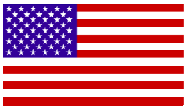

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PAKISTAN-US ENERGY PARTNERSHIP

# FAISALABAD ELECTRIC SUPPLY COMPANY (FESCO) OPERATIONAL AUDIT REPORT

*Produced by:*

**MWP-USAID POWER DISTRIBUTION IMPROVEMENT PROGRAM**

**APRIL 2011**

# PAKISTAN-US ENERGY PARTNERSHIP

## MWP-USAID POWER DISTRIBUTION IMPROVEMENT PROGRAM

### FAISALABAD ELECTRIC SUPPLY COMPANY (FESCO)
### OPERATIONAL AUDIT REPORT

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# ACRONYMS

**ABC** - Aerial Bundled Conductor

**ACR** – Annual Confidential Report

**ADB** – Asian Development Bank

**AEB** – Area Electricity Board (former name for DISCO)

**AMR** – Automated Meter Reading

**BFP** – Book of Financial Powers

**BOD** - Board of Directors

**BPS** - Basic Pay Scale

**CDWP** - Central Development Working Party

**CE** – Chief Engineer

**CEO** – Chief Executive Officer

**CFO** – Chief Financial Officer

**CIS** – Customer Information System

**COBOL -** Common Business-Oriented Language

**CP** – Commercial Procedure

**CPPA** -- Central Power Purchasing Agency

**CSO** – Customer Services Officer

**CSR** - Corporate Social Responsibility

**CT** – Current Transformer

**CTC** – Circle Training Center

**CWIP** – Construction Work in Progress

**D&S** – Design & Standards

**DISCO** – Distribution Company

**DISCOs** – Distribution Companies

**DOP** – Distribution of Power

**DP** – Distribution Planning

**ECNEC** - Executive Committee of National Economic Council

**ELR** – Energy Loss Reduction

**ERO** - Equipment Removal Order

**ERP** – Enterprise Resource Planning

**FDRANA** – Feeder Analysis (Software)

**FESCO** – Faisalabad Electric Supply Company Limited

**GENCO** – Generation Company

**GEPCO** – Gujranwala Electric Power Company Limited

**GIS** – Geographic Information System

**GOP** – Government of Pakistan

**GST –** General Sales Tax

**GWh** – Gigawatt hour

**HESCO** - Hyderabad Electric Supply Company Limited

**HQ** – Headquarter

**HR** – Human Resource

**HT** – High tension(11kV)

**IA** – Internal Audit

**ICT** – Information Communication Technology

**IESCO** – Islamabad Electric Supply Company Limited

**IPP** – Independent Power Producer

**IT** – Information Technology

**KALAMZU book** – Meter Reading book

**Km** – Kilometer

**KPIs** – Key Performance Indicators

**kV** – Kilovolt

**kVA –** Kilovolt Ampere

**kVAR –** Kilovolt Ampere Reactive

**kVAR –** Kilovolt Ampere Reactive Hours

**kW** – Kilowatt

**kWh** – Kilowatt hour

**LDC** – Lower Division Clerk

**LESCO** - Lahore Electric Supply Company Limited

**LPF** – Low Power Factor

**LS** – Line Superintendent

**LT** – Low tension, (0.4 kV)

**M&T** - Metering and Testing

**MDI** - Maximum Demand Indicator

**MEPCO** – Multan Electric Power Company Limited

**MIS** – Management Information System

**MVAR -** Megavolt Ampere Reactive

**MW** – Megawatt

**MWh** – Megawatt hour

**MWP** – Ministry of Water and Power

**NADRA** – National Database and Registration Authority

**NEPRA** – National Electric Power Regulatory Authority

**NRECA** - National Rural Electric Cooperative Association, USA

**NTDC** – National Transmission and Dispatch Company Limited

**PC** - Planning Commission

**PDIP** – Power Distribution Improvement Program

**PEL** – Pak Elektron Ltd.

**PEPCO** - Pakistan Electric Power Company Limited

**PER** - Performance Evaluation Report

**PESCO** – Peshawar Electric Supply Company Limited

**PPRA** – Public Procurement Regulatory Authority

**PR** – Public Relation

**PRO** – Public Relation Officer

**PTCL** – Pakistan Telecommunication Corporation

**QESCO** – Quetta Electric Supply Company Limited

**REA** - Rural Electrification Administration, USA

**RORB** – Return On Regulatory Asset Base

**RTC** - Regional Training Center

**SBP** – State Bank of Pakistan

**SCO** - Service Connection Order

**SDO** – Sub Divisional Officer

**SE** – Superintending Engineer

**USAID** – United States Agency for International Development

**USC** – Use of System Charges

**WACC** - Weighted Average Cost of Capital

**WAPDA** – Water and Power Development Authority

**XEN** – Executive Engineer

# EXECUTIVE SUMMARY

## OVERVIEW OF THE PROJECT

### Background

Pakistan's Power Sector is, and has been for many years, beset by significant challenges. These include limited availability of reliable and affordable electric power, ageing and inadequate transmission and distribution networks, and utility policies and practices that badly lag behind those of modern utilities elsewhere in the world. Moreover, a current-day, technology infrastructure that can enable efficient, back-office operations such as handling customer service requests is not in evidence.

For a major electric distribution utility like Faisalabad Electric Supply Company (FESCO), these deficiencies translate into a level of financial performance that cannot be considered self-sustaining. As a result, achieving financial self-sufficiency is becoming critical for FESCO. Pakistan's power industry is undergoing sweeping changes, transitioning from wholly Government-owned utilities to fully autonomous companies that will engage in power generation, transmission and distribution under the Government's aggressive reform agenda. A similar industry structure exists and functions smoothly in many other countries today. In Pakistan's case however, badly outdated policies, procedures and work practices, as well as chronically low levels of investment in utility infrastructure, pose serious barriers to a successful transition.

### Purpose

The Power Distribution Improvement Program (PDIP) is a three-year, USAID-financed project designed to facilitate improvements in electric power distribution utilities across Pakistan. The project began in September, 2010. PDIP was designed to be implemented in two distinct phases:

- **Component 1** consisted of operational audits of each of the eight Government-owned distribution utilities (DISCOs). The purpose of these in-depth, operational audits was to establish baseline information that can be used to measure improvement in performance over time. Audits covered governance, operational, financial, human resources, communications and customer service areas and identified opportunities for fundamental improvement in all areas. These improvement opportunities are reflected in specific Performance Improvement Action Plans.

- **Component 2** will focus on execution of the Performance Improvement Action Plans by each DISCO, including implementation of pilot projects to demonstrate a number of key operational improvements and directly measure their value to the utility.

- FESCO has adequate investment through ADB Power Distribution Enhancement Investment Program (Tranche I & II) with major emphasis on transmission system expansion, up-gradation and augmentation. Therefore, PDIP focus is mainly on distribution system (11kV and below) improvement as it lacked investment.

## MAJOR FINDINGS & CONCLUSIONS

The operational audit conducted for FESCO during Component 1 provided extensive insights into how FESCO operates and the performance consequences of the company's current approaches and practices. The PDIP team also became acutely aware of deficiencies that obstruct progress toward improvement. Part of the challenge faced by FESCO's management and board in seeking to 'bootstrap' overall performance, enhance customer service and create greater financial self-sufficiency will be to select the *right* actions at all levels, from front-line operations to strategic planning and assign the *right* priorities. This summary of major findings culled from the operational audit findings contained throughout this report is intended to provide a starting point for management consideration.

Table 1 below highlights major findings and conclusions of Component 1 of this project. Additional, detailed findings can be found in Section 2 of this report.

**TABLE 1: KEY FINDINGS OF FESCO OPERATIONAL AUDIT**

| | |
|---|---|
| **GOVERNANCE** | FESCO's governance system has not yet made the transition to a business-like electric utility focus. It remains subject to political intervention, and the Board of Directors has not been empowered to oversee a true corporate entity. Recent reconstitution of the Board by the Government is a positive step toward greater professionalism and operating autonomy; however, additional changes will be required to enable the BOD to exert the strategic influence the company will need to succeed in the restructured Pakistani power sector, and to improve its operating and financial performance to more acceptable levels |
| **ORGANIZATION** | FESCO's current organization is not structured along functional lines as seen in most modern electric distribution utilities worldwide but primarily by geographic areas. Commercial functions responsible for cash flows within the utility should not report to Superintending Engineers whose responsibilities focus on power system stability and reliability. The current arrangement also creates potential conflicts of interest in the performance of key jobs within the utility. |
| **ENGINEERING** | Preliminary loss analysis on four (4) sample feeders using GIS mapping & modeling technique with a load flow software shows that technical loss for FESCO's distribution system is 7.1%. In contrast, FESCO reported total system loss is 10.8% in FY 2009-10. The reported distribution loss was 9.7%. So the difference between the distribution technical loss of 7.1% and a reported total distribution loss is a non-technical (commercial) loss of 2.6%.<br><br>Construction and maintenance work practices in widespread use among FESCO employees are inconsistent, rely on makeshift and stopgap approaches and suffer from lack of available equipment and transportation access. The consequences of these failures are profound—employee safety is routinely jeopardized; worker productivity is low; response to customer requests can be exceedingly slow; and equipment failures occur more frequently than necessary. All of these direct consequences have significant financial impacts for FESCO. |
| **FINANCIAL** | DISCO power supply is pooled; that is, FESCO does not have an individual relationship with its power supplier. The amounts FESCO pays for power are consolidated and parceled out to generators without regard to the volume of power actually supplied to it. This puts FESCO, which is capable of paying the unsubsidized portion of the power bill from its own revenues, in the same class as other DISCOS who cannot, and ensures that FESCO cannot take unilateral steps to improve its power supply picture. The company employs manual financial and management reporting systems resulting in inefficient, slow and sometimes inaccurate or incomplete information. Past due trade debts age without effective efforts for collection. FESCO is currently paying approximately Rs 10.5 million for outdated legacy based software applications. Cash flow generated by operations is satisfactory only for meeting short term needs, making the utility essentially an operations-oriented entity. FESCO also shoulders certain cost burdens that are rarely, if ever, seen among leading utilities worldwide. As a result, investment in both distribution system assets and employee equipment is hampered by low capital availability and operating performance impacted by |

| | |
|---|---|
| | poor cash flows. A new, rationalized financial framework—covering both internal and external relationships and transactions—is needed to assure better bottom-line performance. |
| **COMMERCIAL** | Statistics indicate that FESCO is functioning reasonably well. However, commercial activities need improvement and transparency. The meter reading practices currently employed are subject to influence by operations management.<br><br>Progress toward a modern billing and collections systems is frozen at the most basic level of automated processing typical of the 1970's in other countries' utilities. The entire revenue cycle, from the setup of a new customer account to meter reading to receipt of customer payments and ultimate revenue recognition, remains a highly fragmented and manual process. Inadequate monitoring of all steps in the revenue cycle at FESCO virtually assures negative cash flow impacts, higher than necessary levels of payment arrearages, low customer satisfaction and delays in completing even the simplest jobs. |
| **HUMAN RESOURCES** | FESCO's corporate culture is akin to that of a government agency in which lifetime employment without performance expectations is balanced by low salaries. This environment makes it difficult for it to recruit skilled candidates for open positions because the best candidates command higher salaries in private industry. As a consequence, FESCO is both overstaffed by any reasonable benchmark and under-resourced, with serious shortages of employees possessing the right mix of technical training, experience and motivation to accomplish its mission. Moreover, the corporate culture requires a complete overhaul to instill in all employees the strategic message that quality of work, responsiveness to customer needs and constant attention to safety are among the company's highest values. |
| **COMMUNICATIONS & OUTREACH** | FESCO is still following the outdated and tedious communications and outreach practices of its historical predecessor, which employ extensive and laborious processes, including much paper pushing. Computer penetration is abysmally low. Since major mass media campaigns are carried out by PEPCO, FESCO's outreach remains limited to a few piecemeal public relations activities, mostly related to company announcements, procurement and shut down notices and messages for energy conservation. Customer satisfaction is hampered not just by poor service delivery, but also by untrained, substitute staff which works on an ad-hoc basis. |

## KEY RECOMMENDATIONS

**Table 2 contains key recommendations of Component 1.** Additional, detailed recommendations can be found in Section 3 of this report.

**TABLE 2: KEY RECOMMENDATIONS OF FESCO OPERATIONAL AUDIT**

| | |
|---|---|
| **GOVERNANCE** | The recently reconstituted Board of Directors should be given authority to direct the affairs of FESCO. The Board should be empowered to:<br><br>1. Set company policies, performance objectives and strategic directions.<br>2. Adopt bylaws.<br>3. Name members to its advisory, executive, finance, and other committees. |

| | |
|---|---|
| | 1. Hire, monitor, evaluate, and fire the CEO and senior executives |
| **ORGANIZATION** | An evaluation of organizational changes required to improve FESCO's technical, commercial and overall operational performance should be made. Organizing FESCO along functional lines and establishing lines of authority and responsibility through departments including General and Administration, Commercial Management, Finance, Operations and Maintenance and Engineering and Planning should be considered. Limiting the number of direct reports to the CEO will allow him to focus on strategic issues, leaving day-to-day operational management to qualified senior managers. |
| **ENGINEERING** | The operational audit produced a large number of specific recommendations in the areas of loss reduction, mapping and planning, high tension, low tension and metering. These are detailed in the Recommendations section of this report. One key recommendation which holds the promise of improving many areas of engineering performance is to develop a GIS for the entire FESCO service territory, to link the GIS with engineering software in order to develop long-term system planning capability. This would allow the utility to perform detailed short- and long-range work plans, identifying loss reduction targets, and to expand service capacity where and when necessary. |
| **FINANCIAL** | FESCO's greatest financial vulnerability centers on its relationship with government clients. Given that it is unlikely that FESCO can make significant progress to ensure higher collection rates from this class of customer, the recommended solution is to negotiate tax payment offsets under which unpaid bills are discounted from collections of local and federal taxes.<br><br>In addition, a new financial framework is needed within FESCO and should include:<br><br>1. Updated accounting and internal audit procedures that more effectively serve the needs of the new board of directors.<br><br>2. Insurance coverage for buildings, equipment, inventories, and other assets as deemed necessary to eliminate exposure to significant financial loss.<br><br>3. Development or purchase of a financial forecasting program to aid decision making in allocating FESCO's limited resources |
| **COMMERCIAL** | Commercial management is the fulcrum of successful electric distribution utilities; if commercial practices and procedures are not carefully designed and implemented with discipline and integrity, the financial viability of the utility will be at risk. FESCO's business processes for customer service / revenue cycle should be systematically improved for increased revenue recovery, improved commercial efficiency and more effective consumer service with:<br><br>1. A consumer census to verify/add consumers.<br><br>2. Installation of a new Customer Information System.<br><br>3. Corporate reorganization so that all commercial activities report to the Director of Consumer Services.<br><br>4. Updated metering, using automated metering technology where |

| | |
|---|---|
| | appropriate.<br>5. Reorganized and updated meter reading routes.<br>6. Implementation of energy accounting.<br>7. Design of more comprehensive customer service and consumer awareness programs.<br>8. Enforcement of meter reading audits and meter inspection programs.<br>9. Establishment of a program of systematic meter checking, testing, and replacement. |
| **HUMAN RESOURCES** | FESCO management should strive to create a corporate environment and employment conditions that enable *all* employees to:<br>1. Always know what the company's key goals are.<br>2. Understand their roles in the organization and how they contribute to the company's success.<br>3. Have the appropriate level of authority needed to manage assigned tasks.<br>4. Have the equipment, support, knowledge and training to succeed.<br>5. Be fairly compensated for their work with adequate benefits.<br>6. Feel engaged with their position and the company as their institutional home. |
| **COMMUNICATIONS & OUTREACH** | Every service delivery organization needs to have a strong and well-positioned communications and outreach program. It is recommended that FESCO should:<br>1. Develop and implement a comprehensive communications and outreach strategy.<br>2. Restructure and strengthen the PR department with an enhanced decision making role and a regular budget to lead mass media, consumer advocacy and outreach campaigns.<br>3. Focus on implementing an IT culture for fast and efficient communications by digitizing systems and investing in capacity development of the workforce.<br>4. Develop an annual calendar of outreach activities for consumer awareness and corporate brand building.<br>5. Revamp the existing Customer Service Centers through consumer-centric, gender- sensitive action plans, training and development of staff.<br>6. Upgrade and maintain a strong web presence, a public domain database and its web portal.<br>7. Integrate consumer information products and outreach activities in an annual calendar focusing on role of the DISCO, theft control and energy conservation, etc<br>8. Implement a monitoring and evaluation plan for staying abreast of changing communications needs. |

## STRATEGIC DIRECTIONS

The value inherent in this report comes from its approach—a thorough and independent operational audit of all key areas of the company—and its candor. By speaking directly and without nuance to the array of problems FESCO faces today, the report lays bare what is wrong and what should be considered by FESCO management to fix it. The obvious downside of trying to address this many problems is that the "forest may be lost for the trees." Several management approaches can help counter this.

