumers Department. There are two types of MRCs under the Big Consumers Department, 66kV meter readers and 11 kV meters readers. At present, all meter reading is manual. New meters, once installed, will be read by hand-held devices (new meters will not have a modem). The Alexandria

Zone's responsibility is limited to meter readings for Direct Customers and readings at the interchange points of 66 kV and 220 kV.

Each MRC consists of two members, one from the Financial Department and the second from the Commercial Metering Department. The breakdown is as follows:



The sole function of the MRC is to read the meters. They have a chart on which they write the readings at all substations on the 66 kV and 220 kV networks. All 66 kV and 11 kV meter readings are taken on the first day of each month by the MRCs. Two copies of the readings are prepared. One copy is provided for technical purposes to the AEC Commercial Meter Department and the second copy is provided for financial purposes to the AEC Finance Department. Copies are distributed to the two AEC Departments on the second working day of the month for the purpose of calculating and comparing readings and losses. The technical review includes a review of prior month readings in order to identify defective meters.

On the 1st day of the month representatives from the Commercial Metering Department and counterparts from the organization's various finance functions (Cost Accounting, etc.) measure flows between the EEHC and the Distribution Company.

The Cost Accounting Sector then calculates revenue flows associated with power inflows and outflows. The ARC always imports more than it exports to Behaira. Settlements by the ARC to Behaira are always made by check. Settlements with Behaira depend on the availability of cash within the ARC.

Invoices are prepared from production cost information available from the production system and that separate registers are maintained for the production sector. The AEC Cost Sector is staffed by 55 cost accountants.

Invoices are prepared before the 10th of each month. The ARC always owes a balance to the EEHC so amounts owed by the EEHC to the ARC are deducted.

There are approximately: 34 metering points on the 66 kV and 11 kV network; 10 metering points at the connection points of the EEHC 220 kV, 66 kV and 11 kV networks to the Alexandria Electricity Company (ARC); and, 4 metering points at the generating stations.

Meter Reader Committees (MRCs) measure approximately six meters per team during the hours of 9:00 AM and 3:00 PM on the day scheduled for meter readings.

After verifying 66 kV and 11 kV calculations with the Commercial Meter Department, the Finance Department then calculates losses in the 66 kV grid. The Finance Department then adds 66 kV, 220 kV and 11 kV losses with the difference between their calculations and the sale of energy to consumers of 11 kV and 380 kV. Meter reading calculations, including loss calculations, are done entirely by computer by both the Finance and Commercial Metering Departments. Both Departments use an Excel spreadsheet template. Calculations based on the readings take approximately an additional two days each month. For the remainder of the month, MRCs return to their normal duties (calibration of meters, cost accounting, etc.).

A.12.4 Interaction Between the Alexandria Regional Control Center and the NECC

The NECC can monitor all 220 kV and power generation stations and the ARCC cannot. In the NECC requires data, it can poll data over the telephone. Essentially, there is a one-way data link between the 220 kV stations and generators RTUs through the ARCC to the NECC.

The ARCC has current metering problems. Their biggest problem is when data from station meters and actual measurements do not match. The EEHC is trying to resolve this problem by installing new transducers.

A.12.5 EEHC Metering

3,000 new meters were purchased in 1999 as part of Phase 2 of the EEHC metering project. Under Phase 1 of the project, 474 meters were purchased in 1996. The 474 meters have been installed primarily in the industrial sector and with high consumers and are double tariff meters. Meter readings are collected from hand-held devices and data is used to study load management.

The 3,000 meters purchased under Phase 2 have the same capability as those purchased under Phase 1 and will also be installed in the industrial sector and with high consumers. The new meters can be read by hand-held device or by telephone modem.

A.13 EEHC COMMERCIAL DEPARTMENT

The EEHC has 16 direct customers (500, 200 and 132 only – 66 is retained by the Distribution Companies). The EEHC purchases HV from Distribution Companies and, in turn, sells it to the 16 direct customers. The Distribution Company then invoices the EEHC for the power based on Distribution Company cost. The EEHC then prepares another invoice and bills the Direct Customer based on the fixed national tariff. The direct customer then pays the EEHC invoice. There are no cash flows between the EEHC and ECs related to the 16 direct customers. Quarterly the EEHC and the ECs settle balances and any excess will be carried over to the next period.

The EEHC Commercial Department handles the billings and collections for the EEHC's 16 direct customers. EEHC direct customers are billed on the last day of each month and that they are required to pay within 30 days from the day that they receive their bills. Payments from the direct customers to the EEHC are in the form of check. If payments are late (after 30 days) the customer is subject to a fixed delinquency fee (the late payment fee is established by the Central Bank).

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EEHC direct customers fall within 4 sectors plus Cairo (East, North South and Middle sectors). Each sector bills their direct customers (for example, the are 3 direct customer under the Canal Electric Company), collects payments from the direct customers and then forwards payments to Cairo. The EEHC Commercial Department then returns a portion of direct customer payments back to the ECs so the EC can pay their cost related to wages, fuel, maintenance, etc.

A.13.1 AEC Commercial Department

The AEC Commercial Department maintains a Journal of Billing and a Journal of Collections for each of the AEC's 18 Areas (18 Journals). The meter reading and billing process continues from the 1st through the 30th of each month, cash collections are targeted for the period beginning the 26th of each month (when statements are delivered to customers) through the 7th of the following month – this is the highest period of collection activity within the AEC cash collection cycle. To speed up the meter reading and billing cycles, implementation of remote readings is under study.

The AEC has 13,000 big customers. Meter readings are completed during a 10-day period and customer invoices are issued on the 11th day. Meter readings are reported daily each day by the meter reader to the AEC Headquarters. The following day the AEC, using remote terminals within the AEC, transmits meter reading data to the service bureau's file server. There is then a period of negotiations between the AEC and its big customers (prior to the customer paying their account) where the two parties agree on what amount is actually due. According to the AEC's agreements with its big customers, customer payments are due within two weeks from the date of receipt by the customer of the of AEC's statement.

The AEC does not assess late penalty charges or interest on unpaid and late payments.

According to the AEC's contract with its customers, the AEC can cut-off power if no payment is received within 60 days. As a practical matter, however, the AEC does not cut-off power to its customers.

A.13.2 CEC Commercial Department

30% of CEC customer metering is computerized. Although CEC meters are electromechanical, some meters will soon be digital.

All meters are read monthly, the date differs from location to location and depends on the decision of company management. Although readings are done manually, calculations and billing are automated. The CEC is in the process of implementing remote reading. Existing meters are being upgraded with an interface card to facilitate remote reading.

CEC commercial customers in its eight Zones are divided into two different classes: Big Consumers - more than 500 KVA, and consumers below 500 KVA (includes residential and commercial). There are approximately 600 Big Consumers and 30,000 customers below 500 KVA.

Commercial Department's manual meter reading process. Commercial Department Inspectors (Meter Readers) are tasked with completing a minimum of 100 readings per day. Given 25 workdays per month, each Inspector has to complete a minimum of 2,500 readings per month.

Inspectors forward their readings to the Commercial Department, who, in turn, calculates and issues invoices to CEC customers.

Small consumer (domestic and small shops) readings are forwarded to the Commercial Department during the 15th through the 25th of each month. Billings are issued on the 1st of the following month. Customers are required to pay current bills within 30 days of the receipt of their invoice.

The meter reading/billing cycle differs slightly for Big Consumers. Meter readings are taken at the end of each month, calculations made and a bill generated. Big Consumers are notified that payment is due upon receipt of their invoice.

A.14 RESIDENTIAL AND COMMERCIAL BILLINGS

Although the billing function is automated in the Cairo Electricity Company, the General Ledger is manual. Behaira has developed its own software for billing. All of the other ECs subscribe to a billing service and maintain manual General Ledgers. In general, customer records are difficult to lay hands on. It would be easier, if necessary for analysis, to get a computer printout of customer data and load into a spreadsheet for analysis.

In excess of 1.9 million CEC customers fall under the residential billings classification. Meters for flats are located inside the flat. Although meter readings are currently manual, the CEC is moving towards remote readings to deal with problems related to customers not being available at their residence when the Meter Reader attempts to read the customer's meter. At present, since the Reader cannot gain access to the customer's meter, repeat visits are required in order to obtain meter readings.

The meter reading procedures require that the Meter Reader read the meter, complete the meter log, annotate the historical reading log left at the meter location (customers' can compare their bills with the historical log) with the current reading and submit the meter reading to the CEC office for calculation. With all of the different steps associated with the meter reading process, errors cannot be totally avoided.

The actual criteria underlying residential meter readings mirror Commercial meter readings: Each Meter Reader in each of the 54 Areas is required to read 100 residential meters per day. Given 25 workdays in a typical month, each Meter Reader must read a minimum of 2,500 residential meters per month.

Estimated billings are occasionally billed (based on the customer's consumption from prior months).

A.14.1 Big Consumer Penalties and Bonuses

EC Big Consumers are subject to both power factor (PF) penalties and bonuses. Big consumers are required to meet a PF of .9. If the PF is less than .9 but greater than .7, the penalty is equal to .5% for each .1 of the consumer's total bill. If the PF is less than .7, the penalty is equal to 1.0% of the total bill. In addition, the consumer is notified that it must improve its PF or service will be disconnected. With reference to bonuses, if the CEC's consumer PF is greater than .92, the consumer receives a bonus equal to .5% of their total bill. For PFs between .92 and .95, a bonus of 1.0% will be given for each incremental .1 PF

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improvement. PF improvements exceeding .95 are calculated at the PF .95 ceiling. With reference to AEC bonuses, if the consumer PF is greater than .9, the consumer receives a bonus equal to .5% for each .1 of their total bill up to .92. There are no bonuses for PF improvements exceeding .92.

A.14.2 Customer Billings

The Alexandria Electricity Company (AEC) has outsourced invoicing through a service bureau named El Aharam. El Aharam receives output from the hand-held devices and inserts the data in its server and updates customer records. In the case of manual readings, El Aharam has terminals at the ARC that are linked to the El Aharam server.

El Aharam prints customer invoices and delivers invoices to ARC Branches for delivery to customers by ARC Cash Collectors. Turnaround at EL Aharam (from the meter reading cycle to the delivery of invoices to the customers by the Cash Collectors) averages approximately 9 days.

The AEC has two types of collections: Consumed power (meter reading); and, new installations.

AEC Cash Collectors are very aggressive since they receive a cash bonus based on a percentage of revenues collected. This has had the effect of speeding up AEC cash flows. Cash Collectors actually visit customers' houses in order to collect on invoices.

AEC Cash Collectors collect cash until 8:00 PM each evening and retain collections overnight at their residences. Due to the cash collection bonus scheme in place at the AEC, cash shortages are non-existent.

Canal Electricity Company (CEC) residential customer bills have also been outsourced and are prepared by two outside service bureaus. As with commercial customers, meter reading data is forwarded to the service bureaus by the middle of each month. Customer bill processing (calculation and printing of invoices) takes an additional 13 days. Customer bills are then forwarded to the Area Representative (each of the 54 areas has its own representative) who, in turn, delivers the customers' bills to the Area's Cash Collectors who then deliver the customers' bills to their residences. If the customer is not home when the bill is delivered, the bill and a notice is left at the customer's residence. Customer payment is due within 30 days from the date of receipt of their bill.

Canal Electricity Company (CEC) customer payments are required to be made at the Area office that prepared the customer's bill. Because of issues related to maintenance of customer records, payments must be made at their Area office. Since other Area offices do not have the ability to access customer records from other Areas, customer payments cannot be made at other Area offices. Customer collections stop at noon each day. It is illegal to hold deposits at the Area office overnight, all cash receipts must be deposited by close of business each day. Each Area maintains its own bank account. All Area bank accounts have the same account number. Account activity is transmitted by the bank directly to the central bank account in Ismailia. CEC bank accounts are non-interest bearing.

Every two weeks Area offices notify the CEC Headquarters on collection activity during the prior two weeks. All reporting is currently manual.

A.14.3 Aging of EEHC Commercial Customer Accounts

Since there are only 16 direct customers, an aging is not prepared. In general, direct customers do not present a problem and normally pay on time. The only direct power customers that present collection problems are those affiliated with the GOE.

The Commercial Department's current practice for managing delinquent accounts concerning late payments is that the customer is contacted by the Commercial Department (normally by telephone or through a meeting) and the customer is given an extension to deal with its problem. Current practice requires that, after 90 days, delinquent direct customers have to make a payment on their account. EEHC management will normally permit an extension if a payment on account is made. There are direct customers that have balances outstanding from prior periods but those delinquent amounts are not reflected in an aging that would indicate the length of time and amount of the delinquency.

The EEHC Commercial Department prepares a Quarterly Report for submission to the EEHC Management Council.

A.14.3.1 Accounts Receivable Aging Schedule

The accounts receivable aging schedule is a listing of the customers making up EEHC total accounts receivable balance. Most businesses prepare an accounts receivable aging schedule at the end of each month. Analyzing EEHC accounts receivable aging schedule may help the EEHC identify potential cash flow problems.

The typical accounts receivable aging schedule consists of 10 columns:

- Column 1 lists the name of each customer with an accounts receivable balance.
- Column 2 lists the total amount due from the customers listed in Column 1.
- Column 3 is the "current column." Listed in this column are the amounts due from customers for sales made during the current month.
- Column 4 shows the unpaid amount due from customers for sales made in the previous month. These are the customers with accounts 1 to 30 days past due.
- Column 5 lists the amounts due from customers for sales made two months prior. These are customers with accounts 31 to 60 days past due.
- Column 6 lists the amount due from customers with accounts over 60 days past due.
- Columns 7 through 10 list amounts due from customers with account older than 90 days.

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The following is an illustration of a typical accounts receivable aging schedule:

Accounts Receivable Aging Report (in 1,000) EEHC 31 MARCH 2001									
[1] Customer Name	*[2] Total Accts. Rec.*	*[3] Current*	*[4] 1-30 Days Past Due*	*[5] 31-60 Days Past Due*	*[6] 61-90 Days Past Due*	*[7] 91-120 Days Past Due*	*[8] 121-150 Days Past Due*	*[9] 151-180 Days Past Due*	*[10] Over 180 Days Past Due*
	LE2,600	LE 300	LE 500	LE 500	LE 300	—	—	—	LE 1,000
	3,800	2,800	—	—	—	LE 500	—	LE 500	—
	2,000	1,100	500	400	—	—	—	—	—
	1,400	—	400	—	—	—	LE 500	LE 500	—
	1,600	600	—	—	—	LE 500	LE 500	—	—
	1,200	1,200	—	—	—	—	—	—	—
Total	**LE 15,200**	**LE 7,000**	**LE 3,000**	**LE 900**	**LE 300**	**LE 1,000**	**LE 1,000**	**LE 1,000**	**LE 1,000**

If the EEHC anticipates using accounting software packages for billing and accounts receivable processing, it should insure that it prepares the aging schedule automatically.

The accounts receivable aging schedule is a useful for analyzing the makeup of the EEHC's accounts receivable balance. Analyzing the schedule allows the EEHC to spot problems in accounts receivable early enough to protect the EEHC from major cash flow problems.

A.15 COLLECTIONS CYCLE

In the aggregate, the GOE owes LE 14.0 billion (approximate) for power provided by the ECs while the ECs owe the GOE 11.0 billion (approximate) for the purchase of power generated and transmitted over the HV grid. Unfortunately, the ECs cannot switch off power supplied to the GOE for non-payment but the ECs have to pay the EEHC for power from the generators. Payment calculations are based on what the ECs receive from the HV grid, not from generation.

A.15.1 Remittance of Payment by CEC Commercial Customers

The CEC Cash Management Department either goes directly to the consumer to collect payment in cash or the consumer remits directly to the Area Commercial Department within the Zone that prepared the consumer's bill. Consumer payments are recorded in cash against their invoice (the consumer invoice is stamped as paid and the CEC portion is detached from the consumer invoice and retained for CEC accounting purposes).

A.15.2 EC Cash Collections

A.15.2.1 Alexandria Electricity Company

There are approximately 3,250 Cash Collectors in the AEC's 21 districts. AEC Cash Collectors collect cash daily from 5:00 PM until 8:00 PM. All cash collected is taken to Area offices the same day where the cash is then counted (Area offices are available 24 hours a day

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to Cash Collectors). Cash Collectors do not take cash to their residences overnight for submission to the Area office the following morning. Area offices transmit cash collected the previous day to the AEC the following morning for recounting and subsequent deposit into the AEC's bank accounts. With the exception of 2 or 3 remote Areas that deposit cash collections directly into AEC bank accounts, the remainder of the AEC's 21 Area offices do not maintain bank accounts for depositing cash collections. All Area cash collections are forwarded to the AEC Headquarters. Customer payments are remitted to AEC Cash Collectors in the form of either cash or check.

A.15.2.2 Canal Electricity Company

There are a total of 54 Areas in each of the eight Zones. Cash is collected within each of the 54 Area Cash Management Centers until 12:00 each day. All cash collections are required by law to be deposited into the Area's Bank account by the close of business each working day (it is illegal to hold deposits overnight). The CEC works six days per week (Saturday through Thursday) and has established hours of operation from 8:30 AM through 2:30 PM (or, 3:30 PM, depending on the specific Area). Payments are recorded manually in the accounting records. All manually prepared transaction documents are forwarded to the CEC Financial Department in Ismailia every two weeks.

Late charges and interest rates for a customer's account not paid within 30 days from the date of receipt of their bill. There are no interest or penalty charges for delinquent payments by small consumers. Big Consumers are assessed the same rate of interest charged by the National Bank. Interest charges on Big Consumers, however, are not automatically assessed. CEC management will decide, on a case-by-case basis, whether or not interest charges will be assessed on a Big Consumer's delinquent account balance. All current account balances are required to be paid within 30 days from receipt of the bill. Account balances over 90 days old will be reviewed by CEC management to determine what corrective actions should be taken.

Each of the 54 Areas also has a Collection Department that follows up directly with delinquent customers. Contacts with delinquent customers are usually done in person by the Area Collection Department. In addition, each Zone has its own Commercial Department.

Although EC customers should be disconnected for non-payment on account, the practice is not to disconnect since the customer will simply bypass the meter if disconnected.

A.15.3 Cash Collector Bonus Arrangements

There are two collection bonus schemes currently in place within the CEC. Normal Collections Bonuses and Delinquent Account Collection Bonuses. The highest bonus (fixed percentage) is paid for collecting on delinquent accounts. In order to motivate collectors, the bonus for normal collections is in incremental steps up to an established ceiling.

The AEC has the same Cash Collection bonus scheme as the CEC. AEC Cash Collectors receive a nominal base salary plus commissions. While paid bonuses are subject to social and wag taxes, they are accounted for as AEC "Cost of Collections" under the Salaries and Wages accounts.

AEC customers have to be encouraged to pay. Since most AEC customers are illiterate, Cash Collectors are essential to the AEC billing/cash collection cycles and, since labor cost is low, the AEC can employ a significant number of Cash Collectors.

A.15.4 Other Sources of Revenues

The EEHC expects additional cash flows from the ECs in the form of their participation in EC profits (return on investment). With reference to distribution of profits, the ECs issue the EEHC a check. In addition, the Cairo Electric Company issues the EEHC a check for network wheeling charges on a monthly basis.

There are additional charges assessed by the ECs for new connections and installations that have to be paid in advance of establishing new service. The current deposit structure is: Small consumers LE 8.00, Shops LE 12.00 and Others LE 5.00 for each kW load. Customer deposits are maintained in a non-interest bearing bank account (not the same account as customer payments).

A.16 EEHC CASH MANAGEMENT

The EEHC does not currently prepare cash flow forecasts, however, historical cash flows are available. Under the new Deloitte project, a new Cash Flow Unit has been created within the EEHC and is charged with the responsibility of cash forecasts.

A.16.1 EC Cash Management

There is no ongoing analysis (nor any personnel dedicated to this area) by the AEC related to managing the AEC's bank balances. This is one reason why the Financial Planning Sector is being created. Essentially, AEC accountants simply perform bookkeeper functions in that they post AEC transactions to ledgers. AEC accountants do not shop banks for the best rate of interest and they perform little or no account analysis. AEC banking relations are historical and maintained at the same banks based on traditional relationships between the banks and AEC staff. The AEC does not take advantage of overdraft facilities available through their banks because the AEC does not appreciate their merit.

The AEC deposits cash collections in a number of active current accounts that include the Commercial International Bank, Cairo Bank and MISR Exterior Bank. The AEC is required to maintain minimum balances in its current accounts and that only the minimum balance earns interest.

Within the CEC there is no fixed policy to manage its idle cash balances in order to maximize returns and past efforts in this area have been based on trial and error. Traditionally and historically the CEC maintains its balances at the National Bank. The CEC is currently studying changing its banking relationships to include private banks. Banking within the 54 areas also presents cash management problems since some of the Areas do not have access to bank branches.

The possibility of outsourcing the cash collection activity had been studied by the AEC but it was felt that Egyptian society is not ready for this step. In addition, since customers are not assessed late payment fees or interest, there is really no incentive for AEC customers to even pay their current accounts when due never mind prepaying their accounts. No system will

work as long as the customer is not obliged to pay, especially if is not to the customer's benefit.

A.16.2 Short-term Investment Instruments

There are no overnight investment instruments in Egypt but that, although there are 3-5 day investment instruments available, the AEC does not invest its idle cash balances.

Canal Electricity Company (CEC) customers had been offered the option of paying their bills directly at their Area bank (in order to speed up cash flows - related customer receipts and payment documents could subsequently be forwarded by the bank to the Area causing a one or two day delay in the receipt of customer payment information by the Area from the bank) but that they had refused. In fact, unless pressured by Area Cash Collectors, customers will not normally voluntarily pay balances due on their accounts.

With reference to customer prepayments, budgeted payments and paying directly at banks to speed up cash collections within the AEC, there is virtually no credit in Egypt and that 60%-70% of AEC's customers do not maintain current accounts at banks and are unfamiliar with banking (Customers do maintain savings accounts).

The AEC has tried installment payments for customers with large balances and that it has also tried estimated billings based on the customer's average bill. The ARC is in the process of studying prepaid accounts modeled on the Telecom's enhanced billing system. Telecom has outsourced its billings and discounted collections to collection companies and has seen its billing/collection cycle reduced from 21 days to 36 hours.

The CEC had already looked at prepaid cards (similar to those used by the cellular telephone companies) and was studying the possibility of selling space on the back of customer's statements to advertisers as a mechanism for generating additional revenues.

The CEC will probably evaluate offering customers a discount if the customer prepaid their balance for 6 months or 1 year in advance based on the customer's average consumption for the past year. The rate of discount could be easily calculated based on the CEC's targeted rate of return on investment. The advantage would be the CEC would receive cash up-front to use and invest. The customer would still receive their monthly statement showing actual charges and could compare actual charges with the amount prepaid so the customer would know how much would be due at the end of the prepayment period. This would also reduce CEC collection cost.

A.17 EEHC AND EC BUSINESS RATIOS

In order to assess how the core EEHC and EC businesses are doing, the companies need more than single numbers extracted from their financial statements. Each number has to be viewed in the context of the whole picture.

The true meaning of figures from the financial statements emerges only when they are compared to other figures. Such comparisons are the essence of why business and financial ratios have been developed.

Various ratios can be established from key figures on the financial statements. These ratios can be a powerful tool because they allow the EEHC and its companies to immediately grasp the relationship expressed.