### Importance of a Strategic Plan

A strategic plan is the best way to manage complex change, overcome complacency, galvanize the organization and gradually alter course. Creating a strategic plan for FESCO, adopting long term goals and ensuring that all employees understand them will create a shared awareness and, even more importantly, shared accountability. Every employee should know what is important to the company, where improvement is needed, what they can do to help and how progress will be measured. Without a strategic plan, it is hard to imagine how management can succeed in addressing the problems highlighted in this report, many of which have persisted for decades. A small number of long-term goals typically form the basis of a strategic plan. Meet an ambitious benchmark for power reliability, achieve a highly favorable customer satisfaction level, or achieve financial self-sufficiency for both operating and investment capital by a certain year—these are typical of goals that have been adopted by other major electric distribution companies around the world.

### Benchmarking to Measure Progress

FESCO is in an ideal position to measure its changing performance objectively to judge whether its strategies are working. As one of eight Pakistani DISCOS, the company can compare its measured performance against a group of its peers within a common industry setting. Suitable benchmarking measures may include typical bill (cost for first 500 kWh of monthly service), ratio of employees to customers served, debt-to-equity ratio and other widely used utility statistics which are generally available. Long-term targets for improvement in any area should however come from high-performing utilities of comparable size and customer mix outside Pakistan. Several utility benchmarking organizations routinely publish such data for their subscribers.

## CRITICAL SUCCESS FACTORS

Numerous barriers stand in the way of FESCO improving its operating performance and becoming financially self-sufficient. These may include complacency or unwillingness to change, policies that work against new approaches, lack of convincing leadership or simply inadequate resources. However, some of these barriers carry special importance for a company like FESCO and overcoming them will be critical to success.

### Appropriate Use of Technology

FESCO's business processes are based heavily on manual processing, supplemented by information technology components that are legacies of the 1980's. While business procedures themselves may be reasonable, the growth of the utility has outstripped the ability of its staff to perform many of the checks and balances built into the manual system, allowing for errors and potential manipulation of results. Moreover, time required to complete even the most routine customer requests, such as new account setup, is excessive.

It is evident that automation technology can play a major role in helping FESCO to leverage better performance. Processes can be streamlined and job tasks automated. However, the company may currently lack the organizational capability to successfully implement more advanced technologies that are being adopted by leading utilities elsewhere. Employees are not accustomed to learning how to use new systems and adapting their work flows to take full advantage of technology. Familiarity with computers, local area networks and common desktop software is likely to be severely limited. Procedures that accompany technology-enabled business processes, e.g. backups and system modifications to ensure their robustness may be unfamiliar territory. *Accordingly, failure to allow sufficient time for rank and file employees to assimilate technology changes and participate in the redesign of their own business processes and work practices would put*

*FESCO's technology investments at risk, and technology projects could thus create problems rather than solve them.* In the near term therefore, emphasis should be on widely proven technology solutions that automate manual processes, especially in 'back-office' systems such as customer information and full build-out of ERP. More sophisticated uses of technology can come later.

## Fostering a Corporate Culture that Embraces Change

Obviously, setting a course for the future does not necessarily ensure that the destination will be reached, or reached safely. In FESCO's case, nothing short of a dramatic change in corporate culture will be needed. All employees must feel that they are valued corporate assets in whom investments such as training will be made and whose welfare is considered vital. Leading utilities around the world empower their employees to identify problems, help devise solutions and receive recognition and rewards for doing so. These global leaders in the power sector have created cultures in which continuous improvement of work practices is the responsibility of every employee and no problem is too small to receive specific attention. Empowering FESCO's employees to participate meaningfully in the fundamental changes that lie ahead will help spur the move to a new and higher performing corporate culture.

In particular, FESCO leadership, starting with the CEO and Board, must embrace change; accept that incremental improvements will not be enough for the company to keep pace in the rapidly changing Pakistani power sector; and present change to employees as a positive force - to the extent that employees see their leadership working to address the needs documented in this report as a welcome and long overdue experience..

## How This Report is Organized

The main body of this report is organized in a way that is intended to highlight current challenges FESCO faces and identify actions that can be taken to address them.

- Section 1 provides essential background on the utility industry setting in Pakistan, on Pakistani electric distribution companies in general, and on FESCO in particular.
- Section 2 contains results of the operational audit in all functional areas, with bulleted summaries of findings in the front of each sub-section, followed by analysis and discussion.
- Section 3 provides recommendations to address current needs and improve operating performance. Key recommendations have been brought forward to focus attention and facilitate action.
- A detailed description of the PDIP audit methodology is provided in the Appendix.

# 1. INTRODUCTION

## 1.1 INTRODUCTION AND OVERVIEW

The Power Distribution Improvement Program (PDIP) is a USAID-financed project designed to facilitate improvements in electric power distribution utilities in Pakistan that was initiated in September 2010 with a three-year duration. PDIP was designed to be implemented in two distinct Components, beginning with operational audits at each of the eight Government-owned distribution utilities (DISCOs) and definition of Performance Improvement Action Plans for each DISCO. The second Component will focus on execution of the performance improvement action plans for each DISCO, including implementation of pilot projects to demonstrate a number of key operational improvements.

The principal challenge of successful change management for each DISCO lies in transforming the management practices and the basic work culture of the utility to make it an effective, efficient and service oriented organization, including reining in its corrupt elements. The process requires that virtually all employees buy-in to the new, progressive vision of the organization, receive training in new methods of work and have the liberty of putting into practice the new concepts learned. To do this requires the input of intensive, specialized expertise as well as a DISCO management team committed to the change management objective. It also requires the Government of Pakistan (GOP) to create legal and political space for the management of the utility to operate in the most commercially rational manner, especially with full transparency and streamlined funds transfer arrangements within the energy sector.

Key performance improvement targets will be established on a case by case basis with each of the participating DISCOs to form the foundation of each respective Performance Improvement Action Plan. Each Performance Improvement Action Plan will be jointly developed taking into account the results of the joint self-task force operational audit of each participating DISCO and other participating GOP entities. The purpose of these operational audits is to establish baseline information required to measure achievements under PDIP and other related programs. The audits will cover the managerial, operational, financial and customer service situation of each DISCO and include the identification of opportunities and methodologies that will be used to reduce technical and non-technical, e.g. commercial, losses and improve network, institutional and management and staff performance.

### 1.1.1 Background

#### Industry Environment

Pakistan's Power Sector is beset by a number of significant challenges. These include availability of reliable and affordable electric power, modernization of the aging and inadequate transmission and distribution networks; and focusing on effective, efficient system planning, construction, operation and maintenance to achieve business objectives and customer satisfaction. With respect to retailing electric service to consumers, the challenges include control of an increase in unauthorized connections, elimination of collusion between employees and customers to reduce unauthorized use of electricity and rationalization of retail electricity tariffs; promotion of a cultural change under a more conducive work environment and compensation packages to the employees and introduction and enforcement of merit - based selection of employees. With respect to regulation of service, the challenges include achieving a balance between the business and social objectives, improvement of quality of service and technical performance standards and introduction of advanced technologies.

The Power Sector is currently in a state of transition from the wholly Government-owned utilities to fully autonomous companies in power purchase, generation, transmission and dispatch and distribution. Initially the power sector was run as a monolithic organization under the Water and Power Development Authority (WAPDA) which in turn answered to the Ministry of Water and Power [MWP].The WAPDA Power Wing provided the line and functional control of the Power Distribution Wing directing the operation of eight Area Electricity Boards (AEBs) at Lahore, Faisalabad, Gujranwala, Islamabad, Multan, Hyderabad, Peshawar and Quetta. In 1998, WAPDA was restructured along the now familiar lines calling for unbundling of generation, transmission and distribution. The AEBs were converted into stock

companies called DISCOS with all the shares held by the government, a regulatory agency was established, and a new entity, the Pakistan Electric Power Company (PEPCO), created to supervise the transition to full autonomy of the DISCOS. Twelve years later, the "transition" continues and autonomy remains an objective rather than a reality.

The government recently established a Transition Committee under the Deputy Chairman Planning Commission and is now working on a reform agenda for the entire power sector. The main objective is to achieve a deregulated power sector with independent power generation companies, a central power purchasing agency, a transmission and dispatch company, generation companies (GENCOs) and fully autonomous power distribution companies. The National Electric Power Regulatory Authority (NEPRA) is already overseeing and approving the power tariffs and DISCO quality of service. NEPRA is also developing its role as a regulator and considerable capacity building, legal framework and policy reforms will be required to have a fully functional power sector. The roles of different agencies although defined are not properly implemented to achieve a fully functioning power sector.

The biggest challenge to the power sector is the increasing burden of fossil based power generation at high cost. Past policy decisions, intentional or otherwise, established natural gas with fuel oil backup as the primary power generation fuels. The failure to develop additional gas resources has increased the use of the fuel oil component of the mix, and a decision by the government to protect consumers from the full cost of oil generated power has resulted in an immense subsidy burden on the government. Financing the subsidy was left in part to the DISCOS with the result that a huge (over Rs. 300 billion) circular debt has been created. The continued adherence to building social objectives in the tariff design, huge wastes and inefficiencies, customer non-cooperation, lack of resources for system rehabilitation and expansion and the lack of a well-designed and customer-friendly renewable and demand side management program is crippling the power sector as a whole. Major changes are needed to make the Pakistan Power Sector healthy again.

### Challenges Faced by Pakistan Power Distribution Companies

Pakistan's Power Distribution Companies (DISCOs) were created as independent, state-owned utilities superseding the old Area Electricity Boards in 1998, with the goal of becoming fully autonomous government corporations after a transition period. While the DISCOs have increased autonomy in comparison with the old AEBs, they do not yet operate as fully autonomous, government-owned corporations. This is indeed one of the objectives of the newly launched electric Power Sector Reform Program. Towards this end, the Government of Pakistan (GOP) recently dissolved the Boards of Directors of the DISCOs and is in the process of formulating how the new directors will be selected and appointed. Selection of experienced professionals who are able to govern the DISCOs with integrity and impartiality presents one of the principal challenges towards creating highly functioning electric distribution utilities. The DISCOs must operate as independent companies fully responsible for their business activities according to well established business principles. As wholly-owned GOP corporations, it is not possible to completely prohibit political impact on the governance and operation of the DISCOs, but political influence needs, nonetheless to be minimized to allow these companies to behave as profit-making public service corporations.

DISCO retail tariff petitions are presented to NEPRA for review, evaluation, and final approval. NEPRA is a federal regulatory agency tasked with licensing electric power generation, transmission, and distribution companies, as well as regulating quality of service and evaluation and approval of generation, transmission and distribution tariffs. While NEPRA has the statutory authority to approve tariffs, the MWP nonetheless controls the final tariff setting process by notifying the approved tariff to the DISCOs – essentially, the MWP concessionaires through a tariff approval process. Given that the GOP is highly sensitive to any upward tariff pressures, the MWP has not yet approved application of the full cost of service for the DISCOs, nor have they allowed any tariff differences among the various DISCOS, regardless of differences in customer mix.

As a result of the political sensitivity to application of full cost of service tariffs, several DISCOs show negative financial results and will not be financially viable until and unless the tariff structure is adjusted to allow for higher revenue collection. Recent increases in tariffs have resulted in limited improvement in the cash flow of some DISCOs, especially FESCO that has a much higher load density and energy sales

per km of the distribution network. Application of true cost of service, making profits for reinvestment and better employee and customer care remain amongst the principal challenges of the DISCOs.

Due in part to under-recovery of revenues, the DISCOs have failed to invest in distribution system upgrades; and suffer from overloaded and deteriorating feeders and distribution transformers, inadequate metering and outdated technology. Automated asset management has not yet been implemented at any DISCO. Preparation of expansion and rehabilitation projects by DISCO engineering departments is undertaken on an ad hoc basis, rather than as part of an integrated, annual planning process.

The organizational structure of the DISCOs is not conducive to smooth and effective utility operations. Their policies and procedures need to be realigned to address process inefficiencies, as well as to introduce checks and balances for data integrity and improved financial controls. Realigning the existing manpower to meet the future private sector utility operations will need to be directly addressed by each DISCO, but will likely take significant effort due to complications with unions and the need for significant change in organizational mentality. Bringing DISCO organizational and staffing structure in line with efficient and effective private sector utilities will be a great challenge.

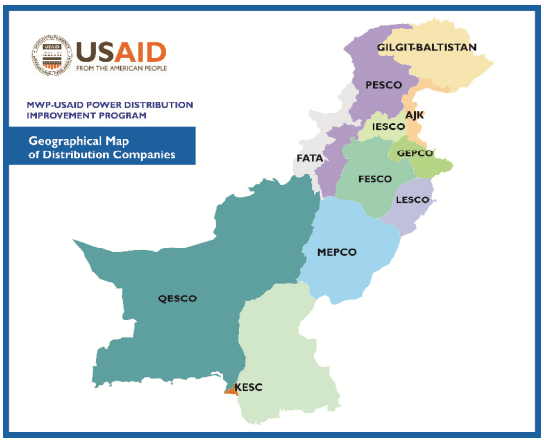
The relationships of the DISCOs to the MWP will, without question, need to be realigned. Ideally, the MWP should establish a Board appointment process that is objective, transparent, and non-politically aligned, and thereafter monitor DISCO financial health through an arm's-length monitoring process. NEPRA, through its regulatory role, will continue to monitor quality of service and tariff-setting in the normal fashion practiced by regulatory agencies throughout the world. DISCO performance should be the purview of DISCO management and its Board of Directors; these are the corporate agents responsible for efficient operation of electric utility operation in well-functioning electric power sector environments elsewhere, and this pattern would benefit Pakistan.

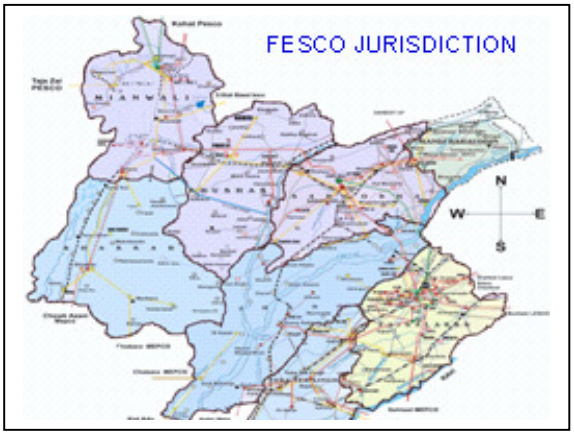
### 1.1.2 Purpose of Operational Audit and Improvement Action Plan

The objective of the FESCO Operational Audit was to evaluate the company's performance in engineering, finance, commercial and human resource functionality, as well as to gather and evaluate the baseline data and information that will be used to measure performance improvements in future years. With the goal of measuring the achievements under PDIP, the FESCO audit covered the managerial, operational, financial and customer service areas and identified opportunities and methodologies that will be used to reduce technical and commercial losses and improve network, organizational, financial and management and staff performance. The Operational Audit provides an objective foundation for FESCO's Performance Improvement Action Plan.