To facilitate a better understanding of the current financial situation of the EHHC and its ECs, comparative Balance Sheets and Incomes Statements for the periods 1 July 1998 through 30 June 1999 and 1 July 1999 through 30 June 2000 were prepared and the change from period to period analyzed and key ratios were prepared (the source financial statements [unaudited] are included at the end of this Appendix).

A.17.1 Current Financial Situation

A review of the comparative financial statements shows that, although EEHC and EC revenues increased from one reporting period to another, Net Operating Income declined during the same period. In general, the decline in the level of profitability can be attributed to an increase in debt service related interest expense.

	EEHC	TOTAL ECs
Change in Revenues from Operations	+6.0%	+8.8%
Change in Net Operating Income	(-62.4%)	(-29.8%)

Had the EEHC's Income Statement been prepared in accordance with International Accounting Standards (IAS), the EEHC would probably posted a loss for the year ending 30 June 2000. Following the same standards, the Cairo Electricity Company, Middle Egypt Electricity Company, Canal Electricity Company and Behaira Electricity Company all would probably have posted a loss for the same reporting period (the Alexandria Electricity Company would probably border on unprofitability).

Unprofitability would probably result from revaluing uncollectable accounts receivable, bad debt expense, depreciation, and revaluing inventory. In addition, Egyptian Accounting Standards capitalize certain expenditures that would be expensed under IAS (Pre-Operation Experiments, Research and Development, Incorporation Expenses and Advertising Campaign Expenses). Adjusting these balances, where appropriate, would decrease the profitability of companies that previously capitalized those expenditures.

Data from the comparative financial statements was used to prepare key operating ratios to facilitate comparison of the EEHC with comparable electric companies in the United States and selected electricity companies in other countries. United States companies were selected due to the availability of data. US Industry Averages include both publicly and privately owned electric companies (generation, distribution and transmission) as well as holding companies and government owned electric utilities (A detailed discussion interpreting the key operating ratios immediately follows the tables.).

EEHC 30 June 2000 Operating Results Compared with United States Electric Utilities Industry Averages (Nine Year Average)

	EEHC 30/6/00	US Average Dec 1999	US Avg Dec 1998	US Avg Dec 1997	US Avg Dec 1996	US Avg Dec 1995	US Avg Dec 1994	US Avg Dec 1993	US Avg Dec 1992	US Avg Dec 1991
Profit Margin %	1.6	7.5	8.4	10.1	10.0	9.3	9.1	6.7	9.3	9.9
Return on Equity %	3.3	10.4	11.1	13.3	12.9	12.2	11.8	8.5	11.0	11.8
Return on Assets %	1.1	3.0	2.8	3.7	3.7	3.3	3.2	2.3	3.3	3.5
Interest Coverage	1.11	2.4	3.0	3.3	3.2	2.8	2.6	2.2	2.4	2.6

SOURCE: *Statistical Yearbook of the Electric Utility Industry.* Washington, D.C.: Edison Electric Institute. Annual. [1954 to present]

EEHC and ECs Compared with United States Electric Utilities Industry Averages

	US Average Dec 1999	EEHC 30/6/00	EC Total	Cairo Elec	Alex. Elec	Behaira Elec	Delta Elec	Canal Elec	Upper Egypt	Middle Egypt
Profit Margin %	7.5	1.6	3.1	2.4	3.6	1.8	4.1	.4	12.8	1.9
Return on Equity %	10.4	3.3	7.0	7.8	7.3	7.3	8.9	1.2	18.9	2.8
Return on Assets %	3.0	1.1	.8	.8	.8	.5	.1	.1	2.3	.3
Receivable Turnover	6.7	2.18	1.18	1.35	1.48	1.19	.94	.83	1.74	1.07
Inventory Turnover	13.4	1.09	3.38	4.58	2.84	3.23	3.47	2.31	2.26	5.15
Debt to Equity	1.34	2.01	7.88	9.34	8.23	5.86	6.2	8.99	7.35	8.16
Interest Coverage	2.4	1.11	1.35	1.35	1.78	1.22	1.64	1.07	1.84	1.10

SOURCE: *Statistical Yearbook of the Electric Utility Industry.* Washington, D.C.: Edison Electric Institute. Annual. [1954 to present]

Selected Electric Industry Operating Ratios Year Ending 31 Dec 2000

	United States Average	EEHC (30 June 2000)	Bangor Hydro Electric (1)	Korea Elec. Power Corp (2)	Kansai Elec. Power Co (3)	Public Service Enter. Group (4)	GPU Inc. (5)	American Electric Power Co (6)
Management Efficiency								
Income/Employee	US $44,000	N/A						
Revenue/Employee	$549,000	N/A						
Receivable Turnover	6.7	2.18				8.5		
Inventory Turnover	13.4	1.09				3.9		
Days Accounts Receivable	N/A	752			20			
Asset Turnover	0.4	.06						
Investment Returns %								
Return On Equity	12.5	3.3	8.71			18.4	6.76	11.69
Return On Assets	3.0	1.1	2.21			3.9	1.12	2.46
Return On Equity (5-Year Avg.)	11.3	N/A						
Return On Assets (5-Year Avg.)	2.9	N/A						
Financial Condition								
Debt/Equity Ratio	1.34	2.01	1.38	.76	2.82	1.1	1.99	1.27
Current Ratio	0.7	.47	.99	.58		.7	.52	.67
Quick Ratio	0.4	.4	1.17			.5	.33	.56
Interest Coverage	3.0	1.11		2.21				
Profitability								
Gross Profit Margin	N/A	17.7			34.3	11.2	28.94	
Operating Margin	7.5	1.6	5.57				11.19	6.79
Growth Rates %								
Sales (Qtr vs. year ago qtr)	0.50	N/A						
Income (Qtr vs. year ago qtr)	-0.70	N/A						
Sales (5-Year Avg.)	8.84	N/A						

1) Bangor Hydro Electric Company is a public utility engaged in the generation, purchase, transmission, distribution and sale of electric energy, with a service area of approximately 7,385 square kilometers.
2) Korea Electric Power Corporation is an electric utility that traces its origins to the establishment of the first electric utility in Korea in 1898. The Company's electric generating system is comprised of a total of 248 generating units, including nuclear, thermal, hydro and internal combustion units, which has an aggregate installed generating capacity of 44,316 megawatts. The Company purchases power output of several generating plants not owned by itself. KEP is an integrated electric utility company engaged in the transmission and distribution of electricity in the Republic of Korea. [SOURCE: http://biz.yahoo.com/p/K/KEP.html]
3) Kansai Electric Power Company, Incorporated was established in 1951 as a result of a nationwide reorganization of the electric power industry and is now one of the nine major investor-owned electric utility companies in Japan. The service area of the company is located in the central part of the main island where the company supplies electricity to 11.11 million households and 1.4 million commercial and industrial customers. [SOURCE: http://profiles.wisi.com/profiles/scripts/corpinfo2.asp?cusip=C392W0860]
4) Public Service Enterprise Group Incorporated (Enterprise) is a public utility holding company that neither owns nor operates any physical properties. Enterprise has two direct, wholly owned subsidiaries, Public Service Electric and Gas Company (PSE&G) and Enterprise Diversified Holdings Incorporated (EDHI). Enterprise's principal subsidiary, PSE&G, is an operating public utility providing electric service in certain areas of the State of New Jersey. [SOURCE: http://411stocks.stockselector.com/stocks.asp?symbol=PEG].
GPU is a holding company for 3 electric utilities serving customers in NJ and PA: Jersey Central Power and Light Company.

If the EEHC and its ECs routinely calculated and recorded a group of ratios at the end of every accounting period, they could assess the performance of their core business over time, and compare their core business to ECs in the same industry or to ECs of a similar size.

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If the companies compared changes in their business ratios from period to period, the companies could pinpoint improvements in performance or developing problem areas. In addition, by comparing EC ratios to other ECs, the ECs could see possibilities for improvement in key areas.

There are dozens and dozens of financial ratios that the EEHC and its ECs could look at but many have little or no meaning for the EEHC's core business. The following ratios have the most value for taking business decisions:

- Liquidity Ratios
- Efficiency Ratios
- Profitability Ratios
- Solvency Ratios

A.17.2 LIQUIDITY RATIOS

Liquidity ratios are probably the most commonly used of all the business ratios. The EEHC and its ECs may be interested in these because they show the ability of their businesses to quickly generate the cash needed to pay their bills. This information should also be highly interesting to the ECs, since the inability to meet EC short-term debts would be a problem that deserves immediate attention. Liquidity ratios (working capital) include:

- Current Ratio
- Quick Ratio

Once privatized, EC lenders will require that the EC continue to maintain a certain minimum ratio as part of the loan agreement. For that reason, steps to improve EC liquidity ratios are sometimes necessary.

A.17.2.1 Current Ratio

The current ratio is a way of looking at EC working capital and measuring EC short-term solvency. EC current ratio shows the ability of EC core businesses to generate cash to meet its short-term obligations. A decline in this ratio can be attributable to an increase in short-term debt, a decrease in current assets, or a combination of both. Regardless of the reasons, a decline in this ratio means a reduced ability to generate cash.

	YE 30 June 2000	YE 30 June 1999
Current Assets	3,394,168,000	3,626,653,000
Current Liabilities	7,182,783,000	7,361,284,000
Current Ratio	.473	.493

Using EEHC cash to pay off current debt just prior to the balance sheet date would have improved this ratio. Since the EEHC lacked cash to reduce current debts, long-term borrowing to repay the short-term debt could have also improved this ratio.

Other possibilities suggest that the EEHC should more carefully scrutinize the elements in the current asset and current liability sections of the EEHC's balance sheet. The EEHC and the ECs should take steps to increase total current assets and/or decrease total current liabilities as

of the balance sheet date. For example, could EC purchases be delayed to reduce accounts payable?

A.17.2.2 Quick Ratio

The quick ratio (acid test) serves a function similar to the current ratio. The difference is that the quick ratio subtracts inventory from current assets and compares the resulting figure to current liabilities.

Since inventory can be turned to cash only through sales the quick ratio gives the EEHC a better picture of EEHC ability to meet EEHC short-term obligations, regardless of EEHC sales levels. Over time, a stable current ratio with a declining quick ratio may indicate that the EEHC has built up too much inventory.

	YE 30 June 2000	YE 30 June 1999
Current Assets	2,855,000,000	3,089,327,000
Current Liabilities	7,182,783,000	7,361,284,000
Current Ratio	.397	.42

Since the quick ratio is quite similar to the current ratio, but excludes inventory from current assets, it could be improved by converting inventory to cash or accounts receivable.

In evaluating the current ratio and the quick ratio, the EEHC should keep in mind that they give only a general picture of EEHC business's ability to meet short-term obligations. They are not an indication of whether each specific obligation can be paid when due. To determine payment probability, the EEHC must construct a cash flow budget.

A.17.3 Efficiency Ratios

As the owner of the Egyptian power sector, the EEHC should be concerned with making the best use of EEHC assets and being a low-cost producer. The EEHC can determine how efficiently the EEHC uses its assets, and where there's room for improvement, by looking at the following ratios:

- Ratios for inventory analysis
- Ratios for accounts receivable analysis
- Fixed asset turnover
- Total asset turnover

A.17.3.1 Ratios For Inventory Analysis

Inventory is the amount of parts, supplies or other goods the EEHC keeps on hand to meet the demands of EEHC customers. Given the nature of EEHC and EC core businesses, the efficiency of inventory management could have a significant impact on EEHC and EC cash flows and, ultimately, success or failure. The following inventory analysis tools were used to evaluate EEHC and EC investment in inventory:

- Average inventory investment period
- Inventory to sales ratio

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- Turnover analysis

Average Inventory Investment Period

The average inventory investment period measures the amount of time it takes to convert a LE of cash outflow, used to purchase inventory, to a LE of sales or accounts receivable from the sale of the inventory. A longer average inventory investment period requires a higher investment in inventory. A higher investment in inventory means less cash is available to the EEHC and ECs for other cash outflows, such as paying current and long-term liabilities. The average inventory investment period can be used by the EEHC to better manage EEHC cash flows.

The EEHC's average inventory investment period was calculated by dividing the EEHC's 30 June 2000 inventory balance by EEHC's average daily cost of goods sold:

$$\textbf{Average Inventory Investment Period} = \frac{\textbf{Current Inventory Balance}}{\textbf{Average Daily Cost of Goods Sold}}$$

The average daily cost of goods sold was computed by dividing the EEHC's annual cost of goods sold 30 June 2000 amount by 360:

$$\textbf{Average Daily Cost of Goods Sold} = \frac{\textbf{Annual Cost of Goods Sold}}{\textbf{360}}$$

To illustrate, according to the EEHC financial statements from 30 June 2000, the EEHC's cost of goods sold for the year were LE 585,806,000 (Fuel, purchase for sales, salaries and wages and materials & serviced inputs). EEHC ending inventory balance at 30 June 2000 was LE 539,168,000. The EEHC's average investment period in inventory was calculated as follows:

The average investment period in inventory was 331.3 days:

$$\frac{\text{LE } 539{,}168{,}000}{\text{LE } 1{,}627{,}239} = 331.3 \text{ days}$$

During the fiscal year ending 30 June 2000, it took the EEHC 331.3 days to convert a LE invested in inventory to a LE of sales. If the EEHC's core business has not changed drastically from the previous year, the cash outflow from the purchase of the inventory will not create a cash inflow from the sale of the inventory for 331.3 days, on average.

Using the annual cost of goods sold amount and inventory balance from a prior year's balance sheet is usually accurate enough for analyzing and managing EEHC cash flow (It is important to compute the average daily cost of goods sold correctly using the number of days actually reflected in the cost of goods sold figure.).

Inventory to Sales Ratio

The inventory to sales ratio analyzed EEHC investment in inventory in relation to EEHC sales amount. The inventory to sales ratio identifies recent increases in inventory. The average

inventory investment period reported inventory information from the previous year since that was the only information available to calculate the period.

The inventory to sales ratio serves as an easy way to look at recent changes in inventory levels. The ratio can help predict early cash flow problems related to EEHC inventories.

The inventory to sales ratio was calculated by dividing EEHC inventory balance at the end of the year ending 30 June 2000 by EEHC total sales for the same year.

$$\textbf{Inventory to Sales Ratio} = \frac{\textbf{Inventory}}{\textbf{Sales for the Year}}$$

	YE 30 June 2000	YE 30 June 1999
Inventory	539,168,000	537,326,000
Sales	1,203,266,000	1,135,687,000
Ratio	.448	.473

When looked at on a period-to-period basis, the inventory to sales ratio can signal potential problems in EEHC cash flow. For example, an *increase* in EEHC inventory to sales ratio from one period to the next indicates that one of the following is happening:

- Either EEHC investment in inventory is growing more rapidly than sales, or,
- Sales are dropping.

No matter which situation causes the problem, an increase in the inventory to sales ratio should signal an oncoming cash flow problem to the EEHC.

Likewise, a *decrease* in the inventory to sales ratio from one period to next might indicate that the EEHC is effectively managing its inventory levels and its cash flow.

Inventory Turnover Ratio

This ratio tells how often the EEHC's inventory turns over during the course of the year. Because inventories are the least liquid form of asset, a high inventory turnover ratio is generally positive. On the other hand, an unusually high ratio compared to the average for the electricity industry could mean that the EEHC is not maximizing revenues because of inadequate stock on hand.

Since the EEHC and its companies have significant assets tied up in inventory, tracking their turnover is critical to successful financial planning. If EEHC and EC inventory is turning too slowly, it could indicate that it may be hampering EEHC and EC cash flows. Because this ratio judges annual inventory turns, it is usually conducted once a year. Inventory Turnover is calculated as:

$$\frac{\textbf{Cost of Goods Sold}}{\textbf{Average Value of Inventory}} = \textbf{Inventory Turnover}$$

Turnover Analysis

Turnover analysis is the most basic and fundamental tool for controlling EEHC and EC investment in inventory. Turnover analysis looks at the companies' investment in individual

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items or groups of items making up the companies' entire inventory. Turnover analysis then helps the ECs decide if EC investment in an inventory item, or groups of items, is excessive, too low, or just right. From a cash flow perspective, performing turnover analysis is particularly useful for finding inventory items that are over-stocked. An excessive investment in inventory results in less cash available for other cash outflow purposes, such as paying liabilities.

Since turnover analysis focuses on individual inventory items or groups of items, it requires that the EEHC and ECs make a periodic count of all the items making up EEHC total inventory. The EEHC and the ECs already take a physical count of its inventory items as part of their year-end closing so the information necessary to perform turnover analysis is already available.

Turnover analysis also requires that the EEHC and ECs know the number of inventory items sold on an individual basis. Although this may appear to require a substantial effort to determine if the investment in a particular inventory item or group of items is excessive, the information provided to the companies by the analysis will make it all worthwhile.

There are some limitations to the information provided by the average inventory investment period calculation. First, as the name implies, the average inventory investment period is an "average." Because it is an average, it assumes that all items are the same, each consumed at the same rate, and each costing the same amount. In reality, the EEHC and ECs carry a substantial number of different items; some consumed faster than others did, and other items cost the companies more to procure.

Turnover analysis goes beyond the average assumptions made by the average inventory investment period. It does this by requiring the EEHC and its companies to look at each product or line individually, taking into account the number currently on hand, the number sold, and the number on hand in relation to the rate at which each item sells. So, turnover analysis could be used to pinpoint the specific inventory items that are creating an excess investment in inventory, thus creating cash flow problems.

Turnover analysis would facilitate the EEHC and ECs in determining if the inventory level for each individual inventory item is excessive, too low, or just right.

Comparing the EEHC Balance Sheets for the periods 30 June 1999 and 30 June 2000, it is evident that the EEHC has been experiencing some cash flow problems, causing the EEHC to draw on the company's overdraft facility more frequently. EEHC revenues remained steady, but the average inventory investment period and the inventory to sales ratio both increased over the last two years.

The EEHC should perform a turnover analysis on repair and maintenance inventory items. Unfortunately, the EEHC and its companies do not complete a mid-year physical inventory count so the number of items held in inventory would be already available. The following is a pro forma turnover analysis schedule:

EEHC Inventory Turnover Analysis 31 December 2000				
Description	*Number in Stock*	*Number Used in Last 30 Days*	*Days Sales in Inventory*	*EEHC's Action*
				Reduce Levels, Increase Levels, Maintain Current Levels

More frequent turnover analysis would help the EEHC and its companies to identify specific items creating a buildup in the inventory. Eliminating excess inventory levels would reduce the size of the companies' investment in inventory and improve its cash flow.

The average inventory investment period could be used to determine the effect of different inventory investment periods on the companies' cash flow. Using the average inventory investment period will help the companies understand how a change in the average period affects their cash flow.

Cost of Goods Sold per Day (in 1,000)					
Average Inventory Investment Per. (days)	*LE 200*	*LE 300*	*LE 400*	*LE 500*	*LE 600*
	Investment in Inventory				
70	LE 14,000	LE 21,000	LE 28,000	LE 35,000	LE 42,000
80	16,000	24,000	32,000	40,000	48,000
90	18,000	27,000	36,000	45,000	54,000
100	20,000	30,000	40,000	50,000	60,000
110	22,000	33,000	44,000	55,000	66,000

The above chart illustrates the effect a change in the average investment in inventory has on the investment in inventory for the EEHC. To illustrate, assume that the EEHC cost of goods sold per day is LE 300,000 and that EEHC average inventory investment period is 100 days. Now assume that the EEHC were able to reduce EEHC average investment period from 100 days to 70 days. From the illustration above, the EEHC would see that the reduction in the average inventory investment period reduces the investment in inventory from LE 30,000,000 to LE 21,000,000. This reduction would generate an additional LE 9,000,000 in EEHC cash flow.

A.17.3.2 Ratios For Accounts Receivable Analysis

Average Collection Period

The average collection period measures the length of time it takes to convert EEHC and EC average sales into cash. This measurement defines the relationship between accounts receivable and cash flows. A longer average collection period requires a higher investment in

accounts receivable. A higher investment in accounts receivable means less cash is available to cover cash outflows, such as paying liabilities. The average collection period was calculated by dividing the EEHC accounts receivable balance at 30 June 2000 by EEHC average daily sales:

$$\text{Average Collection Period} = \frac{\text{Current Accounts Receivable Balance}}{\text{Average Daily Sales}}$$

The average daily sales volume was computed by dividing EEHC annual sales amount by 360:

$$\text{Average Daily Sales} = \frac{\text{Annual Sales}}{360}$$

Using the annual sales amount and accounts receivable balance from the prior year is usually accurate enough for analyzing and managing EEHC cash flow. Computation of the average daily sales uses the number of days actually reflected in the sales figure.

	YE 30 June 2000	YE 30 June 1999
Annual Sales	1,203,266,000	1,135,687,000
Accounts Receivable	2,513,994,000	2,732,139,000
Average Daily Sales	3,342,405	3,155,000
Average Collection Period	**752.2**	**866**

For the ending 30 June 2000, each LE of sales was invested in accounts receivable for 752.2 days. Assuming that the EEHC's business has not changed drastically from last year, the cash inflows from sales on account will not be available for cash outflow purposes for 752.2 days.

The average collection period could be used to determine the effect of different collection periods on EEHC's cash flow. This is best illustrated by the following chart.

	Sales Per Day (in 1,000)				
Average Collection Period	*LE 2,000*	*LE 3,000*	*LE 4,000*	*LE 5,000*	*LE 6,000*
	Investment in Accounts Receivable				
300 days	LE 600,000	LE 900,000	LE1,200,000	LE1,500,000	LE1,800,000
400 days	800,000	1,200,000	1,600,000	2,000,000	2,400,000
500 days	1,000,000	1,500,000	2,000,000	2,500,000	3,000,000
600 days	1,200,000	1,800,000	2,400,000	3,000,000	3,600,000

The above chart illustrates the effect that a change in the average collection might have on the investment in accounts receivable for the EEHC. Accounts receivable represent money that cannot be used for other cash outflow purposes. For example, assume that EEHC average sales amount per day is LE 300,000 and that EEHC average collection period is 600 days. Now assume that the EEHC were able to reduce EEHC average collection period from 600 days to 500 days. From the illustration above, the EEHC can see that the reduction in the average collection period reduces the investment in accounts receivable from LE

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1,800,000,000 to LE 1,500,000,000. This reduction generated an additional LE 300,000,000 in EEHC cash flow.

Accounts Receivable to Sales Ratio

The accounts receivable to sales ratio looks at EEHC investment in accounts receivable in relation to EEHC monthly sales amount. The accounts receivable to sales ratio helps the EEHC identify recent increases in accounts receivable. In contrast, the average collection period may only report accounts receivable information from the previous year, if that was the only information available to calculate it. Using monthly sales information, the accounts receivable to sales ratio can serve as a quick and easy way to look at recent changes in accounts receivable. The more recent information of the accounts receivable to sales ratio will quickly point out cash flow problems related to EEHC business's accounts receivable.

The accounts receivable to sales ratio is calculated by dividing EEHC accounts receivable balance at the end of any given month by EEHC total sales for the month.

$$\textbf{Accounts receivable to sales ratio} = \frac{\textbf{Accounts Receivable}}{\textbf{Sales for the Month}}$$

At first glance, the accounts receivable to sales ratio might not seem like useful information. But, if the EEHC computes it each month and then look at the changes that occur as the months pass, the accounts receivable to sales ratio can signal potential problems in EEHC cash flow. For example, an increase in EEHC accounts receivable to sales ratio from one month to the next indicates that EEHC investment in accounts receivable is growing more rapidly than sales. This is often one of the first signs of a cash flow problem.