## 1.2 FESCO PROFILE

Faisalabad Electric Supply Company (FESCO) is a wholly-owned government distribution company with headquarters located Faisalabad, a major city in the northern part of the province of Punjab. FESCO has boundaries adjoining GEPCO in the north, LESCO in the east and MEPCO in the south. As Figure 1 below illustrates, FESCO territory us spread over about 36,122 sq. km and covers the districts of Faisalabad, Jhang, Chiniot, Bhakkar, T. T. Singh, Khushab and Sargodha, in all 8 districts.



FESCO's has 115 sub-divisions under 21 operational divisions and 4 Operation Circles. At an average about 5 sub-divisions are controlled by 1 division. .

**TABLE 1.1: FESCO CHARACTERISTICS**

| No | Description | Value |
|---|---|---|
| 1. | Administrative Districts Served | 8 |
| 2. | Service Area (km²) | 36,122 |
| 3. | Operation Circles | 4 |
| 4. | Operation Divisions | 21 |
| 5. | Operation Sub-divisions | 115 |

### 1.2.1 General description of market

As of 30th June 2010, FESCO reported over 2.8 million registered customers. Approximately 87% of these are domestic. The other predominant category is commercial. The industrial customers tally around than 1.4% of all customers served.

**TABLE 1.2: FESCO CUSTOMER DISTRIBUTION AS OF 30TH JUNE 2010**

| No. | Customer Class | Customers | Customer Mix % |
|---|---|---|---|
| 1 | Domestic | 2,504,756 | 87.00 |
| 2 | Commercial | 299,925 | 10.42 |
| 3 | Industrial | 39,510 | 1.37 |
| 4 | Single Point Supply | 195 | 0.01 |
| 5 | Tube wells | 33,347 | 1.16 |
| 6 | Other | 1,455 | 0.05 |
| | **Total** | **2,879,188** | **100.00** |

Source : PEPCO Report on DISCOs Performance Statistics for the year ended June 30, 2010

Reported sales by customer category vary widely from the distribution of consumers, however, with industrial sales at approximately 34% of total sales and 44% attributed to domestic consumers. From a revenue standpoint, industrial consumption is very important for FESCO's financial position. Table 1.3 provides a summary of sales by consumer category.

**TABLE 1.3: FESCO ANNUAL SALES AS OF 30TH JUNE, 2010**

| No. | Customer Class | Sales GWH | Proportion % |
|---|---|---|---|
| 1. | Domestic | 3,691 | 44.38 |
| 2. | Commercial | 472 | 5.68 |
| 3. | Industrial | 2,852 | 34.28 |
| 4. | Tube wells | 1,041 | 12.52 |
| 5. | Other | 261 | 3.14 |
| | **Total** | **8,317** | **100.00** |

Source : PEPCO Report on DISCOs Performance Statistics for the year ended June 30, 2010

### 1.2.2 Statistical summary, comparison with other DISCOs

The performance indicators for which statistical data was provided include total losses, unplanned outages, transformers' failure rate, new connections achieved and bills adjusted.

| TABLE 1.4: FESCO 2010 KEY PERFORMANCE INDICATORS | | |
|---|---|---|
| **No** | **Description** | **Value** |
| 1. | Transmission & Distribution Losses | 10.8% |
| 2. | Outages | |
| | Number of Outages | 42,972 |
| | Total Outage Time (hrs) | 6167 |
| | Hours per Outage | 0.144 |
| 3. | Transformer Failure (% MVA) | 2.9% |

FESCO has about 15% of the electric distribution market in Pakistan in terms of number of customers. Yet it retails about 13% of total energy sold in Pakistan and contribution to revenue collected is about 15%. The share of receivables of Government customers is negative indicating that the collection is slightly more than the receivables because of recovery of past arrears, whereas the share of receivables from private customers is about 5%, considerably lower than the share in the number of customers. FESCO's HT and LT network is about 13% and 12% of the total length of HT and LT lines, about the same as the share in number of customers. The transformer capacity is slightly higher than the share in number of customers. FESCO is responsible for about 18 % of the allocated load and 12% the total peak demand of all the DISCOs.

| TABLE 1.5: FESCO FY 2010 STATISTICS | | | |
|---|---|---|---|
| **Description** | **All DISCOS*** | **FESCO** | **Share (%)** |
| Customers | 19,582,224 | 2,879,188 | 14.70 |
| Sanctioned Load (MW) | 47,855 | 8,497 | 17.76 |
| Non-Coincident Peak Demand (MW) | 19,288 | 2,298 | 11.91 |
| Energy Sales (GWh) | 63,660 | 8,317 | 13.06 |
| Employees | 122,530 | 17,243 | 14.90 |
| **Revenue (Million Rs)** | | | |
| - Billed to Customers | 488,022 | 63,537 | 13.02 |
| - Collected from Customers | 517,055 | 61,657 | 11.92 |
| **Receivables from Customers** | | | |
| - Private | 103,351 | 5,676 | 5.49 |
| - Government | 58,026 | -121** | N/A |
| Total | 161,377 | 5,555 | 3.44 |
| **Distribution Network** | | | |
| - HT Line (km) | 279,990 | 35,541 | 12.69 |
| - LT Line (km) | 205,020 | 23,228 | 11.33 |
| - Dist Trans Capacity (MVA) | 32,524 | 4,670 | 14.36 |

Source: PEPCO Report on DISCOs Performance Statistics for Year ended June 30, 2010
*Nine DISCOs Including TESCO
** Includes recovery of past arrears from other periods.

Of the eight licensed DISCOs, FESCO is the third largest company in terms of customers, energy sales, allocated load, power demand, revenue billed and collected per km of medium voltage distribution line (HT line).

FESCO reports reasonably high collection rates and relatively low line losses. Within the confines of the Pakistan power sector, FESCO is a relatively high functioning electric distribution utility; it has been able to show a profit as measured by its ability to live within the means of the distribution margin allowed by NEPRA. In a larger sense, all eight DISCOs contribute to generating staggering losses from the commercialization of electric power, but this is due to the fact that the increasing cost of purchased power has not been passed on to the consumer due to a belief on the part of the Government that consumers are not able to pay the full cost of electric service.

Nonetheless, there are multiple opportunities for FESCO to achieve improved effectiveness and operational efficiencies. The purpose of this report is to explore FESCO's operating practices and procedures; to identify where the company should be able to make improvements in operating practices; and to document the specific policies, procedures and operational practices that will need to be improved to contribute to lower operating costs and enhance overall financial and technical performance.

## 1.3 OVERVIEW OF PDIP AUDIT METHODOLOGY

The PDIP operational audit process was designed to facilitate data collection and to evaluate functional performance in close collaboration with DISCO management. The approach adopted was to evaluate operating performance by analyzing business processes and practices and collecting information through one-on-one interviews with DISCO management and employees. The PDIP team not only collected operational data, but also reviewed and evaluated management practices and processes to gain insights that could not be gleaned from statistics alone. For example, a key business process for all electric distribution utilities is the commercial revenue cycle – the means by which meters are read, bills are processed and delivered, revenues are collected and delinquency notices are delivered.

The operational audit of FESCO followed a process similar to audits undertaken of the other seven DISCOs. The process collected and evaluated data for multiple areas of electric distribution operations, including:

- Governance
- Organization
- Engineering
- Financial
- Commercial
- Human Resources
- Communications and Outreach

Comparison of performance indices for FESCO with those of highly functioning electric distribution utilities outside Pakistan highlighted functional processes that require improvement, while consideration of available best practices allowed the PDIP team to identify high-impact performance interventions.

A complete and detailed description of the operational audit methodology followed is provided in the Appendix.

# 2. RESULTS

## 2.1 GOVERNANCE

### 2.1.1 Overview

The PDIP team evaluated the structure and activities of the Board of Directors of FESCO to understand exactly how the Board was configured and what level of authority it possessed. Key findings and analysis of that review are contained in this section of the report. However, on November 22, 2010, all DISCO Boards were dissolved by order of the MWP, so many of the PDIP observations are no longer germane. Nevertheless, in the interests of identifying potential improvement opportunities, findings of the review will be presented here regardless.

### 2.1.2 Summary of Key Findings

The following are key findings of the PDIP review of LESCO's corporate governance:

- FESCO's Board has not yet completely fulfilled its governance responsibilities, lacking the expertise and authority to meet challenges facing the company in the changing Pakistani power sector. Board powers are limited and it is unclear whether it has the ability to tackle major issues or oversee strategic change.

- The CEO has concurrently served as a member of the Audit Committee of the Board, a conflict of interest.

- There has been no financial expert either on the Audit Committee or on the Board itself, casting doubt on the Board's ability to lead FESCO toward financial self-sustainability.

- A review of Board minutes indicates that matters considered are largely routine and shows little evidence of what might be called strategic issues being taken up by the Board.

- Declaring its intention to reduce the influence of the government in DISCO governance and move these utilities towards greater operating independence, the MWP recently dissolved the FESCO Board, appointing a new Board in its place.

- While the new Board appears to provide a better mix of professionals and stakeholders, appointment of the Joint Secretary, (Power) from the [Power] MWP to its membership is unlikely to advance the stated goal of ensuring autonomy of the Board, high professional standards or greater operating independence.

### 2.1.3 Analysis and Discussion

The Board of Directors of each DISCO is governed by the Memorandum & Articles of Association, a document reflecting provisions described in the Companies Ordinance of 1984, as amended. The FESCO BOD consisted of seven members, including the CEO. Because the company is wholly owned by the government, MWP appoints all public directors and PEPCO appoints all private directors according to a formula as follows:

- Four members from the public sector, including the CEO of the utility.
- Three members from the private sector, of which one will be the Chairman.

The Memorandum and Articles of Association require two meetings each fiscal year with other meetings held at the discretion of the BOD. One of the required meetings is a statutory meeting convened after the end of the fiscal year to review and approve various items, including the state of affairs of the DISCO. This meeting is preparatory in nature to orient board members towards the annual general meeting of shareholders and must take place within four months after the end of the fiscal year. The Board has not

developed any of its own policies specific to the governance of an electric utility in general, nor to FESCO in particular, relying on the requirements of the Companies Ordinance 1984 and the Articles of Association of FESCO.

The FESCO BOD has chosen to voluntarily govern itself, informally, under the Code of Corporate Governance, a set of governing standards for listed companies. These standards are more stringent and as a result the Board meets on a monthly basis to ensure that "important Company business can be reviewed and executed in a timely fashion, as well as to keep up to date with important issues pertaining to FESCO operation". Review of the board minutes indicates that matters considered are largely routine however, pertaining to approvals of procurements and other mundane matters, and that there is little consideration of what might be called strategic issues, which are precisely the topics for BOD discussion.

In reality, BOD powers are limited and it is uncertain as to how well the Board could cope with a requirement to consider strategic issues. For example:

- The appointment and evaluation of the performance of the Chief Executive Officer is perhaps the single most important BOD function in most corporations, but the CEO of FESCO is appointed by PEPCO, and a member of the BOD.
- Similarly, the entire senior executive cadre of the company is appointed by PEPCO rather than being selected or recruited
- Board members nominated from government agencies were senior in position, and therefore senior in chronologic age resulting in short board tenures and high turnover.

In an effort to understand the powers the BOD actually has, the Book of Financial Powers (BFP) was reviewed and discussed with the Secretary of the Board. The BFP is a governing document and was approved by the BOD in October 2002. It establishes various approval authorities and monetary limits for financial transactions and certain other actions taken by FESCO's management and BOD in the operations of day-to-day activities. The current approval authorities and monetary limits are inconsistent with an effective and efficient oversight of the DISCO's operations. The BFP should be reviewed and the necessary changes made to allow for a more effective and efficient operational oversight and governance. Any changes should be made with regards to maintaining high corporate governance and internal control standards. It was the conclusion of the PDIP team that the FESCO BOD had relatively little authority over the management of FESCO and could not be considered a true corporate board.

As noted, in a notification from the Ministry of Water and Power (MWP) dated 22 November 2010 all DISCOs, GENCOs, and NTDC BODs were released from service on the DISCO boards. The order stated the intention to reconstitute the BODs "on professional lines" in accordance with the guidelines of the Cabinet Committee on Reforms with special emphasis on representation from consumers. Significant effects of the change include that:

- The majority of directors must come from the private sector.
- Ministers/Secretaries/Government officials may not be nominated as Chairmen of the BODs.
- Representation from the administrative Ministry/Division on the BODs of the DISCO is restricted to one.

This is clearly an action intended to reduce the influence of Government in the governance of the DISCOs. The notification should be considered a definitive step towards establishing the DISCOs as more independent public corporations. To serve the DISCOs in a professional manner, the new Directors will require training to strengthen their understanding of the role and function of independent boards of directors, as well as training to understand the commercial and technical nature of electric distribution utilities. PEPCO had previously been involved in BOD governance primarily as a manpower transition planning authority for the CEO and senior management. In addition, PEPCO also acted as an authority on any proposed new positions at the DISCO. This was a role PEPCO assumed during a transition period after DISCO formation and never relinquished. The DISCOs must be enabled to manage their own manpower requirements.

## 2.2 ENGINEERING REVIEW AND ANALYSIS

### 2.2.1 Overview

The PDIP review of engineering operations considered four components—transmission system management; distribution system management; mapping and power flow analysis to determine technical and commercial losses; and distribution standards, as described in detail in the Appendix. This section provides the findings and analysis that resulted from this four-pronged engineering review.

### 2.2.2 Summary of Key Findings

**Transmission System Management**: The following are key findings of the PDIP review of FESCO's engineering operations in the area of transmission system management:

- **Network—F**ESCO's transmission network, while heavily loaded and in need of upgrading, is robust and appears to provide adequate service. It is unlikely to be a significant contributor to total system losses or a drag on overall financial performance; reported transmission losses were 1.4%, while modeled losses were 1.6%. The transmission system, while in need of some improvements, is adequately providing service while yielding acceptable loss levels.

- **Losses—** A preliminary estimate of transmission losses using estimated values and a simple model of the system yields a likely transmission loss of 1.6%, including loss in grid substation transformers. This confirms the value measured by FESCO and indicates that metering for the transmission system is adequate. There was no compelling evidence that transmission issues were contributing negatively to the financial performance of FESCO and it was decided early in the assessment to focus effort on distribution issues, which were clearly more demanding.

**Distribution System Management**: The PDIP review of distribution system management produced the following key findings:

- **Load forecasting—** FESCO prepares a five year load forecast, however the determination of growth percentages for the various customer classes is made by NTDC and communicated to the DISCO. FESCO engineering staff do not engage in efforts to collect load forecasting data, such as population growth, demographics or historical sales data. Data on sales by consumer class is supplied to NTDC, but the process is prescriptive once the growth factors have been received, that is the FESCO staff projects demand and energy requirements at the established growth rates, and then subdivides the resulting load among the various grid substations. The Chief Engineer Planning was aware of the need for adequate load forecasting as a local capability.

- **Feeder mapping**—Feeder mapping is not carried out on a systematic basis. Each operations subdivision has its own single line drawings of the feeders in its territory, but no geographic maps exist anywhere in the company.

- **Feeder analysis software—**The software used by FESCO for feeder analysis is obsolete and lacks many of the features found in contemporary distribution analysis software, such as direct input of Geographic Information System (GIS) mapping data, optimization of capacitor placement, analysis of looped systems, modeling of multiple feeders and graphical presentation of results.