Analyzing the Accounts Receivable Aging Schedule

The aging schedule can be used to identify the customers that are extending the time it takes to collect EEHC accounts receivable. With the exception of the GOE, if the bulk of the overdue amount in receivables is attributable to several customers, then steps can be taken to see that these customers' account are collected more promptly. Overdue amounts attributable to a number of customers may signal that EEHC business needs to tighten its credit policy with reference to the charging of interest and late fees and possible interruption or disconnection of service for non-payment.

The aging schedule also identifies any recent changes in the accounts making up EEHC total accounts receivable balance. Almost every business has to deal with customers that are slow to pay; the EEHC has already identified that this is the same with its core business. However, if the makeup of EEHC accounts receivable changes, when compared to the previous month, the EEHC should be able to spot the change instantly. Is the change the result of a change in EEHC credit policy? Did some sort of billing problem cause the change in accounts receivable? What effect will this change in accounts receivable have on next month's cash inflows? The accounts receivable aging schedule can help the EEHC spot these problems in accounts receivable, and provide the necessary answers early enough to protect EEHC business from cash flow problems.

A.17.3.3 Fixed Asset Turnover

Fixed asset turnover is the ratio of sales (from the EEHC income statement) to the value of EEHC fixed assets (from the EEHC balance sheet). It indicates how well the EEHC is using its fixed assets to generate sales.

Generally speaking, the higher the ratio, the better because a high ratio indicates the EEHC has less money tied up in fixed assets for each LE of sales revenue. A declining ratio may indicate that the EEHC may have over-invested in plant, equipment, or other fixed assets.

A.17.3.4 Total Asset Turnover

The ratio of total sales (on EEHC income statement) to total assets (on EEHC balance sheet) indicates how well the EEHC uses all EEHC business assets (rather than just inventories or fixed assets) to generate revenue.

A high asset turnover ratio means a higher return on assets, which can compensate for a low profit margin. In computing the ratio, the EEHC computes total assets by averaging the total assets at the beginning and end of the accounting period.

A.17.4 Profitability Ratios

Another set of ratios is available to assess the profitability of EEHC business and changes in its profit performance. These ratios are probably the most important indicators of the EEHC's financial success. Investors (including the EEHC self, as the business owner) are interested in these ratios insofar as they demonstrate the performance and growth potential of the business:

- Gross profit margin ratio
- Net profit margin or net profit percentage
- Operating profit percentage
- Return on assets
- Return on equity

A.17.4.1 Gross Profit Margin

Gross profit margin can be calculated as follows:

$$\textbf{Gross Profit Margin} = \frac{\textbf{Gross Profits}}{\textbf{Sales}}$$

Gross profit is the amount of sales LEs remaining after the cost of goods sold has been deducted.

If EC gross profit margin is declining over time, it may mean that EC inventory management needs to be improved, or that EC tariffs are not rising as fast as the costs of the power the EC sells. Since the EC is a producer of power, it may mean that EC costs of production are rising faster than EC prices, and adjustments on either side (or both) are necessary.

Gross profit margin should be closely monitored to make sure that the EC is operating at the same profitability levels as it grows. If the percentage is going down, it is a clear indicator that the EEHC needs to try to raise tariffs.

With reference to EC selling expenses, they should increase only in proportion to increases in revenues. Disproportionate increases in selling expense should be followed up and corrected.

General and administrative expenses should also be closely watched. Increases in this area may mean that the EC is getting too bureaucratic and is in line for some cost-cutting measures, or that equipment maintenance is too expensive and new equipment should be considered.

Interest expense is an important measure of how the EC is performing. If EC interest expense is increasing rapidly as a percentage of revenues or net income, the EC may be in the process of becoming overburdened with debt.

A.17.4.2 Net Profit Margin

EEHC and EC net profit margin shows the bottom line: how much of each LE in revenue is ultimately available for the companies to draw out of the business or to receive as dividends. It's probably the figure the EEHC is most accustomed to looking at. This ratio takes into account all company expenses, including income taxes and interest.

	YE 30 June 2000	YE 30 June 1999
Net Income	212,440,000	304,423,000
Operating Revenues	1,203,266,000	1,135,687,000
Profit Margin	**17.7**	**26.8**

The EEHC should have some idea of the range within which the EEHC expect EEHC profit margin to be, which will be determined in large part by industry standards. If the EEHC fails to meet its target, it could mean that the EEHC set an unrealistic goal, or it could mean that the EEHC's doing something wrong. (However, the ratio itself will not point to *what* the EEHC may be doing wrong. Looking at the EEHC gross margin or operating margin is a better way to get a fix on the problem.)

Even if the EEHC meets its goal, the EEHC should continually monitor its profit margin. If it should decline it may indicate that the EEHC needs to determine whether EEHC costs are increasing to unacceptable levels.

A.17.4.3 Operating Profit Margin

The operating profit percentage can be calculated using the following formula:

$$\text{Operating Profit Margin} = \frac{\text{Operating Income}}{\text{Sales}}$$

	YE 30 June 2000	YE 30 June 1999
Operating Income	19,824,000	52,745,000
Operating Revenues	1,203,266,000	1,135,687,000
Profit Margin	**.016**	**.046**

This ratio is designed to give the EEHC an accurate idea of how much money the EEHC's making on the EEHC's primary business operations. It shows the percentage of each sales LE remaining after all normal costs of operations. By looking at this ratio over time, the EEHC can determine whether EEHC overall costs are trending up or down.

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A.17.4.4 Return On Assets

Return on assets is the ratio of net income to total assets. It is basically a measure of how well the EEHC is using its assets to produce more income. It can be viewed as a combination of two other ratios, net profit margin (ratio of net income to sales) and asset turnover (ratio of sales to total assets):

$$\frac{\text{Net Income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} = \frac{\text{Net Income}}{\text{Total Assets}}$$

	YE 30 June 2000	YE 30 June 1999
Net Income	212,440,0	304,423,000
Total Assets	19,812,979,000	20,063,117,000
Return on Assets	**.011**	**.015**

The low return on EEHC assets can be attributable to a combination of both a low profit margin and a slow turnover of assets.

A.17.4.5 Return On Equity

The return on equity ratio can be calculated using the following formula:

$$\text{Return on Equity} = \frac{\text{Net Income}}{\text{Owner's Equity}}$$

The ratio of net income to net worth or stockholders' equity shows the EEHC what the EEHC's earned on EEHC investment in the business during the accounting period (Also referred to as ROI — return on investment).

	YE 30 June 2000	YE 30 June 1999
Net Income	212,440,000	304,423,000
Owners' Equity	6,490,100,000	6,388,695,000
Return on Equity	**.033**	**.048**

The EEHC can compare its return on equity to what the EEHC might have earned on the stock market (or even a simple bank account) during the same period. Over time, the EEHC should be generating at least the same return that the EEHC could earn in more passive investments like stocks, bonds, and bank CDs.

The EEHC's low return on equity may be a result of a combination of a low return on assets and extensive use of debt financing.

In analyzing both return on equity and return on assets, the effects of inflation on the book value of the assets should be considered. While EEHC financial statements show all assets at their book value (i.e., original cost minus depreciation), the replacement value of many older assets may be substantially higher than their book value. As the EEHC assets grow older, the EEHC should, generally, show higher return percentages than comparable energy sector (transmission, generation and distribution) companies using newer assets.

A.17.5 Solvency Ratios

The final group of ratios facilitates the EEHC and its companies measuring the degree of financial risk that they face. "Financial risk," in this context, means the extent to which the EEHC and its companies have debt obligations that must be met, regardless of EEHC and EC cash flow. By examining these ratios, the companies can assess their level of debt and decide whether this level is appropriate for the EEHC and ECs. Commonly used solvency ratios are:

- Debt to equity
- Debt to assets
- Coverage of fixed costs
- Interest coverage

A.17.5.1 Debt To Equity

The debt-to-equity ratio can be computed with the following formula, using figures from EEHC balance sheet:

$$\text{Debt-to-Equity} = \frac{\text{Total Debt}}{\text{Owners' (or Stockholder's) Equity}}$$

	YE 30 June 2000	YE 30 June 1999
Total Debt	6,490,100,000	13,472,942,000
Owners' Equity	6,490,100,000	6,388,695,000
Debt to Equity	**2.01**	**2.11**

The ratio of debt-to-owner's equity or net worth indicates the degree of financial leverage that the EEHC's using to enhance EEHC return. A rising debt-to-equity ratio may signal that further increases in debt caused by purchases of inventory or fixed assets should be restrained.

An improvement in this ratio from 1999 to 2000 involved paying off debt and increasing the amount of earnings retained in the business until after the balance sheet date. Other improvements in the ratio can be attained by deferring expenses beyond the balance sheet date to increase EEHC retained earnings or delaying any planned bonus expense, which also serves to increase EEHC retained earnings.

As another example, the EEHC might think about repaying revolving debt (such as a line of credit) before the balance sheet date and borrowing again after the balance sheet date.

A.17.5.2 Debt To Assets

This ratio measures the percentage of EEHC assets that are financed with debt and is calculated as follows:

$$\text{Debt-to-Assets} = \frac{\text{Total Debt}}{\text{Total Assets}}$$

	YE 30 June 2000	YE 30 June 1999
Total Debt	6,490,100,000	13,472,942,000
Total Assets	13,055,231,000	13,472,942,000
Debt to Assets	.659	.672

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This ratio measures the percentage of EEHC assets financed by creditors, compared to the percentage that have been financed by the EEHC. Historically, a debt-to-asset ratio of no more than 50 percent has been considered prudent. A higher ratio indicates a possible overuse of leverage, and it may indicate potential problems meeting the debt payments.

Improving this ratio means taking steps to either increase the value of EEHC assets, or to pay off debt. For example, the EEHC might explore whether inventory or other assets can be given a higher value. If the EEHC moves towards liquidating its debt, the EEHC will also improve EEHC current ratio and debt-to-equity ratio.

A.17.5.3 Coverage of Fixed Costs

Coverage of fixed charges (also called "times fixed charges earned") is computed by taking EEHC net income, *before* taxes and fixed charges (debt repayment, long-term leases, preferred stock dividends etc.), and dividing by the amount of fixed charges. The resulting number shows the EEHC's ability to meet EEHC fixed obligations of all types — the higher the coverage ratio, the better. Fixed costs or charges include such items as rent or depreciation on plant and equipment items, property taxes, and salaries of executive or management personnel, etc. Fixed costs do not respond to changes in EEHC activity. These are expenses the EEHC incurs regardless of revenue and are at a fixed rate.

	YE 30 June 2000	YE 30 June 1999
Net Income Before Taxes and Fixed Charges	560,014,000	509,335,000
Fixed Charges	520,291,000	467,487,000
Coverage of Fixed Costs	**1.08**	**1.09**

Obviously, an inability to meet any fixed obligation threatens the EEHC's well being. As a practical matter, many working capital loan agreements normally specify that borrower must maintain this ratio at a specified level, so that the lender has some assurance that the borrower will continue to be able to make debt service payments.

A.17.5.4 Interest Coverage

Interest coverage is also sometimes known as the "times interest earned ratio." It is very similar to the "times fixed charges earned" ratio but focuses more narrowly on the interest portion of EEHC debt payments and is calculated as:

$$\text{Interest Coverage} = \frac{\text{Operating Income}}{\text{Interest Expense}}$$

	YE 30 June 2000	YE 30 June 1999
Operating Income	202,945,000	182,605,000
Interest Expense	183,121,000	129,860,000
Interest Coverage	**1.11**	**1.41**

By comparing the ratio of operating income to interest expense, the EEHC can evaluate how many times EEHC interest obligations are covered by earnings from operations. The higher

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the ratio, the bigger the EEHC cushion and the more the EEHC will be able to meet interest payments. Since the ratio appears to be declining over time, it could be an indication that EEHC financial risk may be increasing.

A.18 EEHC AND ELECTRICITY COMPANY FINANCIAL STATEMENTS

A.18.1 EEHC Comparative Income Statements

Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
1/1. Goods for Sale	552,086	581,942	29,856	5.4%
1/2. Power Passing Revenue	575,270	609,078	33,808	5.9%
Other Operating Revenue	8,331	12,246	3,915	47.0%
TOTAL OPERATING REVENUE	**1,135,687**	**1,203,266**	67,579	6.0%
2. Operating Expenses				
2/1. Fuel	6,755	5,526	-1,229	-18.2%
2/2. Purchase for Sales	352,053	395,189	43,136	12.3%
2/4. Salaries and Wages	118,162	117,645	-517	-0.4%
2/5. Materials & Serviced Inputs	76,085	67,446	-8,639	-11.4%
2/6. Other Operating Expenses (Admin)	191,459	175,091	-16,368	-8.5%
2/7. Depreciation	208,568	239,424	30,856	14.8%
TOTAL OPERATING EXPENSES	**953,082**	**1,000,321**	47,239	5.0%
3. Income from Operations	**182,605**	**202,945**	20,340	11.1%
Gross Interest	680,093	N/A	N/A	N/A
Interest During Construction	-550,233	N/A	N/A	N/A
NET INTEREST EXPENSES	**129,860**	**183,121**	53,261	41.0%
4. Net Operating Income	**52,745**	**19,824**	-32,921	-62.4%
Non-Operating Revenue	435,094	373,516	-61,578	-14.2%
Less: Non-Operating Expenses	-183,416	-180,900	2,516	-1.4%
5. Net Non-Operating Income/(Loss)	**251,678**	**192,616**	-59,062	-23.5%
6. Net Income	**304,423**	**212,440**	**-91,983**	**-30.2%**

A.18.2 EEHC Comparative Balance Sheets

Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Fixed Assets				
Gross Fixed Assets in Service	8,389,935	9,250,570	860,635	10.3%
Less: Accumulated Depreciation	-1,359,670	-1,588,835	-229,165	16.9%
1/1. Net Fixed Assets in Service	7,030,265	7,661,735	631,470	9.0%
1/2. Work-in-Progress	6,102,284	5,454,943	-647,341	-10.6%
Total Fixed Assets	**13,132,549**	**13,116,678**	-15,871	-0.1%
2. Investments	3,115,746	3,115,746	0	0.0%
3. Long-Term Receivables (Loans)	188,169	186,387	-1,782	-0.9%
4. Current Assets				
4/1. Cash	357,188	341,006	-16,182	-4.5%
4/2. Inventories	537,326	539,168	1,842	0.3%
4/3. Clients	467,167	654,640	187,473	40.1%
4/4. Other Accounts Receivable	2,264,972	1,859,354	-405,618	-17.9%
Total Current Assets	**3,626,653**	**3,394,168**	-232,485	-6.4%
Overdrafts	0	0	0	N/A
Total Assets	**20,063,117**	**19,812,979**	-250,138	-1.2%
B. LIABILITIES				
Capital	4,227,259	4,227,259	0	0.0%
Reserves	487,240	335,571	-151,669	-31.1%
Other Provisions	31,380	72,014	40,634	129.5%
Year's Results	304,423	212,440	-91,983	-30.2%
Carried Surplus	1,338,393	1,642,816	304,423	22.7%
1. TOTAL CAPITAL AND RESERVES	**6,388,695**	**6,490,100**	101,405	1.6%
2. Overdrafts	201,480	267,648	66,168	32.8%
3. Long-Term Liabilities				
3/1. Foreign Long-Term Debt	2,750,754	2,930,503	179,749	6.5%
3/2. Local Long-Term Debt	3,360,904	2,941,945	-418,959	-12.5%
TOTAL LONG-TERM DEBTS	**6,111,658**	**5,872,448**	-239,210	-3.9%
4. Current Liabilities				
4/1. Foreign Current Portion	408,069	582,736		0.0%
4/2. Local Current Portion	126,481	173,361	46,880	37.1%
4/3. Suppliers	361,473	108,476	-252,997	-70.0%
4/4. Ministry of Finance	1,664,268	1,716,864	52,596	3.2%
4/5. Other Accounts Payable	3,185,618	2,905,686	-279,932	-8.8%
4/6. Deferred Liabilities	1,423,338	1,505,435	82,097	5.8%
4/7. Deposits	87,037	85,215	-1,822	-2.1%
4/8. Provision for Taxes	105,000	105,010	10	0.0%
TOTAL CURRENT LIABILITIES	**7,361,284**	**7,182,783**	-178,501	-2.4%
TOTAL LIABILITIES	**20,063,117**	**19,812,979**	-250,138	-1.2%

A.18.3 EEHC Comparative Sources and Uses of Funds Statements

Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 98 to 30-Jun-99	Period 1 July 99 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. SOURCES OF FUNDS				
1. Internal Cash Generation				
1/1. Gross Income (Net Income Plus Interest)	434,283	395,561	-38,722	-8.9%
1/2. Depreciation	221,403	229,165	7,762	3.5%
1/3. Reserve for Higher Prices of Assets	6,045	4,271	-1,774	-29.3%
TOTAL INTERNAL CASH GENERATION	**661,731**	**628,997**	-32,734	-4.9%
2. External Sources				
2/1. Reserves	91,101	-155,941	-247,042	-271.2%
2/2. Overdraft	174,216	66,168	-108,048	-62.0%
BORROWINGS				
Foreign Loans	-647,087	618,801		
Local Loans	1,058,608	-299,294	-1,357,902	-128.3%
2/3. TOTAL BORROWINGS	**411,521**	**319,507**	-92,014	-22.4%
2/4. Provisions	5,055	40,634	35,579	703.8%
2/5. Capital	0	0	0	N/A
TOTAL SOURCES OF FUNDS	**1,343,624**	**899,365**	-444,259	-33.1%
B. APPLICATIONS OF FUNDS				
1. Work-in-Progress (Including Interest During Construction)	1,152,543	213,294	-939,249	-81.5%
2. DEBT SERVICE				
2/1. Foreign Amortization	268,577	264,385	-4,192	-1.6%
2/2. Local Amortization	69,050	72,785	3,735	5.4%
2/3. Interest (Net)	129,860	183,121	53,261	41.0%
TOTAL NET DEBT SERVICE	**467,487**	**520,291**	52,804	11.3%
3. Increase in Long-Term Receivables	-30,313	-1,782		0.0%
4. Investment	0	0	0	N/A
5. Net Change in Working Capital	-246,093	167,562	413,655	-168.1%
TOTAL APPLICATIONS OF FUNDS	**1,343,624**	**899,365**	-444,259	-33.1%

A.18.4 Electricity Companies' Combined Comparative Income Statement and Balance Sheet

Income Statement
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	9,270,791	10,080,220	809,429	8.7%
Financial Papers Revenue	3,045	2,839	-206	-6.8%
Transformed Revenue	346,479	384,352	37,873	10.9%
Subtotal:	**9,620,315**	**10,467,411**	847,096	8.8%
2. Fees	1,130,786	1,317,561	186,775	16.5%
3. General Changing				
Requirement Materials	2,760,617	2,832,734	72,117	2.6%
Labor	760,532	828,931	68,399	9.0%
Purchase for Resale	1,751,856	2,109,148	357,292	20.4%
Subtotal:	**5,273,005**	**5,770,813**	497,808	9.4%
4. Current Expenses				
Taxes	78,627	101,497	22,870	29.1%
Depreciation	899,866	931,184	31,318	3.5%
Actual Leases	693	1,188	495	71.4%
Local Interest	773,361	990,575	217,214	28.1%
External Interest	520,624	432,891	-87,733	-16.9%
TOTAL OPERATING EXPENSES	**2,273,171**	**2,457,335**	184,164	8.1%
5. Current Specific Orders	**289,582**	**429,344**	139,762	48.3%
6. Total Current Uses	**8,966,543**	**9,975,053**	1,008,510	11.2%
Remaining before Internal Taxes	**653,772**	**492,358**	-161,414	-24.7%
Internal Taxes	189,707	166,360	-23,347	-12.3%
Remaining for Distribution	**464,065**	**325,998**	-138,067	-29.8%
Reserves				
Legal Reserves	23,160	16,265	-6,895	-29.8%
Other Reserves	845	710	-135	-16.0%
Reserves Subtotal:	**24,005**	**16,975**	-7,030	-29.3%
Distributions				
Shareholders	326,820	229,518	-97,302	-29.8%
Workers	108,940	76,506	-32,434	-29.8%
Sports Activity	2,316	1,626	-690	-29.8%
Board of Directors Bonuses	1,984	1,373	-611	-30.8%
Distributed Subtotal:	**440,060**	**309,023**	-131,037	-29.8%
Total Distributed	**464,065**	**325,998**	-138,067	-29.8%

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Balance Sheet
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	30,334,618	31,461,049	1,126,431	3.7%
Work in Progress	361,863	1,800,863	1,439,000	397.7%
Inventories	2,049,900	2,149,558	99,658	4.9%
Investments	18,565	18,565	0	0.0%
Accounts Receivable	9,286,022	10,276,805	990,783	10.7%
Other Accounts Receivable	1,526,135	3,706,556	2,180,421	142.9%
Cash in Banks	457,394	488,656	31,262	6.8%
Other Debt Balances	518,920	249,699	-269,221	N/A
Creditor Accounts	40,417	0	-40,417	N/A
Total Current Assets	**44,593,834**	**50,151,751**	5,557,917	12.5%
		41,385,561		
B. LIABILITIES AND OWNERS' EQUITY				
Capital	3,109,625	3,109,625	0	0.0%
Reserves	685,897	926,617	240,720	35.1%
Depreciation	7,767,782	8,766,190	998,408	12.9%
Other Specifications	551,059	624,658	73,599	13.4%
Loans	14,462,858	15,952,989	1,490,131	10.3%
Accounts Payable	8,337,967	8,291,625	-46,342	-0.6%
Other Accounts Payable	9,655,752	10,009,942	354,190	3.7%
Other Creditor Balances	22,894	1,988,125	1,965,231	N/A
Creditor Accounts	0	481,980	481,980	N/A
TOTAL LIABILITIES & OWNERS' EQUITY	**44,593,834**	**50,151,751**	5,557,917	12.5%

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A.18.5 Individual Electricity Company Comparative Income Statements and Balance Sheets

A.18.5.1 Cairo Electricity Company

Income Statement
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	3,028,539	3,170,314	141,775	4.7%
Financial Papers Revenue	1,442	1,321	-121	-8.4%
Transformed Revenue	126,035	138,485	12,450	9.9%
Subtotal:	**3,156,016**	**3,310,120**	154,104	4.9%
2. Fees	299,593	330,407	30,814	10.3%
3. General Changing				
Requirement Materials	839,707	858,039	18,332	2.2%
Labor	308,329	307,454	-875	-0.3%
Purchase for Resale	658,376	810,798	152,422	23.2%
Subtotal:	**1,806,412**	**1,976,291**	169,879	9.4%
4. Current Expenses				
Taxes	34,502	44,876	10,374	30.1%
Depreciation	222,836	214,286	-8,550	-3.8%
Actual Leases	35	554	519	1482.9%
Local Interest	255,357	256,130	773	0.3%
External Interest	164,164	193,007	28,843	17.6%
TOTAL OPERATING EXPENSES	**676,894**	**708,853**	31,959	4.7%
5. Current Specific Orders	**97,960**	**137,433**	39,473	40.3%
6. Total Current Uses	**2,879,859**	**3,152,984**	273,125	9.5%
Remaining before Internal Taxes	**276,157**	**157,136**	-119,021	-43.1%
Internal Taxes	100,519	78,007	-22,512	-22.4%
Remaining for Distribution	**175,638**	**79,129**	-96,509	-54.9%
Reserves				
Legal Reserves	8,779	3,950	-4,829	-55.0%
Other Reserves	54	136	82	151.9%
Reserves Subtotal:	**8,833**	**4,086**	-4,747	-53.7%
Distributions				
Shareholders	124,241	55,708	-68,533	-55.2%
Workers	41,413	18,570	-22,843	-55.2%
Sports Activity	878	395	-483	-55.0%
Board of Directors Bonuses	273	370	97	35.5%
Distributed Subtotal:	**166,805**	**75,043**	-91,762	-55.0%
Total Distributed	**175,638**	**79,129**	-96,509	-54.9%