- **National design standards—**Current national design standards do not address congested area construction very well, but this does not to be a significant problem for FESCO.

- **Construction quality**—There are no construction inspectors in the Project Division and projects are self-inspected. Each responsible foreman and line superintendent is supposed to inspect 100% of construction under his responsibility. This approach has the predictable effect of uneven quality of construction. Poles were found to be not properly plumb, transformer platforms not level and sags of conductors not even.

- **Work practices—**Construction and maintenance work practices in widespread use among FESCO employees are inconsistent, rely on makeshift and stopgap approaches and suffer from

lack of available equipment and transportation access. The consequences of these failures are profound—employee safety is routinely jeopardized; worker productivity is low; response to customer requests can be exceedingly slow; and equipment failures occur more frequently than necessary. All of these direct consequences have negative financial impacts for FESCO.

- **Safety**—Thirty-eight linesmen lost their lives while performing company work during the 2009-10 fiscal year. Without question, improved work practices and safety policies could reduce this number and alter perceptions among the workforce that distribution maintenance and repair work is too dangerous to perform.

- **Meter security**—Meter security was found to be compromised by both the ease with which meter installations can be tampered with and equally vulnerable service drops.

- **Procurement**—FESCO conducts a large number of procurements annually, often for relatively small dollar amounts. Materials are divided among 29 categories, although in reality only approximately 19 categories are commonly used. Each category has sub-classifications which may be separately procured, and solicitations for any given subclass are held twice a year resulting in a large number of bids. The largest tenders are for distribution transformers while the smallest are for hardware items. Also, procurement practices that are non-standard effectively preclude international companies from bidding, unnecessarily narrowing the competitive field and obviating potential savings.

**Distribution feeder mapping and loss segregation**: Here are key findings of the review of feeder mapping and segregation of technical versus commercial losses:

- Detailed modeling of distribution system losses (see Appendix for a full description of the estimation approach used) indicates that technical losses on FESCO's system should be approximately 7.1% of annual energy (kWh), the lowest among the Pakistani DISCOs according to the benchmark comparison.

- In contrast, FESCO reported total system energy losses of 10.8% in the 2009-10 fiscal year. If transmission losses were 1.1% as PDIP estimated, the distribution component of loss would be 9.7%. The difference between the distribution technical loss of 7.1% and a reported total distribution loss 9.7% is a non-technical (commercial) loss of 2.6%. This figure is likely to reflect large-scale meter tampering, illegal line taps and meter reading fraud aided and abetted by company employees.

### 2.2.3 Analysis and Discussion

FESCO is a utility with a total of 2.8 million consumers and almost 36,000 km of 11kV distribution line, 2,800km of 132kV and 66kV transmission and 92 grid substations. Peak demand for FY2009-10 was 2,300MW and purchases were 9,329 GWh, giving an annual load factor of 46%.

The engineering assessment of FESCO consisted of three components. The first is an evaluation of transmission issues. The transmission system at FESCO was not seen as a source of problems and therefore this segment of the evaluation was very limited. The second component is an evaluation of distribution system management resulting from a series of interviews with staff from the Planning and Design, Construction, Operations, and Procurement departments. During these interviews FESCO staff responded to the team's questions and provided insight into the technical operations of the utility. These interviews are inevitably colored by the attitudes of the interviewees, as well as the misunderstandings of the interviewers, and should be taken as indicative rather than absolute truth.

The third component consists of a mapping exercise and power flow assessment in which the team attempted to use a sampling technique to segregate distribution losses between technical and non-technical, and between the various components of technical loss. The team attempted to select 11kV feeders that were, in the aggregate representative of all FESCO's feeders and therefore indicative of the level of technical loss of the entire company. An even smaller subset of low voltage (LT) networks was surveyed in detail with the objective of identifying the contribution of LT systems to FESCO corporate technical losses.

### Transmission System Assessment

Initial visits indicated that the transmission system, while heavily loaded, and no doubt in need of improvement, was providing adequate service. FESCO has a transmission network totaling 2800km of 132kV and 66kV line, receiving power from NTDC at five locations. There are 92 grid substations, with only 14 of them serving the area around Faisalabad City. System peak demand is 2,298MW, a figure that is somewhat suppressed by load shedding. This is a robust transmission network, and while it probably has issues of its own, is not likely to be a significant contributor to system losses.

FESCO prepares a five year plan covering the requirements of the 132kV and 66kV transmission system, using PSS/E, a widely utilized power flow software, to model the system. Total expenditures for the transmission network (STG) amounted to RS 958 million, as opposed to 900 million for distribution improvements, a relatively balanced approach to both transmission and distribution.

Total system losses in FESCO during FY2009-10 were 10.9%, as published by NEPRA. A review of the data provided to the team on 11kV feeders indicates that distribution loss was 9.7%, leaving 1.2% for transmission loss. A preliminary estimate of transmission losses using estimated values and a simple model of the system yields a likely transmission loss of 1.6%, including loss in grid substation transformers. This confirms the value measured by FESCO and indicates that metering for the transmission system is adequate. There was no compelling evidence that transmission issues were contributing negatively to the financial performance of FESCO and it was decided early in the assessment to focus effort on distribution issues, which were clearly more demanding.

## 2.2.4 Distribution System Management Assessment

### Planning and Design

Planning and design of distribution lines are carried out in the same department under the direction of a Chief Engineer of Planning and Design-Distribution. This department is responsible for planning of expansion and improvements to the distribution system and for designing those improvements so that they can be constructed by the Project Department.

The planning environment at FESCO can best be described as evolving. Distribution planning has traditionally been carried out in response to identified problems, but efforts are underway to develop new systems and improve old ones with the goal of developing an integrated distribution plan. Comments on the various components of utility planning are as follows:

### Load Forecasting

FESCO prepares a five year load forecast, however the determination of growth percentages for the various customer classes is made by NTDC and communicated to the DISCO. FESCO engineering staff do not engage in efforts to collect load forecasting data, such as population growth, demographics, or historical sales data. Data on sales by consumer class is supplied to NTDC, but the process is prescriptive once the growth factors have been received, that is the FESCO staff projects demand and energy requirements at the established growth rates, and then subdivides the resulting load among the various grid substations. The Chief Engineer Planning was aware of the need for adequate load forecasting as a local capability.

### Mapping

The Chief Engineer Planning clearly understands the importance of system mapping as a planning tool and has instigated an effort to prepare distribution maps on a systematic basis. Unfortunately the process chosen is very laborious and the results are not as helpful as they might be. Distribution circuits are hand plotted on paper copies of Survey of Pakistan quadrangle maps and these hand copies are scanned and digitized into an Autocad system. The resulting maps are used as if they were paper to derive line lengths for system analysis. This system serves the purpose for which it was developed, and is consistent with the limitations of the feeder analysis software, which only accepts manual entry of line segment lengths. The system has been used to prepare an integrated plan for the installation of some new grid substations, so it is certainly useful to the utility.

For the same investment in effort, the development of a geographic information system (GIS) would provide considerably more capability. Ironically, FESCO has obtained three software licenses for ESRI ArcGIS software, but none of the mapping staff have been trained in its use. The mapping office has also been equipped with some very expensive equipment, such as a large scale plotter, so the implementation of a GIS would not require a great investment.

### System Analysis

The software used for distribution feeder analysis is called Feeder Analysis (shortened to FDRANA), and was developed during the 1980's under a USAID program. It operates in MS-DOS and is capable of analysis of a single feeder and its branches, producing a tabular output that assesses voltage drop and calculates losses both for demand and energy. The software can model capacitors and also functions as a work order generation tool, with a database that can produce a material list for new construction. Produced as it was by USAID, the software has no cost to the utility and any number of users can be accommodated. This can be a problem in that multiple persons may have different versions of the same feeder model, leading to confusion during analysis.

While certainly advanced for its time, the software is currently obsolete and lacking in many of the features found in contemporary distribution analysis software, such as direct input of GIS mapping data, optimization of capacitor placement, analysis of looped systems, modeling of multiple feeders and graphical presentation of results. The software is also extremely laborious to use, as all input is manual and any changes in the system configuration require the creation of a new case, somewhat inhibiting the incentive to do alternative evaluations. The limitations of the software make it difficult to do multi-feeder area planning and exploration of system alternatives that could result in sound distribution expansion, operation and maintenance.

The transmission department of FESCO, in common with that of other DISCOS, has a license for PSS/E, the software produced by Power Technologies Incorporated and widely used in the US for transmission system analysis. Some consideration was given to using PSS/E for distribution planning, but this was abandoned due to the complexity of the software and lack of resources to renew software licenses. What is needed is an intermediate solution that addresses the shortcomings of FDRANA while still being simple to use and low in cost.

### Design

Design of distribution facilities is governed by standards published by the former WAPDA in the 1960's. These standards are based on HT lines with bare ACSR conductors serving relatively large (100 and 200kVA) transformers installed on overhead platforms which in turn serve three phase low voltage networks using bare aluminum conductors. In the case of FESCO, many customers have paid for installation of dedicated transformers ranging in size from 25kVA to 630kVA. In the vast majority of cases these dedicated transformers are installed in the same fashion as the public use transformers, i.e. on overhead platforms.

The only significant alterations in these standards since they were established have been the introduction of concrete poles. Prestressed reinforced concrete poles were initially approved, but design is moving toward centrifuged poles due to their higher strength and the resulting ability to carry three circuits. An additional change has been the adoption in the 1980's of the Osprey (556MCM 18/1) conductor for 11kV circuits with heavy electrical loading. Osprey has a current carrying capacity of 700 amps (13MVA) so should provide considerable capacity. In actuality, the majority of FESCO's switchgear is limited to 400 amps per phase by the current transformers in the breakers, hence the need to consider circuit adjustment at 300amps. This limitation severely limits the usefulness of the Osprey conductor.

The FESCO system is not significantly congested, and the national design standards adequately address the challenges they face. Therefore the Chief Engineer Planning did not consider it a high priority to seek changes to the standards. One area which FESCO has not pursued and which could have an effect on their operations is the use of multiplex or aerial bundled conductor (ABC) LT line. While there are no congested areas in which covered LT would be required, it could be of use to reduce the possibility of unauthorized hooking or "kunda connections".

## Construction

The mission of the Project Department at FESCO is, as stated by the Director, that of execution. He emphasized that his Department does not do any design or procurement but that it is responsible for construction of all distribution facilities in the FESCO service area. The projects undertaken by the Project Department fall into three categories:

- Projects funded from FESCO's budget for distribution upgrading and loss reduction
- Projects for the Power Distribution Enhancement Investment Program funded by the Asian Development Bank (mainly meter upgrades)
- Deposit work paid for by others, such as line relocation required by road widening and village electrification

Village electrification, which amounts to approximately 20% of FESCO's construction activity, is considered deposit work due to the way in which it is carried out. There is no village electrification master plan, so the annual budget does not contain any expenditure for this purpose. Rather, a member of the national assembly identifies an area that he/she wants to be electrified, and obtains the funding from the national or local government for the project. According to the rules governing these sorts of projects, FESCO can include in the budget for a village electrification project only those amounts that are necessary to construct the necessary line extension. There is no planning study to determine what effects the proposed extension will have on the backbone system, or even whether voltage service will be adequate once the service is constructed. These problems are all left for the DISCO to correct or accommodate during the operational phase. Members of the national assembly, depending on their influence or relationship with the governing party, have allocations they can use to demand construction of projects.

Projects come to the Project Department pre-designed and with a material list from the Planning and Design department. The Project Department examines the locale of the project and prepares its own material list for drawing on stores. In many cases, according to staff, the total material requirements for a particular project are not available in stores, sometimes missing only a single class of item (bolts, or D-irons, for example), which then requires a delay in construction.

The Project Department constructs all projects with its own work force, with the exception of the setting of concrete poles which is contracted out. The Division is self inspecting, i.e. there are no construction inspectors as such. Each responsible foreman and line superintendent is supposed to inspect 100% of the construction, with higher level officers required to inspect declining amounts of the work.

A field inspection of the FESCO system by the PDIP engineering team indicated that the work was generally well done but lacking in specific items. In particular, even though most of the older installations used connectors, none of the newer projects did. On new projects connections were wrapped or served, and full tension conductor splices did not use joining sleeves but were served as well. The use of served connections will certainly contribute to overheating in the future.

The Project Director for Construction indicated that it was also difficult to keep linesmen in the Construction Division. As soon as they attained their certifications as linemen, they would try to transfer to the Operations Division where the work is less strenuous. The Director cited instances in which political influence, even extending upto Ministry level, was used to pressure the reassignment of linemen from the construction to operations divisions.

## Operations and Maintenance

The fundamental organizational unit for operations at FESCO is the subdivision, of which there are 115 in the company, each serving approximately 25,000 consumers. Operations subdivisions are defined geographically by feeder service areas and are grouped into divisions with approximately five subdivisions per division for a total of 21 operations divisions. Divisions are grouped into circles with approximately five divisions per circle. FESCO has a total of four operations circles. In addition to the operations subdivisions there are other subdivisions for Meters and Testing as well as for construction.

The principle activities of subdivision staff are as follows:

- Continuity of supply, or repair of system failures.
- Meter reading.
- New connections, but only for direct reading meters. All indirect reading meters (with current transformers) are installed by the Meter and Testing Department.
- Disconnection of defaulters for non-payment of bills.
- Line maintenance, including line patrol and rectification of problems, as well as measurement of transformer loading.

Each subdivision typically has approximately 70 staff, of whom roughly 60% are assistant linemen, linemen, or line supervisors, 15% are meter readers and bill delivery staff, 5-10% are complaint center staff, and the remainder are managers or other support staff. It was stated that only about half of the linemen could be depended upon to carry out climbing duties due to age, infirmities and overweight, although this could not be verified.

Each subdivision has a complaint center to receive and log complaints, and at least one lineman per shift to respond to them. The complaint centers receive complaints either in person or by telephone and record the complaint in rough form on notepaper, transferring the information later to a ledger.

In the subdivision complaint center visited by the PDIP team the lineman on call was waiting in the complaint center to be dispatched. His tools were inspected and found to consist of a hard hat, leather and rubber gloves, a climbing belt, and a collection of hand tools such as pliers and screwdrivers in a small bag. All items were heavily used and the hand tools were in very poor condition, with taped handles, and dulled and notched cutting edges. The rubber gloves were for use up to 600V only, but were intact, without punctures or tears. The leather gloves were in very poor condition with holes and wear. If the rubber gloves were actually being used under the leather gloves it is difficult to see how they could be kept in good working condition, so either the rubber gloves are replaced frequently or they are actually not used very often. The latter is more likely.

In addition to the hand tools, the complaint center had some larger tools, including a grounding set, fiberglass ladders and various switch sticks and tree trimming hooks. The grounding sets were of a design that simply hangs on the conductor rather than being clamped to it, and would not be considered adequate for personnel protection. The grounding set inspected had failed at the joint between the three leads and been repaired by wrapping the joint with aluminum wire. The ladders were fiberglass, of high quality, and in relatively good condition. The switch sticks were generally made with bamboo handles or with pieced together fiberglass handles. Neither type of handle had a surface finish that would be considered adequate for use on high voltage lines. All of the switch sticks and ladders were stored in ways and places that exposed them to damage from other items lying against them. The tree trimming hooks were dull and unlikely to be of any use whatsoever. The subdivision building was very cramped and in poor condition, and the stores area full mainly of junk such as broken insulators, recovered wire and hardware etc. No doubt some of these items were to be reused to restore service, but there was little new material to be seen.