Cairo Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	7,299,932	7,417,789	117,857	1.6%
Less: Depreciation	-2,047,823	-2,289,433	-241,610	11.8%
Net Fixed Assets in Service	5,252,109	5,128,356	-123,753	-2.4%
Work in Progress	127,033	186,566	59,533	46.9%
Total Fixed Assets	**5,379,142**	**5,314,922**	-64,220	-1.2%
Inventories	504,146	504,116	-30	0.0%
Investments	9,029	9,029	0	0.0%
Accounts Receivable	3,271,819	3,651,338	379,519	11.6%
Other Accounts Receivable	807,723	801,278	-6,445	-0.8%
Cash in Banks	143,883	138,059	-5,824	-4.0%
Other Debt Balances	0	11,882	11,882	N/A
Total Current Assets	**4,736,600**	**5,115,702**	379,102	8.0%
Total Assets	**10,115,742**	**10,430,624**	314,882	3.1%
B. LIABILITIES AND OWNERS' EQUITY				
Capital	464,762	464,762	0	0.0%
Reserves	275,106	295,569	20,463	7.4%
Other Specifications	195,566	248,253	52,687	26.9%
Total Capital and Reserves	**935,434**	**1,008,584**	73,150	7.8%
Loans	3,535,317	3,791,698	256,381	7.3%
Total Long-Term Debts	**3,535,317**	**3,791,698**	256,381	7.3%
Accounts Payable	2,643,758	2,605,511	-38,247	-1.4%
Other Accounts Payable	3,001,233	2,992,027	-9,206	-0.3%
Other Creditor Balances	0	32,804	32,804	N/A
Total Current Liabilities	**5,644,991**	**5,630,342**	-14,649	-0.3%
Total Owners' Equity and Liabilities	**10,115,742**	**10,430,624**	629,764	6.2%

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A.18.5.2 *Alexandria Electricity Company*

Alexandria Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	966,745	1,049,341	82,596	8.5%
Financial Papers Revenue	538	532	-6	-1.1%
Transformed Revenue	51,883	60,724	8,841	17.0%
Subtotal:	**1,019,166**	**1,110,597**	91,431	9.0%
2. Fees	133,806	167,258	33,452	25.0%
3. General Changing				
Requirement Materials	312,153	294,004	-18,149	-5.8%
Labor	73,550	87,858	14,308	19.5%
Purchase for Resale	240,261	287,395	47,134	19.6%
Subtotal:	**625,964**	**669,257**	43,293	6.9%
4. Current Expenses				
Taxes	4,428	6,712	2,284	51.6%
Depreciation	90,847	95,033	4,186	4.6%
Actual Leases	144	54	-90	-62.5%
Local Interest	37,738	36,021	-1,717	-4.5%
External Interest	40,374	37,133	-3,241	-8.0%
TOTAL OPERATING EXPENSES	**173,531**	**174,953**	1,422	0.8%
5. Current Specific Orders	**23,145**	**42,129**	18,984	82.0%
6. Total Current Uses	**956,446**	**1,053,597**	97,151	10.2%
Remaining before Internal Taxes	**62,720**	**57,000**	-5,720	-9.1%
Internal Taxes	21,544	16,754	-4,790	-22.2%
Remaining for Distribution	**41,176**	**40,246**	-930	-2.3%
Reserves				
Legal Reserves	2,057	2,004	-53	-2.6%
Other Reserves	33	163	130	393.9%
Reserves Subtotal:	**2,090**	**2,167**	77	3.7%
Distributions				
Shareholders	28,958	28,158	-800	-2.8%
Workers	9,653	9,386	-267	-2.8%
Sports Activity	205	200	-5	-2.4%
Board of Directors Bonuses	270	335	65	24.1%
Distributed Subtotal:	**39,086**	**38,079**	-1,007	-2.6%
Total Distributed	**41,176**	**40,246**	-930	-2.3%

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Alexandria Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	2,999,843	3,085,773	85,930	2.9%
Work in Progress	112,378	122,332	9,954	8.9%
Inventories	295,667	293,257	-2,410	-0.8%
Investments	3,266	3,266	0	0.0%
Accounts Receivable	792,489	545,691	-246,798	-31.1%
Different Account Debts	68,096	1,894,840	1,826,744	2682.6%
Cash in Banks	44,980	57,207	12,227	27.2%
Other Debt Balances	369,953	175,437	-194,516	N/A
Creditor Accounts	0	0	0	N/A
Total Current Assets	**4,686,672**	**6,177,803**	1,491,131	31.8%
		5,087,550		
B. LIABILITIES AND OWNERS' EQUITY				
Capital	390,175	390,175	0	0.0%
Reserves	95,208	100,564	5,356	5.6%
Depreciation	998,651	1,090,253	91,602	9.2%
Other Specifications	56,324	60,408	4,084	7.3%
Loans	1,468,716	1,780,618	311,902	21.2%
Accounts Payable	1,134,025	355,729	-778,296	-68.6%
Other Accounts Payable	531,752	522,926	-8,826	-1.7%
Other Creditor Balances	11,821	1,877,130	1,865,309	N/A
Creditor Accounts	0	0	0	N/A
TOTAL LIABILITIES & OWNERS' EQUITY	**4,686,672**	**6,177,803**	1,491,131	31.8%

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A.18.5.3 Behaira Electricity Company

Behaira Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	791,309	878,518	87,209	11.0%
Financial Papers Revenue	54	49	-5	-9.3%
Transformed Revenue	45,178	21,418	-23,760	-52.6%
Subtotal:	**836,541**	**899,985**	63,444	7.6%
2. Fees	92,254	100,601	8,347	9.0%
3. General Changing				
Requirement Materials	269,809	319,276	49,467	18.3%
Labor	34,630	38,970	4,340	12.5%
Purchase for Resale	198,479	212,009	13,530	6.8%
Subtotal:	**502,918**	**570,255**	67,337	13.4%
4. Current Expenses				
Taxes	2,754	2,320	-434	-15.8%
Depreciation	90,589	95,211	4,622	5.1%
Actual Leases	21	21	0	0.0%
Local Interest	43,438	59,332	15,894	36.6%
External Interest	40,899	30,418	-10,481	-25.6%
TOTAL OPERATING EXPENSES	**177,701**	**187,302**	9,601	5.4%
5. Current Specific Orders	**22,509**	**21,784**	-725	-3.2%
6. Total Current Uses	**795,382**	**879,942**	84,560	10.6%
Remaining before Internal Taxes	**41,159**	**20,043**	-21,116	-51.3%
Internal Taxes	**9,582**	**3,660**	-5,922	-61.8%
Remaining for Distribution	**31,577**	**16,383**	-15,194	-48.1%
Reserves				
Legal Reserves	1,579	819	-760	-48.1%
Other Reserves	0	5	5	#DIV/0!
Reserves Subtotal:	**1,579**	**824**	-755	-47.8%
Distributions				
Shareholders	22,181	11,608	-10,573	-47.7%
Workers	7,394	3,869	-3,525	-47.7%
Sports Activity	158	82	-76	-48.1%
Board of Directors Bonuses	265	0	-265	-100.0%
Distributed Subtotal:	**29,998**	**15,559**	-14,439	-48.1%
Total Distributed	**31,577**	**16,383**	-15,194	-48.1%

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Behaira Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	2,663,068	2,711,458	48,390	1.8%
Work in Progress	27,766	57,170	29,404	105.9%
Inventories	201,032	214,153	13,121	6.5%
Investments	467	467	0	0.0%
Accounts Receivable	781,790	907,400	125,610	16.1%
Other Accounts Receivable	204,897	256,690	51,793	25.3%
Cash in Banks	23,323	30,258	6,935	29.7%
Other Debt Balances	30,128	42,717	12,589	41.8%
Creditor Accounts	0	0	0	N/A
Total Current Assets	**3,932,471**	**4,220,313**	287,842	7.3%
		3,435,556		
B. LIABILITIES AND OWNERS' EQUITY				
Capital	412,830	412,830	0	0.0%
Reserves	58,740	60,978	2,238	3.8%
Depreciation	689,523	784,757	95,234	13.8%
Other Specifications	25,941	26,816	875	3.4%
Loans	1,101,995	1,052,180	-49,815	-4.5%
Accounts Payable	817,021	934,109	117,088	14.3%
Other Accounts Payable	826,070	948,062	121,992	14.8%
Other Creditor Balances	351	581	230	65.5%
Creditor Accounts	0	0	0	N/A
TOTAL LIABILITIES & OWNERS' EQUITY	**3,932,471**	**4,220,313**	287,842	7.3%

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A.18.5.4 *Delta Electricity Company*

Delta Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	1,435,280	1,560,743	125,463	8.7%
Financial Papers Revenue	288	262	-26	-9.0%
Transformed Revenue	55,705	69,340	13,635	24.5%
Subtotal:	**1,491,273**	**1,630,345**	139,072	9.3%
2. Fees	186,122	227,303	41,181	22.1%
3. General Changing				
Requirement Materials	459,447	493,013	33,566	7.3%
Labor	106,333	121,192	14,859	14.0%
Purchase for Resale	265,640	298,823	33,183	12.5%
Subtotal:	**831,420**	**913,028**	81,608	9.8%
4. Current Expenses				
Taxes	12,583	17,074	4,491	35.7%
Depreciation	145,123	148,874	3,751	2.6%
Actual Leases	117	164	47	40.2%
Local Interest	111,214	105,409	-5,805	-5.2%
External Interest	59,118	51,246	-7,872	-13.3%
TOTAL OPERATING EXPENSES	**328,155**	**322,767**	-5,388	-1.6%
5. Current Specific Orders	**50,860**	**67,413**	16,553	32.5%
6. Total Current Uses	**1,396,557**	**1,530,511**	133,954	9.6%
Remaining before Internal Taxes	**94,716**	**99,834**	5,118	5.4%
Internal Taxes	**26,635**	**32,859**	6,224	23.4%
Remaining for Distribution	**68,081**	**66,975**	-1,106	-1.6%
Reserves				
Legal Reserves	3,386	3,329	-57	-1.7%
Other Reserves	360	406	46	12.8%
Reserves Subtotal:	**3,746**	**3,735**	-11	-0.3%
Distributions				
Shareholders	47,755	46,939	-816	-1.7%
Workers	15,919	15,646	-273	-1.7%
Sports Activity	339	333	-6	-1.8%
Board of Directors Bonuses	322	322	0	0.0%
Distributed Subtotal:	**64,335**	**63,240**	-1,095	-1.7%
Total Distributed	**68,081**	**66,975**	-1,106	-1.6%

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Delta Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	4,590,022	4,719,801	129,779	2.8%
Work in Progress	15,828	52,667	36,839	232.7%
Inventories	329,271	327,404	-1,867	-0.6%
Investments	1,325	1,325	0	0.0%
Accounts Receivable	1,323,828	1,538,027	214,199	16.2%
Other Accounts Receivable	54,837	152,737	97,900	178.5%
Cash in Banks	57,066	50,127	-6,939	-12.2%
Other Debt Balances	71,100	3,537	-67,563	-95.0%
Creditor Accounts	0	0	0	N/A
Total Current Assets	**6,443,277**	**6,845,625**	402,348	6.2%
		5,441,968		
B. LIABILITIES AND OWNERS' EQUITY				
Capital	591,493	591,493	0	0.0%
Reserves	61,693	67,161	5,468	8.9%
Depreciation	1,254,920	1,403,657	148,737	11.9%
Other Specifications	79,606	93,925	14,319	18.0%
Loans	1,794,736	1,892,890	98,154	5.5%
Accounts Payable	896,244	1,063,506	167,262	18.7%
Other Accounts Payable	1,763,095	1,704,312	-58,783	-3.3%
Other Creditor Balances	1,490	1,654	164	11.0%
Creditor Accounts	0	27	27	N/A
TOTAL LIABILITIES & OWNERS' EQUITY	**6,443,277**	**6,818,625**	375,348	5.8%