The subdivision had one or two light vehicles for general transportation, though it was stated that the complaint center lineman and the meter readers used their own motorcycles to transport themselves, or walked. The division office has heavier trucks for transporting transformers and a crane for setting them. Given the shortage of transport, it is understandable that the trouble center lineman carries only his hand tools when called out. If more extensive work is involved than can be attended to by one man with a pair of pliers, it is necessary to program the work and utilize more personnel. It would be under these circumstances that the heavier tools, ladders, grounding sets etc. would be used.

There are two components to the line maintenance activity as practiced in the subdivisions: line patrol/rectification; and transformer load measurement and balancing. Line patrol is carried out generally during the winter months, as summer seems to be taken up with continuity of service problems resulting from the generally higher loads and temperatures occurring at that time.

The line patrol reports were examined and found to list mainly problems with high and low voltage jumpers, loose or excessively sagging conductors, and requirements for tree trimming. Correction of these issues do not require any significant amount of material and are carried out during the winter months also, as soon as the patrol reports are transcribed and work is planned. In the subdivision visited, the patrol register and the work accomplished register were examined and found to correspond, that is that problems reported on the patrol report could be located in the work performed register. There was no evidence that the registers had been falsified, so it appeared that the work had actually been done.

A second maintenance objective of the subdivision is to keep up a log of measurements of loading of transformers, and to periodically rebalance the loads so as to make the full capacity of the transformer available. Transformer load measurements are to be taken twice yearly and recorded in a ledger. Examination of the ledger in the subdivision office visited indicated that recording of loads had been done for all the transformers in the subdivision on a regular basis and that transformer balancing had in fact been carried out as required by the rules.

The issue of lineman safety was discussed with division and subdivision staff visited. FESCO suffered a total of 38 fatal lineman accidents during the 2009-10 fiscal year. FESCO has about 2000 climbing linemen (classes LM-I and LM-II), not including assistant linemen (ALM) who are not allowed to climb poles, and line supervisors. A fatality rate of 38 per year corresponds to one fatality for every 54 climbing linemen. This is a very high fatality rate and denotes a serious problem with safety.

The approximate distribution of causes was reported to be 20% due to electrocutions and 80% due to falls, and most accidents were blamed by management on failure of the linemen to use available protective equipment. In some cases electrocutions were reportedly caused by backfeeds to the low voltage network combined with failure to install earthing sets.

Given the high level of lineman fatalities, FESCO is having difficulty convincing assistant linemen to transition to full climbing linemen, and it is true that most of the linemen observed by the engineering team to be climbing poles were senior.

The engineering team observes that issues affecting lineman safety in electric utilities are not unique to FESCO and usually fall into one of the following categories:

- Personal protective equipment that is either inadequate for the purpose, or difficult or unpleasant to use. The climbing belts and grounding sets used by FESCO fall into this category. The belts are too narrow and uncomfortable to lean into for any length of time, and the grounding sets are of a design that is completely inadequate for preventing electrocution.

- Shortages of personal protective equipment are such that jobs are attempted even in the absence of equipment. This may be an issue in accidents involving trouble call linemen, as they cannot carry all the necessary equipment with them due to a lack of transport.

- Construction standards do not consider maintenance requirements and do not provide adequate clearances for linemen to work or climb near energized conductors. This should generally not be an issue in FESCO as WAPDA standards are adequately complied with.

- Inadequate tools for cutting, lifting and pulling, requiring linemen to exert force- either pulling or pushing- that can result in injury if the load shifts unexpectedly.

- Poor tagging and clearance practices. It was reported that some line work is done during load shedding outages, without proper work permits preventing lines from being reenergized..

- Inadequate training in safety practices at lineman training schools. This needs further evaluation.

- Pressure from supervisors to sidestep safety procedures in order to complete work. This was reported by FESCO staff but needs further examination.

- Poor work planning procedures that do not consider safety as a goal of each project.

- Failure to maintain an environment in which safety is emphasized on a daily basis as part of the work schedule.
- Lack of sanctions against staff that knowingly violates safety procedures and by its example encourage others to do so.

Most of these issues are within the control of management, they have solutions, and should be addressed in the near future.

### Meter Security

FESCO has not undertaken a large scale campaign to replace electromechanical meters with electronic units, and approximately 90% of meters remain electromechanical. This means that meter vulnerabilities at FESCO are the same as they have always been and that attempts may continue by the consumers to disable meters by tilting, dirtying or otherwise stopping the meter disc. Moreover, these meters are vulnerable to gradual loss of accuracy over time as meters become dirty or are exposed to other hazards. A problem common to both new and old meters is the unauthorized access to meter bottom connections, a perennial risk with A-base meters.

FESCO's generally low level of losses indicates that these vulnerabilities are not a major issue, and observation indicated that most meters were properly attached to the building or bracket and were upright and relatively clean. Bottom connections on the meters were not covered or sealed however, and FESCO does not have a meter checking & testing program, so older meters are likely to be slow. The inspection of the meter fleet indicates that meters are generally not secure and still constitute some vulnerability for FESCO.

### Procurement

Procurement is carried out by the Procurement Department. The Department prepares a procurement budget based upon the averages of material issues during the previous three years, taking into account requests from the Operations Department, and controlled by the available funds. In addition, the budget for new material is developed on the basis of available stock in stores.

Materials are divided among 29 categories according to a legacy WAPDA classification list, although in reality, only approximately 19 categories are commonly used. However, each category has sub-classifications which may be separately procured, and solicitations for any given subclass are requested twice a year. The result is a large number of solicitations. The largest tenders are for distribution transformers while the smallest are for hardware items.

Most suppliers for items produced in Pakistan are Pakistani sourced. Although there is no prohibition against foreign suppliers, all suppliers must be prequalified and the process of prequalification, the small size of the procurements, and in some cases the existence of special requirements tends to limit the interest of foreign vendors. For instance, transformers must be warranted against all hazards whether related to workmanship and materials or not, and damaged units must be replaced rather than credited. This is not a standard international commercial practice and has been accepted only by Pakistani vendors. Procurements for projects funded with donor funds (World Bank, Asian Development Bank etc.) follow different procedures and are handled by the respective project management units.

The Procurement Department is responsible for management of the central warehouse as well as for procurement, but materials pass from the direct control of the Department to the Operations Department when they are transferred from central stores to warehouses associated with the operations circles. Once materials are transferred to a circle storehouse, they are generally not available for use in other circles even though a subdivision in a different circle may have needs that cannot be met by the relevant circle storehouse.

## 2.2.5 Distribution Feeder Mapping and Loss Segregation Analysis

As discussed in the Methodology section, the segregation of technical and non–technical losses for the FESCO distribution system will be based on power flow models of a sample of FESCO feeders. The process calls for selection of feeders on the basis of a consistent sampling method, mapping the feeders

using a simplified geographic information system (GIS) tool, collection of feeder peak load and power factor data from substation feeder metering and modeling of the feeders using power flow software.

The intent of the exercise is that the technical losses as determined from this process will then be a valid proxy for the technical losses of the entire system. The difference between the total distribution losses and the technical losses so determined can then be presumed to represent non-technical (administrative and commercial) losses. Further, the power flow model will allow segregation of technical loss between 11kV lines, distribution transformers, LT networks and service drops.

### Selection of Feeders

According to data provided during its annual business plan presentation in October 2010, FESCO has 758 - 11kV feeders, totaling 35,543km of line. Average feeder length is approximately 47km. There are however many feeders both considerably longer and shorter than this value, with different combinations of consumer load types. Clearly, in order to select a sample of feeders that is representative of the utility feeder population as a whole, it will be necessary to employ a sampling technique with specific criteria. The sampling criteria chosen were as follows:

- Average feeder length of sample population should be close to the average feeder length of the overall feeder population.
- Distribution of sales in kWh/year between domestic, commercial, industrial, agricultural and other consumers for the population of sample feeders should be close to that of the overall FESCO feeder population.
- The proportion of rural and urban consumers in the sample feeders should be similar to that in the system as a whole.
- The sample feeders should have complete data, including total sales and feeder input data, and total length. Feeders with data anomalies would be excluded.

Data was obtained from FESCO on the entire feeder database. Because FESCO's customer information system links customers to the feeder that serves them, it is possible to obtain data on sales by feeder and this was also requested. FESCO feeders are classified as to whether they are urban (U), rural (R), industrial (I), or dedicated (D) to a single consumer. Issues with the data provided are summarized below:

- FESCO provided data on a total of 860 feeders, however 15 of these had sales of zero for FY2010. This means that there are a total 845 active feeders
- A total of 160 feeders showed losses of 0% or less and 25 showed losses in excess of 40%.
- 260 feeders did not have classifications and those that did were qualified with a total of 12 classifications, so it will not be possible to disaggregate urban and rural feeders for the sample.
- A total of 341 feeders lacked data on length.

The anomalies in the data appear to be due to a slow process for updating feeder information. Feeders that show either negative losses or excessive losses have probably been adjusted in coverage and the changes not reflected in the customer information system.

After excluding feeders with anomalous or missing data, a selection was made using a random number system and tested against the criteria. A total of four feeders emanating from four grid substations were chosen for mapping. A comparison of the characteristics and sales proportions of the selected feeders, compared with the length and sales characteristics of the system is given in Table 2.1 below.

**TABLE 2.1 CHARACTERISTICS OF RANDOMLY SELECTED FEEDERS**

| Feeder | Length | Demand | Sales MWh | | | | |
|---|---|---|---|---|---|---|---|
| NAME | KM | AMPS | DOMESTIC | COMMERCIAL | INDUSTRIAL | AGRICULTURAL | OTHER |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Farooqabad | 10 | 330 | 8502 | 2,013 | 3,450 | 1 | 6 |
| Gullab | 16.6 | 240 | 2,296 | 223 | 22,941 | 8 | 0 |
| Amin Pur | 70.0 | 290 | 11,215 | 433 | 1,458 | 4,166 | 0 |
| Al-Barkat | 100.0 | 345 | 12,422 | 323 | 1,551 | 226 | 0 |
| Sample Average | 49.2 | | 48.3% | 4.2% | 41.3% | 6.2% | 0.0% |
| **FESCO Average** | **46.9** | | **45.7%** | **5.8%** | **35.3%** | **12.9%** | **0.2%** |

The table shows the sales breakdown for the sample of feeders chosen for mapping. The length of the feeders chosen for mapping averages 49.2km, compared with an average length of 46.9km for the system as a whole. The sales breakdown between consumer types for the sample urban feeders is very close to that of the system as a whole.

### Mapping and Modeling of Feeders and LT Networks

The feeders were all mapped using a rapid GIS technique that identifies only corner and intersection poles and poles with equipment installed on them. Observable data such as conductor size, transformer capacity and transformer status, whether general service or dedicated, was noted manually and transferred to an attribute database. Once the circuit was mapped, the information was transferred to a Milsoft Windmil model. Milsoft Windmil is a standard distribution analysis software used widely in the US and Latin America. Windmil can model single or three phase loads, 60Hz or 50Hz systems, and accepts user information on all conductors and transformer characteristics not in the default database.

The majority of the conductors used at 11kV by FESCO are Osprey and Dog, with some Panther and Rabbit, all of which are ACSR conductors. LT conductors are mainly Wasp and Ant, which are all aluminum conductors. Characteristics for these conductors were obtained from tables and incorporated into the database. Similarly, FESCO specifies transformers with maximum allowable levels of losses, a legacy of WAPDA procurement practices. The maximum allowable levels of loss have recently been changed, but none of the new units have been supplied yet. Transformer characteristics used in the model therefore correspond to legacy FESCO transformer values of no-load and load losses, as shown in Table 2.2 below.

**TABLE 2.2. TRANSFORMER CHARACTERISTICS**

| KVA Rating | 10 | 15 | 25 | 50 | 100 | 200 | 400 | 630 |
|---|---|---|---|---|---|---|---|---|
| Impedance | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% |
| Core Loss (W) | 65 | 85 | 123 | 175 | 310 | 495 | 925 | 1350 |
| Load Loss (W) | 320 | 435 | 640 | 1170 | 2020 | 3410 | 5600 | 8150 |

It should be noted that these are the values specified in the WAPDA transformer specification DDS-84 for prototype transformers. The standard allows a +15% tolerance in the individual no-load and load loss values of individual production units and a +10% tolerance in total losses. No attempt was made to incorporate these tolerances into the model, so it is likely that transformer losses are in reality slightly higher than those indicated.

While Milsoft can accept data on location linked consumer loading, the time available for this project did not permit data on actual loading to be used in the model. Instead, the feeder peak load was obtained from substation records and this known load was allocated among the various transformers on the basis of transformer capacity, i.e. a transformer of 200kVA was allocated twice as much of the actual feeder demand as a 100kVA transformer.

Another matter to be decided was the level of power factor to be used in the model. Substation meters record kWh and kVARh, from which power factor could be calculated, however only circuit amperes and

kWh readings are actually recorded by the substation operators. The engineering team obtained station log sheets from the period around the feeder summer peak. Estimated average hourly power factor was computed by calculating kVA using logged amperes and an assumed bus voltage of 11.5kV and the differences between the hourly kWh meter readings to estimate kW. The result of this calculation is presented in Table 2.3 below for the sample feeders.

**TABLE 2.3. FEEDER LOAD FACTORS.**

| Feeder | Power Factor at Max Load (%) | Power Factor at Min Load (%) |
|---|---|---|
| Farooqabad | 73% | 71% |
| Gullab | 94% | 100% |
| Amin Pur | 82% | 64% |
| Al-Barkat | 100% | 100% |

It is apparent that power factor for some of the feeders is as low as 72%, while for others it approaches 100%. The preparation of the data indicated that the method used to determine power factor was not entirely satisfactory, probably due to variations resulting from manual reading of the substation meters. Rather than generalize as to what may be an exceptional value for power factor, and due to the small sample, it was decided to use 80% as the power factor for all feeders in the analysis.

Once the model, loading and power factor are established the feeder power flow analysis can be carried out. Table 2.4 below shows the results, disaggregated by line (conductor) loss, and transformer no load and load loss.

**TABLE 2.4 FEEDER CHARACTERISTICS AND TRANSFORMER LOSS ESTIMATES.**

| Feeder | Length KM | Peak Demand kW | Line Loss kW | Transformer Loss | |
|---|---|---|---|---|---|
| | | | | No-Load kW | Load Loss kW |
| Farooqabad | 10.1 | 4,590 | 135.2 | 37.8 | 49.7 |
| Gullab | 16.6 | 4,298 | 79.8 | 30.1 | 32.0 |
| Amin Pur | 70 | 4,531 | 274.0 | 47.3 | 47.5 |
| Al-Barkat | 100 | 6,573 | 795.1 | 34.4 | 76.2 |

While these results assess the line and transformer losses of the feeders, it is necessary to evaluate the losses of the LT networks and the service drops to obtain a complete picture. Because the number of LT networks on any of the feeders is substantial, it was necessary to carry out a sample survey. A total of five LT networks was mapped and modeled. The process of mapping differed from that used for the 11kV feeders in that for the LT networks, the mapping included a consumer census of all the consumers fed by the network. In addition, a meter reader accompanied the survey team, carrying with him the meter read route book from June 2010, the month of assumed peak demand. It was therefore possible to obtain and record in the GIS database for the LT network the metered consumption for each consumer.

Since the majority of the consumers located on the LT networks are billed by kWH consumption only, it was necessary to convert the kWH data to demand (kW) for modeling. As no measurements of actual demand were available, it was necessary to estimate demand using only the average energy consumption of the consumers. In order to determine the peak demand in kW likely from consumers on each LT network during the month of June, the data on consumption was applied to the demand equation below. This equation was derived many years ago by the Rural Electrification Administration (REA) in the United States, and has been verified by NRECA as acceptably accurate for use in developing countries as well. The equation is as follows:

$$D = N*(1-0.4N+(N^2+40)^{0.5})\ 0.005925*C^{0.885}$$

Where:

D= Monthly peak demand in kW for a particular group of consumers
N= Number of consumers in the group
C= Average monthly consumption per consumer in kWh/mo.

The demand value calculated by the equation was applied as the source demand for the particular LT network, at the power factor of resulting from the HT model, and the demand allocated to the segments of the LT network in proportion to the kWh of the consumers connected to that segment. The result is shown in Table 2.5 below.

**TABLE 2.5 FEEDER LOSS CALCULATIONS.**

| Feeder Name | U/R | LT Length | Transformer Size | LT Source Load | Total Losses | | |
|---|---|---|---|---|---|---|---|
| | | KM | kVA | kW | kW | (%) | W/kVA |
| Farooqabad | U | 0.31 | 100 | 114 | 2.467 | 2.2% | 24.7 |
| Gullab | U | 1.34 | 100 | 58 | 0.62 | 1.1% | 6.2 |
| | | | | Average Urban | | 1.8% | 15.4 |
| Al-Barkat | | 0.908 | 100 | 37 | 1.158 | 3.1% | 11.6 |
| | R | 1.55 | 200 | 116 | 2.044 | 1.8% | 10.2 |
| | | 0.895 | 100 | 52 | 0.648 | 1.2% | 6.5 |
| | | | | Average Rural | | 1.9% | 9.6 |
| | | | | **Average All LT** | | **1.8%** | **11.6** |

The results of the LT analysis show that LT losses vary from 1.1% to 3.1% of the power delivered by the transformer. Average loss for the LT network is 1.8%. The lengths of both urban and rural LT networks were in the order of 1000 meters per transformer, although one of those sampled was only 300 meters. Loading for this group of transformers varied from loads of no more than 37% of capacity to 114% of capacity. Of the transformers chosen, only the one overloaded transformer exceeded 60% of its capacity in June 2010. No attempt was made to assess balance, but it is clear that only relatively few of FESCO's transformers are likely to be overloaded.

For purposes of this analysis, it is necessary to generalize these results so that they can be applied to all general use transformers on all the modeled feeders, so as to obtain a value for LT losses. A value of average loss of 11.6 watts per kVA of general use transformer capacity was developed. As can be seen, there is considerable variation in the value of this parameter from one transformer sector to another for the urban transformers, and more uniformity for the rural transformers.

### Service Drop Loss

Service drop losses were calculated on the basis of the assumption that most domestic sales used single phase meters, while all commercial and direct reading industrial sales used three phase meters. At some time in the past, an effort was made to move meters to the base of the pole as opposed to being mounted on the exterior of the residence. This had the effect of shortening the effective length of the service drop from the utility's standpoint to something less than 10 meters. Examination of the system indicates that this process has not been completed in many urban areas, and the meters are still located on the exterior of the buildings. For this reason, the average service drop length has been assumed to be 12 meters. Table 2.6 below illustrates the assumptions for the three types of consumer.

| TABLE 2.6 CHARACTERISTICS OF SERVICE CONDUCTOR | | | | |
|---|---|---|---|---|
| Consumer Type | Service Wire | Cores | Service Type | Length M |
| Domestic | 7 x 0.052 | Two | 1 Ph | 12 |
| Commercial | 7 x 0.052 | Four | 3 Ph | 12 |
| Industrial | 19 x 0.052 | Four | 3 Ph | 12 |
| Agricultural | 19 x 0.083 | Four | 3 Ph | 12 |

Average service loading was determined using the REA equation described above to calculate the total demand of the consumers of each class on each of the modeled feeders. Knowing the number of consumers of each type on the feeder allowed for an average demand per consumer to be calculated. Three phase loads were assumed to be balanced.

### Loss Summary and Segregation Analysis

Once the components of demand loss have been calculated, it is necessary to convert the values derived from demand loss on peak to average energy loss. Because losses are a function of the square of load, it is necessary to account for the variation in load during the course of a year. The standard way in which this is handled is to determine a loss load factor based on the annual load factor of the system. The standard form of this equation is

$$LLF = K*(ALF)^2 + (1-K)*(ALF)$$

Where:

LLF= Loss Load Factor, or the load factor of the on-peak losses
ALF= Average annual load factor for the element under consideration.
K= A constant <1.0 such that loss load factor approximates the results of an analysis of loss curve shape for the system in question. Most common values of K range from 0.7 to 0.9.

The PDIP team used substation log sheet data to estimate the shape of the loss curve for the sample feeders in the FESCO system. A value of K of 0.84 was found to provide the closest match for the loss curve of the sample feeders. The resulting loss load factor equation is therefore:

$$LLF = 0.84*(ALF)^2 + 0.16*(ALF)$$

Annual load factor was computed for each feeder on the basis of the data supplied by FESCO and the loss load factor calculated according to the given equation. The same feeder loss load factor was applied to all components of loss. The results for the sampled feeders are shown in Table 2.7 below.

| TABLE 2.7 RESULTS OF SAMPLED FEEDER LINE LOSS ANALYSIS. | | | | | |
|---|---|---|---|---|---|
| Feeder Type | Conductor Loss % | Transformer Loss % | LT Network Loss % | Service Drop Loss % | Annual Energy Loss % |
| Total Sample | 3.67% | 2.1% | 1.0% | 0.4% | 7.1% |

Because the sample was chosen to be representative of FESCO as a whole, the interpretation of this result is that the technical losses of the FESCO distribution system are in the range of 7.1%. As noted above, the company had actual distribution system losses of 9.5% in the 2009-10 fiscal year. The difference between the distribution technical loss of 7.1% and the total distribution loss 9.5% is a non-technical loss of 2.4%. This is a relatively small proportion of non-technical loss, especially given the manual systems in place, and is a tribute to FESCO management.

## Validation

FESCO, in its report to the Ministry of Water and Power of October 2010, reported technical losses of 7.9% and non technical losses of 1.7%. This is only slightly at variance with the results presented here, but nonetheless it was decided to carry out an independent evaluation using a benchmarking technique developed for electric systems in the rural US. Studies conducted by the Rural Utilities Service, the financing and monitoring arm of the US rural electric program, have determined that for systems using conductors and voltages typical of good engineering practice, distribution system loss is a complex function mainly of sales density, that is MWH sales per km of line. The equation developed based upon that parameter is as follows:

L= (-1.8458*(LN(H7*1.609))+17)

Where:

L= Total losses (technical and non-technical) in percent
H7= Sales density in MWH of sales of all types per km of distribution line
LN= Natural logarithm function

For purposes of this analysis, distribution line is considered to include both HT and LT line. The tendency of this equation is to assess higher losses for utilities with lower sales densities, that is for utilities with dispersed consumers and low sales in MWH/km of distribution line, losses are higher than for utilities with more dense service areas. Thus increasing the amount of distribution line considered tends to increase the allowable level of losses.

Applying this equation to FESCO, results in the characteristics shown in Table 2.8:

**TABLE 2.8 RESULTS OF LOAD VERSUS LOSS ANALYSIS.**

| Total KM | Sales Density MWh/Km | Benchmark Loss % | Actual Distribution Loss % |
|---|---|---|---|
| 61,615 | 135.0 | 7.1% | 9.7% |

It is apparent that, according to this benchmark, FESCO should have a distribution loss of approximately 7.1%, a value which is in close agreement with the assessment of technical losses presented in this report.

## Possible Technical Opportunities for Reduction of Non-technical Loss

The fact that the majority of FESCO's losses are technical does not preclude an effort to further reduce non-technical loss. Potential opportunities are as follows:

1. Mapping of lines and consumers using a GIS provides important information for use not only in planning but also in monitoring of transformer loading. Accurate location of consumers with respect to the feeder and transformer that serves them allows for better tracking of feeder losses and can aid in identifying areas where theft is high, as well as provide a means for evaluating the impact of other improvements.
2. Open conductor LT line is notoriously vulnerable to unauthorized hooking or "kunda" connections. Replacement of at least some of the open LT system with covered multiplex conductor would assist in limiting loss from this source.
3. The engineering team was advised that approximately 90% of FESCO meters are still of the old electromechanical type, and these are notorious for slowing as they age and for vulnerability to tampering. While wholesale replacement of these meters with electronic units may be more expensive than FESCO wishes to undertake at the present time, a campaign for calibration of the existing meters would have immediate results at much reduced cost.
4. Meter reading improvements that minimize the number of error prone manual transcriptions of data would help minimize errors and assist in identifying problematic meters for replacement.

Another technical measure that, while having minimal effect on losses will improve customer service and reduce resistance to payment, could be as simple as installation of connectors on all high current joints.

The type of connectors used should be compression connectors which can in most cases be installed with hand tools. Compression connectors are much cheaper and more reliable than bolted connections.

## 2.3 FINANCIAL

### 2.3.1 Overview

The financial management operational audit was designed to evaluate the effectiveness and efficiency of financial management for FESCO. The audit process has been designed to evaluate operational control against standards set by management. Factors included in the audit process include long term plans, budgets and operating policies and procedures.

### 2.3.2 Summary of Key Findings

The following are key findings of the PDIP review of FESCO's financial management.

#### Cash Receipts and Disbursements

- FESCO's collection rate for government clients is much lower than it is for private clients; the collection rate for government clients is 73.5%, while FESCO has a collection rate for private clients of 94.7%. GOP accounting regulations prohibit making provision for past due receivables from government clients and therefore FESCO must consider all government receivables as collectible.

- FESCO is forced to remit payments for GST on all billings, regardless of whether the bills are actually collected. Thus, even though taxes are considered a pass-through, the difference between billed and collected taxes is paid from company's distribution margin. These taxes represent a significant financial burden.

#### Financing and Investments

- In 2008 four DISCOs, including FESCO, were asked by the GOP to obtain loans to pay for government shortfalls in power costs which were incurred by all DISCOs. FESCO was required to absorb a portion of the interest expense incurred on these loans.

- FESCO, though it has revenues of Rs. 130 billion ($US1.5 billion) per year, could only afford to undertake about $60 million of system investment in 2009-10. Approximately 70% of this investment was taken up by the transmission network, leaving only about $15 million for investment in the distribution network, of which almost half was paid for by either consumers or other government agencies as deposit work. This level of investment is insufficient to maintain the distribution infrastructure over the long term.

#### Internal Controls

- FESCO's annual financial audit makes no reference to shortages in distribution and transmission stores. This is significant since there were specific references to store shortages in the annual audited financial statements of five other Pakistani DISCOs.

- Internal Audit only functions as a financial control in the review and certification of consumer electricity billings. Moreover, the external auditor is unable to rely on the work of Internal Audit due to the function's lack of independence and professional competence. The existing audit manual does not address the specific audit procedures that will be required to perform internal auditing procedures in FESCO's planned ERP environment.

#### Cost Containment

- FESCO's vehicle fleet consists of a total of 1,096 vehicles, 349 of which are 20 years old or older. The company's fleet management policy requires vehicle replacement when a vehicle reaches ten years of age, but vehicles are rarely replaced on schedule due to conflicting approval policies. Even if the utility were to demonstrate that purchase of a new vehicle would result in lower operating and maintenance costs, there is no policy allowing for a replacement of a vehicle. Not

surprisingly, older vehicle maintenance costs are significant. These costs are exacerbated by a PEPCO policy that requires FESCO to send all fleet vehicles to a WAPDA vehicle repair workshop, where prices are approximately twice the market rate.

- FESCO has significant financial vulnerability due to a lack of insurance on its facilities. Grid stations and certain new vehicles are presently the only facilities covered by insurance.

### Financial Reporting

- FESCO's ERP project has the potential to make a major impact. As many as 1,000 employees may be affected by its implementation. However, training in ERP systems is an issue as various modules are rolled out through the organization. In addition, there is concern regarding the organizational unit structure needed to support the ERP program. Presently, third party consultants are playing a major role in the implementation and training of this project.

### Financial Performance

- Maintenance expense as a percentage of operating revenue indicates that FESCO is spending significantly less than US rural electric cooperatives to maintain its electric system; 1.28% for the former as compared to 7.98% for the latter. However, this is partially explained by the fact that FESCO has invested a significantly smaller amount in total utility plant per kilometer of line than have the US cooperatives.

- The plant revenue ratio (total utility plant/operating revenue less cost of power) indicates FESCO has significantly more operating revenue remaining after power costs to support its existing plant through operations and maintenance expense when compared to the US cooperatives; 2.8 for FESCO and 6.3 for U.S. rural electric cooperatives. A smaller plant revenue ratio indicates higher revenue per unit of investments in plant. The U.S. rural electric cooperatives have invested significantly more in total plant per kilometer of line: Rs. 2,622,327 as contrasted with FESCO: Rs. 1,063,381..

- The amount of trade debt receivables over 60 days as a percentage of operating revenue is significantly higher for FESCO than for the US electric cooperatives, the former's trade debt to operating revenue ratio being 1.8%, while the latter's average is 0.23%. This comparison is based upon FY 2010 FESCO trade debt.

- US rural electric cooperatives' consumer density averages 8 consumers per kilometer, while FESCO has 81 consumers per kilometer of line. The large US cooperatives have consumers to employee ratios of 467/1, while FESCO's consumer to employee ratio is 161 to 1. Even though FESCO is above average in consumers per employee when compared to other DISCOs (see Table 10 below), it could improve its financial position significantly by improving its consumer to employee ratio. Were FESCO able to achieve a consumer to employee ratio close to 467:1, the savings would approach Rs. 2.7 billion per year.

## 2.3.3 Analysis and Discussion

The financial management operational audit was designed to evaluate the effectiveness and efficiency of financial management for FESCO, to evaluate operational control against standards set by management. Factors included in the audit process include long term plans, budgets and operating policies and procedures.

Financial management responsibilities rest with the entire FESCO management structure. However, direct responsibility for overseeing financial management lies with the Director of Finance who is responsible for providing leadership with regard to management of and direction of cash receipts and disbursements, financing and investment management, internal control and cost containment and financial reporting. This report highlights the important aspects of each of these functional areas.

### Cash Receipts and Disbursements

FESCO receives cash from various pay points including banks, post offices and NADRA with methods of payment including cash, online banking and credit cards. All payment collection centers are required to

transfer funds collected (net of collection fees of Rs 8 per receipt) to the respective FESCO central bank account. The company receives 80% of its deposits the same day in its bank account; 10% of deposits, primarily from offline banking, are received within two to three days after payments have been made. The remaining 10% of deposits, received from post offices, take up to a week to be transferred to the FESCO primary bank account. The utility then makes periodic payments from central bank accounts to PEPCO/CPPA after deducting the NEPRA-approved distribution margin and applicable taxes. Taxes are paid directly to local, provincial and central government authorities, while the DISCOs are authorized to employ the distribution margins to finance non-power operating costs. While improvements can be made to reduce the time required for financial transfers, a significant portion of payment receipts are transferred from pay points to the FESCO account on a timely basis.

Currently, capacity charges can only be passed from FESCO to its consumers on a quarterly basis while excess energy fuel cost adjustments are passed through on a monthly basis. The time lag involved in recovery of excess capacity charges represents a direct loss of cash flow to FESCO.

FESCO's budgetary process begins with a NEPRA notification of amounts allowed for operations, maintenance and capital budgets. Departmental budgets are allocated expenditures based on the previous year's actual expenses and current year requested budgets. Budget variance reports are prepared monthly and reported to the BOD quarterly. However, because these reports have to be prepared manually, this results in a reporting lag of an average of one month. Variance analysis is carried out on a monthly basis and explanations sought for significant variances. Significant variance reporting levels (i.e. to the CEO and BOD) should be more timely.

FESCO's trade debt receivables amount to Rs 6,704,148,683 at FY 2010. Of this amount, approximately Rs 4,238,715,000 is either current or less than 60 days past due. Included in trade debt receivables is Rs 2,530,877,866 of government receivables that are considered collectible.