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A.18.5.5 *Canal Electricity Company*

Canal Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	1,447,113	1,626,873	179,760	12.4%
Financial Papers Revenue	503	462	-41	-8.2%
Transformed Revenue	42,343	44,593	2,250	5.3%
Subtotal:	**1,489,959**	**1,671,928**	181,969	12.2%
2. Fees	193,942	221,447	27,505	14.2%
3. General Changing				
Requirement Materials	549,771	506,888	-42,883	-7.8%
Labor	68,538	113,560	45,022	65.7%
Purchase for Resale	232,307	294,077	61,770	26.6%
Subtotal:	**850,616**	**914,525**	63,909	7.5%
4. Current Expenses				
Taxes	14,898	8,614	-6,284	-42.2%
Depreciation	145,663	151,098	5,435	3.7%
Actual Leases	276	270	-6	-2.2%
Local Interest	169,511	218,449	48,938	28.9%
External Interest	54,059	77,483	23,424	43.3%
TOTAL OPERATING EXPENSES	**384,407**	**455,914**	71,507	18.6%
5. Current Specific Orders	**31,455**	**59,318**	27,863	88.6%
6. Total Current Uses	**1,460,420**	**1,651,204**	190,784	13.1%
Remaining before Internal Taxes	**29,539**	**20,724**	-8,815	-29.8%
Internal Taxes	**6,228**	**13,322**	7,094	113.9%
Remaining for Distribution	**23,311**	**7,402**	-15,909	-68.2%
Reserves				
Legal Reserves	1,163	370	-793	-68.2%
Other Reserves	44	0	-44	-100.0%
Reserves Subtotal:	**1,207**	370	-837	-69.3%
Distributions				
Shareholders	16,284	5,246	-11,038	-67.8%
Workers	5,428	1,749	-3,679	-67.8%
Sports Activity	116	37	-79	-68.1%
Board of Directors Bonuses	276	0	-276	-100.0%
Distributed Subtotal:	**22,104**	**7,032**	-15,072	-68.2%
Total Distributed	**23,311**	**7,402**	-15,909	-68.2%

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Canal Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	5,377,053	5,449,668	72,615	1.4%
Work in Progress	50,374	103,938	53,564	106.3%
Inventories	479,989	503,904	23,915	5.0%
Investments	3,331	3,331	0	0.0%
Accounts Receivable	1,181,731	1,366,635	184,904	15.6%
Other Accounts Receivable	84,757	140,484	55,727	65.7%
Cash in Banks	112,286	114,168	1,882	1.7%
Other Debt Balances	44,828	6,476	-38,352	N/A
Creditor Accounts	0	0	0	N/A
Total Current Assets	**7,334,349**	**7,688,604**	354,255	4.8%
		5,969,574		
B. LIABILITIES AND OWNERS' EQUITY				
Capital	329,333	329,333	0	0.0%
Reserves	91,797	113,349	21,552	23.5%
Depreciation	1,568,704	1,719,030	150,326	9.6%
Other Specifications	139,481	154,657	15,176	10.9%
Loans	2,068,244	2,080,289	12,045	0.6%
Accounts Payable	1,515,528	1,615,261	99,733	6.6%
Other Accounts Payable	1,612,217	1,600,745	-11,472	-0.7%
Other Creditor Balances	9,045	75,940	66,895	N/A
Creditor Accounts	0	0	0	N/A
TOTAL LIABILITIES & OWNERS' EQUITY	**7,334,349**	**7,688,604**	354,255	4.8%

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A.18.5.6 *Middle Egypt Electricity Company*

Middle Egypt Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	943,753	1,096,873	153,120	16.2%
Financial Papers Revenue	143	143	0	0.0%
Transformed Revenue	6,412	7,559	1,147	17.9%
Subtotal:	**950,308**	**1,104,575**	154,267	16.2%
2. Fees	95,620	123,842	28,222	29.5%
3. General Changing				
Requirement Materials	277,749	309,764	32,015	11.5%
Labor	65,230	77,322	12,092	18.5%
Purchase for Resale	137,854	166,983	29,129	21.1%
Subtotal:	**480,833**	**554,069**	73,236	15.2%
4. Current Expenses				
Taxes	3,974	9,973	5,999	151.0%
Depreciation	122,261	139,187	16,926	13.8%
Actual Leases	64	87	23	35.9%
Local Interest	75,584	220,626	145,042	191.9%
External Interest	116,800	0	-116,800	-100.0%
TOTAL OPERATING EXPENSES	**318,683**	**369,873**	51,190	16.1%
5. Current Specific Orders	**14,770**	**35,494**	20,724	140.3%
6. Total Current Uses	**909,906**	**1,083,278**	173,372	19.1%
Remaining before Internal Taxes	**40,402**	**21,297**	-19,105	-47.3%
Internal Taxes	**0**	**0**	0	N/A
Remaining for Distribution	**40,402**	**21,297**	-19,105	-47.3%
Reserves				
Legal Reserves	2,020	1,065	-955	-47.3%
Other Reserves	0	0	0	N/A
Reserves Subtotal:	**2,020**	**1,065**	-955	-47.3%
Distributions				
Shareholders	28,424	15,095	-13,329	-46.9%
Workers	9,475	5,031	-4,444	-46.9%
Sports Activity	202	106	-96	-47.5%
Board of Directors Bonuses	281	0	-281	-100.0%
Distributed Subtotal:	**38,382**	**20,232**	-18,150	-47.3%
Total Distributed	**40,402**	**21,297**	-19,105	-47.3%

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Middle Egypt Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	4,517,151	4,973,412	456,261	10.1%
Less: Depreciation	-612,127	-794,910	-182,783	29.9%
Net Fixed Assets in Service	3,905,024	4,178,502	273,478	7.0%
Work in Progress	13,077	1,279,133	1,266,056	9681.5%
Total Fixed Assets	**3,918,101**	**5,457,635**	1,539,534	39.3%
Inventories	99,428	163,920	64,492	64.9%
Investments	650	650	0	0.0%
Accounts Receivable	1,157,365	1,210,639	53,274	4.6%
Other Accounts Receivable	18,643	2,639	-16,004	-85.8%
Cash in Banks	14,605	27,660	13,055	89.4%
Other Debt Balances	2,911	885	-2,026	N/A
Total Current Assets	**1,293,602**	**1,406,393**	112,791	8.7%
Total Assets	**5,211,703**	**6,864,028**	1,652,325	31.7%
B. LIABILITIES AND OWNERS' EQUITY				
Capital	508,556	508,556	0	0.0%
Reserves	48,234	227,893	179,659	372.5%
Other Specifications	30,492	13,156	-17,336	-56.9%
Total Capital and Reserves	**587,282**	**749,605**	162,323	27.6%
Loans	3,209,004	3,875,116	666,112	20.8%
Total Long-Term Debts	**3,209,004**	**3,875,116**	666,112	20.8%
Accounts Payable	884,278	1,322,610	438,332	49.6%
Other Accounts Payable	530,952	916,681	385,729	72.6%
Other Creditor Balances	187	16	-171	N/A
Total Current Liabilities	**1,415,417**	**2,239,307**	823,890	58.2%
Total Owners' Equity and Liabilities	**5,211,703**	**6,864,028**	3,304,650	63.4%

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A.18.5.7 *Upper Egypt Electricity Company*

Upper Egypt Electricity Company Comparative Income Statements
Period Covered: 1 July 1998 through 30 June 2000

	Period 1 July 1998 to 30-Jun-99	Period 1 July 1999 to 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
1. Operating Revenue				
Current Activity Revenue	658,052	697,558	39,506	6.0%
Financial Papers Revenue	77	70	-7	-9.1%
Transformed Revenue	18,923	42,233	23,310	123.2%
Subtotal:	**677,052**	**739,861**	62,809	9.3%
2. Fees	129,449	146,703	17,254	13.3%
3. General Changing				
Requirement Materials	51,981	51,750	-231	-0.4%
Labor	104,922	82,575	-22,347	-21.3%
Purchase for Resale	18,939	39,063	20,124	106.3%
Subtotal:	**175,842**	**173,388**	-2,454	-1.4%
4. Current Expenses				
Taxes	5,488	11,928	6,440	117.3%
Depreciation	82,547	87,495	4,948	6.0%
Actual Leases	36	38	2	5.6%
Local Interest	80,519	94,608	14,089	17.5%
External Interest	45,210	43,604	-1,606	-3.6%
TOTAL OPERATING EXPENSES	**213,800**	**237,673**	23,873	11.2%
5. Current Specific Orders	**48,883**	**65,773**	16,890	34.6%
6. Total Current Uses	**567,973**	**623,537**	55,564	9.8%
Remaining before Internal Taxes	**109,079**	**116,324**	7,245	6.6%
Internal Taxes	**25,199**	**21,758**	-3,441	-13.7%
Remaining for Distribution	**83,880**	**94,566**	10,686	12.7%
Reserves				
Legal Reserves	4,176	4,728	552	13.2%
Other Reserves	354	0	-354	-100.0%
Reserves Subtotal:	**4,530**	**4,728**	198	4.4%
Distributions				
Shareholders	58,977	66,764	7,787	13.2%
Workers	19,658	22,255	2,597	13.2%
Sports Activity	418	473	55	13.2%
Board of Directors Bonuses	297	346	49	16.5%
Distributed Subtotal:	**79,350**	**89,838**	10,488	13.2%
Total Distributed	**83,880**	**94,566**	10,686	12.7%

Upper Egypt Electricity Company Comparative Historical Balance Sheets
Period Covered: 1 July 1998 through 30 June 2000

	Year Ending 30-Jun-99	Year Ending 30-Jun-00	Net Change 1999 to 2000	% Change 1999 to 2000
A. ASSETS				
Gross Fixed Assts in Service	2,887,549	3,103,148	215,599	7.5%
Less: Depreciation	-596,034	-684,150	-88,116	14.8%
Net Fixed Assets in Service	2,291,515	2,418,998	127,483	5.6%
Work in Progress	15,407	26,057	10,650	69.1%
Total Fixed Assets	**2,306,922**	**2,445,055**	138,133	6.0%
Inventories	140,367	142,804	2,437	1.7%
Investments	497	497	0	0.0%
Accounts Receivable	777,000	1,057,975	280,975	36.2%
Other Accounts Receivable	287,182	457,888	170,706	59.4%
Cash in Banks	61,251	71,177	9,926	16.2%
Other Debt Balances	40,417	7,865	-32,552	N/A
Total Current Assets	**1,306,714**	**1,738,206**	431,492	33.0%
Total Assets	**3,613,636**	**4,183,261**	569,625	15.8%
B. LIABILITIES AND OWNERS' EQUITY				
Capital	412,476	412,476	0	0.0%
Reserves	55,119	61,103	5,984	10.9%
Other Specifications	23,649	27,443	3,794	16.0%
Total Capital and Reserves	**491,244**	**501,022**	9,778	2.0%
Loans	1,284,846	1,480,198	195,352	15.2%
Total Long-Term Debts	**1,284,846**	**1,480,198**	195,352	15.2%
Accounts Payable	447,113	394,899	-52,214	-11.7%
Other Accounts Payable	1,390,433	1,325,189	-65,244	-4.7%
Other Creditor Balances	0	481,953	481,953	N/A
Total Current Liabilities	**1,837,546**	**2,202,041**	364,495	19.8%
Total Owners' Equity and Liabilities	**3,613,636**	**4,183,261**	1,139,250	31.5%

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