Trade debt receivables had a current year provision of Rs 141,746,881 for FY 2010 and a cumulative provision of Rs 335,056,286. The cumulative provision represents amounts expensed but not yet written off. The amount written off for the current year was Rs 227,859. It is FESCO's practice to make provisions and expense any balance that is aged one year or more except for government balances which are considered recoverable. Given that FESCO considers that these accounts are uncollectable, it makes no further attempt to collect them. Alternatively, the company could consider engaging a collection agency to make further attempts to collect against these accounts, paying a percentage of the collected total towards achieving the collection targets paid on a contingency basis. Amounts are written off only when a consumer, who has been off the system for five years or more, returns at which time the consumer pays 50% of the amount due, the remaining 50% being written off.

Currently FESCO is making no efforts to collect provisional amounts. It may be advantageous to turn these over to a collection agency for collection with payment to the agency made on a contingency basis. Additionally, FESCO receivables from government accounts equal Rs 2,530,877,866. The utility's collection rate for government clients (51.3%) is much lower than for private clients (96.7%). As with all other DISCOs, FESCO does not make provisions for uncollected government accounts; GOP accounting regulations prohibit making provision for past due receivables from government clients and the DISCO is required to consider all government receivables as collectible. A legal remedy will be required to force the government to pay past due debts – or perhaps to allow a tax offset against aging, unpaid electric bills.

FESCO and other DISCOs are required to retain and later pay taxes and license fees to local and federal agencies as a function of commercializing electric power. Some of the taxes that are due to the government are assessed on the basis of electricity sales rather than receipts against billings. The following describes amounts collected monthly in addition to the consumer electric bill:

- General sales tax (GST) assessed at 17% on domestic consumers and export industries.
- Income withholding tax: 5% and 10% retained at for industrial and commercial consumers respectively.
- Excise duty of 1.5% on all consumers (varies by local jurisdiction).

- A flat fee of Rs 35 on domestic consumers to support the national television network.
- Surcharges may be assessed as needed to cover the costs of certain power plant projects.

Given that GST is levied on the basis of billings, the DISCO is forced to remit payments for GST on all billings, regardless of whether the bills are actually collected. Thus, even though taxes are considered a pass-through, the difference between billed and collected taxes is paid from the DISCO's distribution margin. These taxes represent a significant burden for those utilities with low collection rates. The net general sales tax payable was Rs 1,467,809,317 at FY 2010.

### Financing and Investments

Electric utilities are capital intensive operations, requiring a regular and dependable stream of long term financing at reasonable rates in order to be able to undertake system improvements when prudent and necessary. FESCO's financing needs are met from two sources, internal cash generated by the distribution margin, and long term financing arranged through the government. Of the two, the only dependable source is internally generated cash. Long term financing may be typified as World Bank, or Asian Development Bank lending, but in reality, these funds are lent by the donor to the Government of Pakistan who on-lends them to the DISCO. Subject as they are to government and multilateral bank relations, the availability of such financing is not related to the financial strength or the particular needs of the utility, is always project specific and cannot be relied upon to be available when needed by the DISCO.

Local banks are not likely to be enthusiastic about extending long-term credit to the DISCOS, since as government entities they are subject to political requirements that are not always aligned with the DISCO's individual financial sustainability. For instance in 2008 four DISCOs, which included FESCO, were asked to obtain loans to pay for government shortfalls in power costs which were incurred by all DISCOs. FESCO was required to absorb a portion of the interest expense incurred on these loans. Accordingly, the company will claim 68% of the total interest paid on Rs. 11.5 billion loan from WAPDA and 8% from NTDC through MF after each payment of interest during tenure of loans.

Generally, cash flow generated by operations is satisfactory only for meeting short term needs, making FESCO essentially an operations-oriented entity. One of the reasons that system planning is so constrained is the shortage and uncertain availability of significant investment funds. Though it has revenues of Rs61 billion ($US 718 million) per year, the utility could only reliably undertake about $60 million of system investment in 2009-10.

All DISCO investment projects are required to be filed with the Planning Commission (PC), Central Development Working Party (CDWP) and Executive Committee of the National Economic Council (ECNEC) for approval regardless of funding status. Each project is evaluated on a cost benefit basis and only projects that have a calculated benefit proceed. The documentation required for these filings is burdensome regardless of the funding source. The Finance Director would like to see the process streamlined to minimize documentation and reporting requirements, especially of those projects with no government funding.

The weighted average cost of capital (WACC) is used in the computation of rate of return on rate base. It is a blended rate of the cost of debt and the cost of equity. This rate is then used to compute the rate of return on rate base. FESCO's rate of return on rate base may range from 13%-17%.

### Internal Control

The team visited one of the four regional warehouse site locations and reviewed policies, procedures and operations. The FESCO warehouse procurement policies are provided for under the Public Procurement Regulatory Authority (PPRA) manual. There are two distinctly different warehouse operations, one for 11 kV distribution system materials and the other for 132 kV transmission materials. The 11 kV warehouse operations consist of one regional warehouse and 12 field warehouses. The FESCO annual financial audit included references to store shortages recoverable from employees and store shortages due to external theft (commonly referred to as "dacoit") in the amount of Rs 7,662,202 and 3,690,458 respectively. It was noted that during the year, there was a theft of scrap copper from the regional store at Faisalabad in the amount of Rs 3,000,000. An investigation committee was constituted. This theft is being investigated

under the guidelines of the WAPDA Manual of General Rules, Guidelines for Enforcing the Responsibility for Losses Sustained by the Authority through Fraud or Negligence of Individuals 1982. It was noted that there are approximately 75-100 investigations per year, primarily stores related.

Perimeter security is a primary concern for the inventory yard due to surrounding low walls. However, the FY 2011 budget includes resources to increase the size of the perimeter wall and add barbed wire on top. System controls are also weak which permit inventory adjustments without authorization or verification. Lack of timely reconciliations and ease of system access to make unauthorized adjustments contributes significantly to the opportunity to breach the system. It was noted that the Jhang regional warehouse is the primary location of dacoit and represents an area of undesirable influences.

There was a provision in the amount of Rs 20,185,089 for slow moving and obsolete items for FY 2010. The cumulative provision at FY 2010 was Rs 34,173,875. While the board of directors has the authority to approve/ write off amounts, action will not be taken without PEPCO approval.

The Book of Financial Powers (BFP) is a governing document and was approved by FESCO's Board of Directors in October 2002. The BFP establishes various approval authorities and monetary limits for financial transactions and certain other actions taken by company management and the Board in the operations of day-to-day activities. The BFP was reviewed and discussed with the Secretary of the Board. FESCO has acknowledged the need to update its BFP with more efficient approval authorities and monetary limits to reflect the current financial environment. These changes are consistent with maintaining high corporate governance and internal control standards. This change to the BFP will require approval by PEPCO.

In a review of the Internal Audit (IA) function, the PDIP team found that FESCO has a three person audit committee that meets regularly. The IA team has a dual reporting function to the Audit Committee of the BOD as well as to the CEO. The BOD Audit Committee is an active committee and involved in the implementation of reforms in the system.

The IA cell is headed by the Deputy Chief Auditor. The Audit Department employs 114 professionals from a total of 128 sanctioned positions. IA continues to employ the WAPDA audit manual dated August 1985. In addition to this, it uses the Revenue Audit Manual issued by WAPDA in June 1998 to replace Chapter 1 and Chapter 6 of the Audit Manual. The Revenue Audit Manual was designed to assist in the review and certification of consumer electricity billings and to report to Management regarding the status of compliance of policies and procedures regarding commercial operations. The functions of the IA Division, as defined in the Audit Manual under section 2.1 are as follows: "Internal Audit Division has to insure that rules and orders framed/adopted by the Authority from time to time in connection with execution of works, pay and allowances, stores etc. and for maintenance of various accounts, books etc. are followed by all WAPDA formations/offices and the defects and irregularities noticed in such accounts/books are rectified as far as possible". IA performs only a limited review that includes three types of audit: a revenue audit, primarily related to electricity billings; a financial audit, primarily composed of transactions to verify that amounts received and amounts billed are accurate; and a fixed asset audit that traces physical assets to recorded assets and recorded assets to physical assets. IA conducts approximately 150 to 200 investigations per year.

The audit manual does not address specific audit functions that are required to perform internal auditing procedures in an ERP environment. Recent Audit Committee meeting minutes indicate the need to update the Audit Manual to better support FESCO needs as it moves towards deployment of ERP functionality. Towards this end, the internal procedures and audit policies and procedures will need to be updated to incorporate a structured approach and to undertake full reviews of internal control systems.

The internal audit function is primarily credited with identifying stores shortages which amounted to approximately Rs 11,352,000. Its approach focuses only on transactions rather than full reviews of internal control systems.

### Cost Containment

Cost containment refers to the process of identifying expense items and categories that offer opportunities for significant savings through identification of alternative sources for goods and services.

DISCOs have historically been required to employ WAPDA services for software and other services that are not cost competitive with other private sector sources. The application of WAPDA requirements is not uniform across all DISCOs, so opportunities for savings may vary from one to the other.

FESCO pays a PEPCO license fee of Rs 10,377,683 for three business software applications including billing, payroll and inventory control. This expense will be offset, as licensing fees would be eliminated, to help fund the migration to ERP.

The vehicle fleet consists of a total of 723 vehicles that are up to and in some cases over twenty years old. Official fleet management policy requires replacement when vehicles reach ten years of age, while the private sector practice usually requires replacement after five years. The ban on purchase of new vehicles by PEPCO—a policy adopted by FESCO and other DISCOs- has made replacement of vehicles quite problematic.

With many very old vehicles, vehicle maintenance costs are significant. These costs are exacerbated by a PEPCO policy that requires FESCO to send all fleet vehicles to a WAPDA vehicle repair workshop, where prices are approximately 20% higher than the market rate. While FESCO is authorized to use local market repair facilities to make minor repairs, it must obtain a no objection certification (NOC) from WAPDA if it wishes to use a private workshop for major vehicular repairs. Even if the utility were to demonstrate that purchase of a new vehicle would result in lower operating and maintenance costs, there is no policy which would allow for replacement of a vehicle.

It was noted during a comparison with the largest US rural electric distribution cooperatives (REC) that FESCO employs over two and one half times the number of employees per consumer than REC. One would expect a DISCO with a density of more than 10 times than a corresponding REC to achieve an economy of scale of more consumers per employees not less. If FESCO could achieve parity with the REC it could reduce its labor costs by approximately Rs 2,760,953,850.

FESCO may have vulnerability due to a lack of insurance on its facilities. Grid substations and selected vehicles are the only facilities covered by insurance. WAPDA insurance covers the grid substations while private insurance has been purchased for selected vehicles.

### Financial Reporting

FESCO is experiencing significant reporting problems as expressed in the recent external auditor's letter to the BOD that states: "the accounting function of FESCO relies on manual systems and takes excessive time and effort in data entry and information retrieval. There are certain stand alone software applications such as inventories, payroll and billing which require manual entries to the general ledger. Data generated from these applications are used for manual entries in the general ledger. FESCO, due to its size and multi-location operational units needs a proper ERP system." The report also noted problems in warehouse management where issues related to reconciliation of store items issued during the year with those capitalized, expensed and transferred, was not possible due to a lack of clear warehouse practice.

The DISCO budgetary process is initiated by NEPRA with an authorization of amounts allowed for capital expenses, as well as the DISCO (FESCO) operating margin (operating and maintenance expenses). With the NEPRA notification in hand, FESCO departments budget fiscal year expenditures on the basis of previous year actual expenses and current year requested budgets. Throughout the budget year, variance reports are prepared and submitted to management on a monthly basis, and reported to the BOD quarterly. However, because these reports have to be prepared manually, there is usually a month delay in receiving the reports. Variance analysis is carried out on a monthly basis and explanations sought for significant variances.

A financial management study performed by an external consultant in 2009 observed that FESCO transactions all operate on a manual system that imposes excessive responsibility on both internal and external auditors to verify controls and accuracy. The importance of automating of accounting and financial management functions is of utmost importance and should be pursued immediately.

Accounting practices are predominantly manual, and while personal computers are used for specific functions at the head office, all field accounting activities employ manual accounting methods. It is

important to ensure that financial accounting and reporting systems have built in controls and allow for system controls to prevent misappropriation of the utility's assets.

The need for automation and improved processing, performance monitoring, timely and accurate reporting and improved system controls has led FESCO management to consider procurement and implementation of ERP. The ERP, when implemented, will include modules to integrate financial, material and human resource management functions in similar fashion to the features discussed in the FESCO report. As seen by the company's financial management, ERP will yield the following benefits:

1. Improved control at all levels.
2. Facilitation of day-to-day management reporting.
3. Facilitation of information coordination and access across all FESCO work units.
4. Integration of accounting, finance, commercial and human resource functions.
5. Enhancement of quality and accuracy of data and information.
6. Improvement of financial management and corporate governance.

FESCO began an evaluation to implement an ERP system in 2006. However, the process has not been aggressively pursued and the work done in the previous five years has become obsolete. This process will need to be re-initiated. Preliminary results indicate an Oracle based accounting system.

A primary concern for the successful implementation of an ERP system is the current level of organizational IT competence to evaluate, administrate and drive the implementation process. An ERP system implementation will require competent staff, outside consulting, employee involvement and training.

FESCO continues to use the WAPDA legacy (1982) accounting manual. However, all DISCOs are required to implement the NEPRA uniform system of accounts by December 31, 2010. The accounting manual will need to be updated to accommodate this new system of accounts, changes in the processes of the DISCO, changes in international accounting standards and related pronouncements.

### Financial Performance Indicators

Financial performance indicators provide a means of measuring distribution utility performance quickly and more objectively than traditional income statements and balance sheets alone are able to do. These can also be used to compare the electric utility of interest with other utilities of similar size and serving communities of similar characteristics.

Use of performance benchmarks requires establishing a reasonable baseline for comparison – that is, finding a group of electric utilities that are of similar size and characteristics (geographic scope, gross sales, sales density etc.). While the DISCO community in Pakistan provides a reasonable peer group for comparison between one another, the performance of the DISCO community has been stunted by a lack of independence and of clear incentives to achieve high performance standards. For this reason, an alternate group of utilities should be used as the basis of performance benchmarking FESCO and its sister distribution companies in Pakistan.

For purposes of comparison, PDIP proposes to use financial and technical performance characteristics of the large group of rural electric utilities in the United States. These utilities are small in comparison to the Pakistan DISCOs; have far fewer consumers per kilometer of distribution line; but are characterized by low line losses and extremely high collection rates; and have been financially self-sustaining without capital or operating subsidies. For purposes of this comparison, the largest of the US rural electric distribution cooperatives were selected for this benchmarking process. These cooperatives range in size from slightly more than 80,000 consumers to over 200,000 consumers; DISCO sizes range from 400,000 to over 3 million consumers.

Maintenance expense as a percentage of operating revenue indicates that FESCO is spending significantly less than US rural electric cooperatives to maintain its electric system, .87% for FESCO compared to

7.98% for the US cooperatives. However, this is partially explained by the fact that the former has invested a significantly smaller amount in total utility plant per kilometer of line than the latter. The plant revenue ratio (total utility plant/operating revenue less cost of power) indicates FESCO has slightly more operating revenue remaining after power costs to support its existing plant through operations and maintenance expense when compared to the US coops., 5.1 for FESCO and 6.3 for the cooperatives. The cooperatives have invested significantly more in total plant per kilometer of line: Rs 2,622,327, than FESCO: Rs 1,083,462.

Given the very low consumer density per kilometer of line, the level of line losses for US rural cooperatives (5 %) should present a reasonable target for overall technical losses for the DISCOs. Line loss in excess of 5% could therefore be viewed as non-technical losses, and an opportunity for operational improvement.

The amount of trade debt receivables over 60 days as a percentage of operating revenue is extremely favorable when compared to US electric cooperatives: FESCOs trade debt to operating revenue ratio is .13%, while the US electric cooperative average is 0.23%. This comparison is based upon FY 2010 FESCO trade debt.

US electric cooperative consumer density averages 8 consumers per kilometer, while FESCO has 81 consumers per kilometer of line. The large US cooperatives have consumers to employee ratios of 467/1, while FESCO's consumer to employee ratio is 183 to 1. Even though FESCO is above average in consumers per employee when compared to other DISCOs (see Table 3.1 below), it could improve its financial position significantly by steadily working to improve the consumer to employee ratio close to the US electric cooperative average. Were FESCO able to achieve a consumer to employee ratio close to the US average, its savings would approach RS 2.7 billion per year.

| TABLE 2.9: FESCO/US COOPERATIVE PERFORMANCE RATIO COMPARISON | | |
|---|---|---|
| **Category/Performance Indicator** | **FESCO** | **US Cooperative Avg.** |
| **Liquidity** | | |
| Current Ratio | 1.3 | 1.6 |
| Amt over 60 days/Oper. Rev (%) | 0.13% | 0.23 |
| **Profitability** | | |
| Return on assets | 3.9% | 5.07 |
| Op Rev/km line (Rs) | 2,130,485 | 1,528,519 |
| Consumers/km line | 81 | 8 |
| Consumers/employee | 183 | 467 |
| Main Exp/Op Rev (%) | 0.87% | 7.98% |
| Op Exp/Op Rev (%) | 6.5% | 7.03% |
| Cost of Power/Op Rev (%) | 90.1% | 70.55% |
| **Plant Utilization** | | |
| PRR (one year plant rev ratio) | 5.1 | 6.3 |
| Total Plant/km line | 1,083,462 | 2,622,327 |
| **Solvency** | | |
| Equity/Assets (%0 | 4.2% | 42.4% |
| Long term Debt/Ttl Capitalization (%) | 83.3% | 52.0% |
| Line loss (%) | 10.8% | 5.0% |
| Elec Sales collected/Elec Sales billed (%) | 81.7% | N/A |
| Government | 51.3% | N/A |
| Non-government | 96.7% | N/A |

## 2.4 COMMERCIAL MANAGEMENT

### 2.4.1 Overview

This chapter describes commercial management practices at FESCO, followed by an analysis of the impact of selected changes to commercial practices. The policies, practices and procedures employed by FESCO are not unique to the utility; they are in general common to all Pakistani DISCOs, varying in scale and in some particulars.

### 2.4.2 Summary of Key Findings

The following are key findings of the PDIP review of FESCO's commercial management:

- **New service connections—** Several factors designed to minimize mistakes in the data entry into the customer information system unfortunately contribute to significant delays in consumer billing – sometimes for several billing cycles. As a result, some newly connected consumers have received service for more than a year before receiving their first bill.

- **Meter reading—**Numerous problems were found in the area of meter reading. Commercial management and employees indicate that there is insufficient time to perform the randomized evaluations of meter reading accuracy that are supposed to occur. Moreover, review of meter

reader logs revealed that meter readers do not consistently identify and record problems with meters. Furthermore, FESCO does not employ a practice to remove, clean and calibrate meters.

- **Bill preparation—**The billing process involves manual data transfers and data entry, which often cause delays. Data entry for 6000 meter reads requires a full day for the revenue office team, so if one reader is behind schedule the entire batch is delayed.

- **Bill delivery—**Inadequate time is allowed for bill delivery with the result that there are instances where bills have been delivered on or even after the payment due date. The billing timeframe is very tight meaning that delays in any part of the process will result in delays of delivery of bills to the revenue office where the bills are sorted and delivered to each subdivision. Delivery of bills is often by hand, so lack of transportation also routinely delays bill receipt and payment.

- **Bill adjustments—**Adjustments to consumer bills can be made at any center, but the bill must be returned to the consumer's revenue office for data entry. Since there may be a substantial time lag in processing the adjustment, the consumer may have to return to the billing center for another billing adjustment. In simple terms, the company's back-office procedures do not follow through with actually adjusting the consumer records.

- **Payments—**The payment handling arrangement is also fraught with inefficiencies and requires frequent, manual intervention. For pay points without online facilities, scrolls and payment stubs are physically transferred to the revenue office. The revenue office reconciles stubs and scrolls; this usually takes three-four business days. The bank will not accept payment amounts less than the amount indicated on the printed bill.

- **Disconnection/reconnection—**While FESCO's process for disconnecting/reconnecting delinquent customers is reasonable, it involves a number of separate departments and is not automated, introducing potential risks and delays.

- **Customer service**— At the local levels, there are no dedicated customer service representatives. Personnel are assigned to man the windows for a few hours and then return to their other duties; hence there is little or no continuity in resolving customer issues. The current customer care system is dependent on telephone lines which are either busy or faulty much of the time, creating customer frustration. An efficient and effective customer care system is needed by FESCO and its counterpart DISCOs.

- **Meter maintenance—**Meter inspection, testing, repair and replacement are inconsistent at best. Established procedures are not followed, documentation is not completed and handling of meters appears haphazard. Management of meter assets would be much better served by enforcing existing guidelines.

- **Theft control—**Theft of electricity and related fraudulent activity that reduces revenue to FESCO is rampant and varied in its manifestations. Many instances appear to involve company employees. Reconciliation of customer meter readings to known area meter readings, which would highlight areas for investigation, has not been implemented.

- **Meter integrity and meter reading practices—**When a meter is declared to be defective, the consumer is billed on the average consumption of the last 11 months. Because it is the meter reader that declares a meter defective, it is possible for collusion between the reader and the consumer, especially during the peak season of summer. Since it takes 3-4 months for the meter to be replaced, the air conditioning season is over before the consumer is billed on actual consumption again. Also, with many meters located 7-10 feet above ground, it is difficult to detect meter tampering.

- **Information technology**—Presently FESCO business processes are characterized by manual and cumbersome practices, inadequate controls, insufficient commercial focus, limited transparency and lack of reliable information. The use of information technology to improve efficiency and effectiveness has not yet proven successful. Several stand-alone applications are

not integrated either with other applications or with potential applications to be deployed in the future. Although the level of deployment of IT varies significantly from one DISCO to another, the key applications have been in multilevel aggregation of data or large-scale data processing. In other words, IT is being used as a tool to address a specific issue or two at a time and not as a long-term, holistic strategy to achieve fundamental business goals. FESCO's move to an ERP environment is an opportunity to rationalize and update core business processes as a prerequisite to further automation.

### 2.4.3 Analysis and Discussion

The revenue cycle in DISCOs, including FESCO, is governed by three documents including:

1. Commercial Procedures Manual, 6th edition-November 2000, plus amendments which have not been codified
2. Consumer Eligibility Criteria, 2003
3. Consumer Service Manual, 2010

The Commercial Procedures Manual is a true procedures manual developed by USAID in the 1980s and is still the primary document for carrying out such activities. Revisions that have been made primarily raise authorization limits and reassign signing authority as needed.

In response to the Regulation of Generation, Transmission and Distribution of Electric Power Act 1997 (the Act), the National Electric Power Regulatory Authority (NEPRA) developed the Consumer Eligibility Criteria manual in 2003 to ensure a non-discriminatory provision of distribution service and sale of electric power to all consumers within the service territory of a distribution company. This document is included as an appendix to the Consumer Service Manual.

The Act also led NEPRA to prepare the Consumer Service Manual that provides instructions and a code of conduct and procedures for dealing with the consumer. This Manual describes the obligations and rights of the consumer, as well as the rights and obligations of the DISCO. The timeframes for processing consumer applications, completing service connections, meter reading, bill processing and delivery and resolving complaints are addressed in the Manual. It also includes safety and conservation tips for the consumer. The frequent clause "(DISCO to insert its name)" implies that all DISCOs are to follow the policies stated and not develop their own.

#### Overview of Revenue Cycle

The revenue cycle is composed of a number of interrelated steps. The first step – perhaps a pre-revenue prerequisite - is the application for service connection. There are non-recurring fees assessed in the application and connection process, so this is in fact a part of the revenue cycle process. Once a consumer has received a service connection and begins consuming electricity, the DISCO revenue system must collect consumption data, process the data, print and deliver the bill and collect revenues from the consumer. Each step requires a structured set of actions that must be orchestrated to allow the DISCO to manage an extremely high volume of transactions on a monthly basis. The following sections of this report describe each step of the revenue cycle for FESCO; much of this information applies to all DISCOs, since they use very similar commercial practices.

#### New Connections

The first step in revenue cycle management is to register and connect the consumer. The location associated with the meter is identified as the consumer; that is, the premise is assigned a billing account number. Should the occupant of the premise change, the billing account number does not follow the consumer, and the name associated with the number is changed. Numbers are assigned in the walk order of the meter route. As new structures are added, the route must be renumbered to adjust to the additional locations.

FESCO's new connection policy is similar for general and industrial consumers. The difference is in the documentation required and in who has the authority to approve the application. General consumers (domestic and commercial) can apply for service at the local subdivision office. Large consumers must

apply at the marketing and tariff office located at the headquarters complex. Once the application and the terms of agreement are completed, signed and appropriate documentation attached, the application is assigned a registration number.

Within two weeks of receiving a consumer application, the subdivision shall conduct a site survey to determine if there is available power and prepare the cost estimate for the connection. General consumers who are within 40 meters of the connection point are charged a flat fee. A demand note for the connection fee and another demand note for the security deposit are prepared and sent to the consumer. He/she has 30 days to pay the demand notes at the pay point specified. Once payment has been made and the subdivision office is notified, the consumer is added to the queue for new connections. New connection efficiency is measured by the length of time from payment of the demand notes until the consumer is connected and billed.

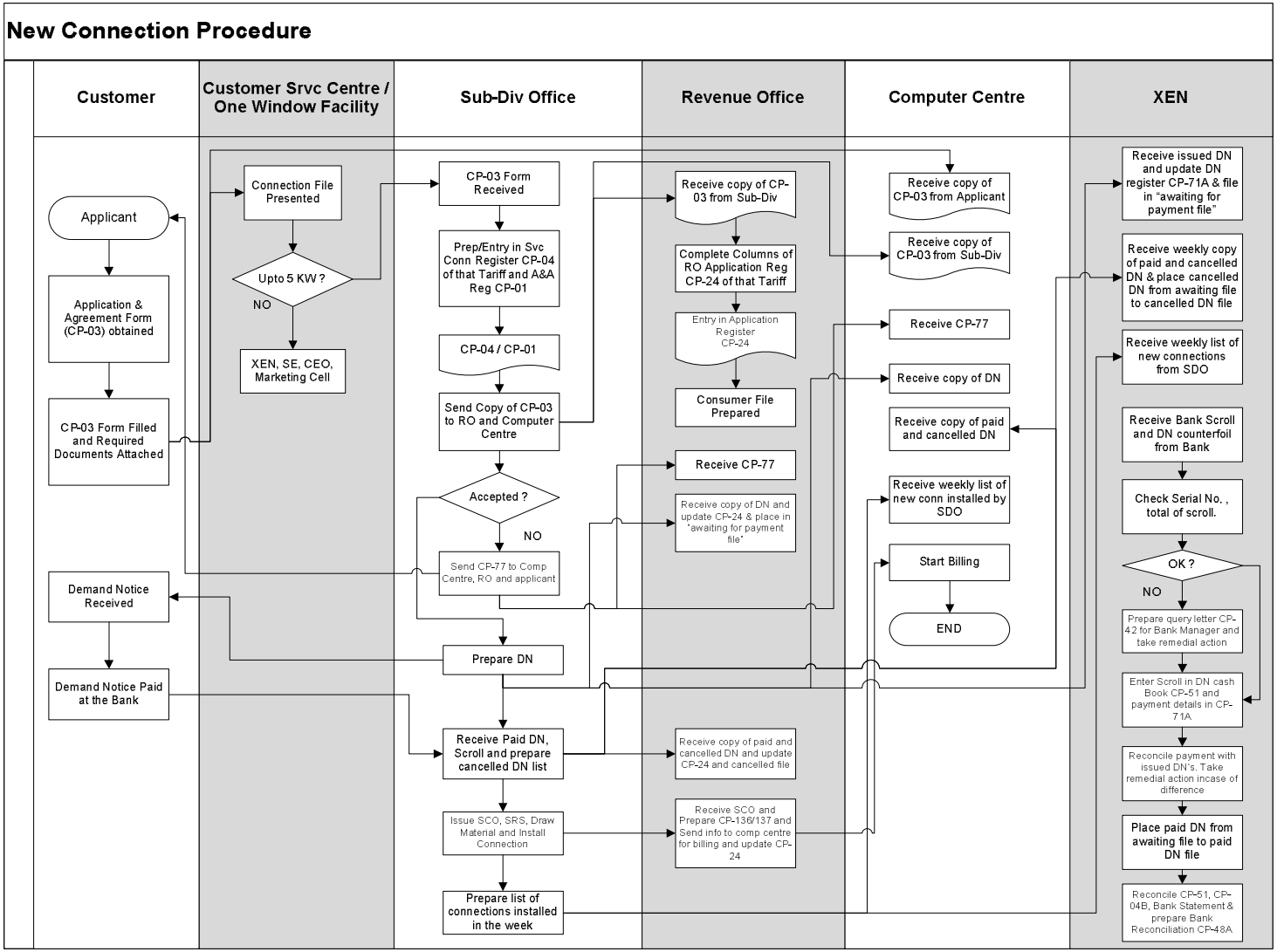
A service connection order (SCO) is prepared after the fees are paid. The meter, cable and necessary materials are drawn from stores, and the connection installed. Unfortunately, the materials needed are often not available for several months after payment of the demand note. There is no communication between stores and the personnel preparing demand notes. Inventory has a computer system, but it is not integrated with any other system. The consumer will still pay his/her note in order to get onto the priority list for installation. Management reports that there is pressure to expedite certain customers. When the consumer finally gets connected, the completed SCO is sent to the revenue office to enter the new consumer into the billing system.

FESCO follows the prescribed process to some degree. The target is to have new connections installed 35-45 days after the registration of the application. However, this target does not take into account the delay of payment by the consumer or the shortage of materials in the warehouse. Data on the register used to notify the revenue office as to which connections have been completed, indicated that most domestic connections were completed within an average of 46 days of application.

Several factors designed to minimize mistakes in the data entry into the customer information system unfortunately result in significant delays in consumer billing – sometimes for several billing cycles. For example, the transfer of documentation needed to include the new consumer in the billing system is a low priority for the technical personnel and is usually done once a month. In extreme cases, newly connected consumers have received service for more than a year before receiving the first bill. Even if the SCO is transferred immediately, it still may take FESCO two months to process the first bill.

The delay in billing the consumer is the result of the process. The process is as follows. First, the revenue office prepares an input sheet of customer data. This information is sent in electronic format to the billing center. The billing center then prints a "pre-bill" listing so the revenue office can verify that the data is correct. If the data is not correct, the errors are corrected, sent back to the billing center, and a pre-bill is printed again. Once the data is verified and accepted as correct, the first billing cycle may have passed. Because the meter reading list is prepared days in advance, the new consumer may have missed the first billing cycle by a matter of a few days. Fig 2.1 illustrates the new connections procedures.

**FIGURE 2.1 NEW CONNECTION PROCESS**



## Meter Reading

Effective, efficient, and reliable metering and recording of electric power consumption is the heart of the electric power distribution utility commercial system. Many utilities experience significant difficulties in the meter reading process, including inaccurate or faulty meters; human error in recording and/or transcribing meter reading data; delays in recording and transferring metering data; and, meter reading fraud involving consumers, meter reading employees, and third parties.

There are a variety of strategies that can be employed to address problems with meter reading, including auditing meter readings; rotation of meter reading employees; outsourcing meter reading services; use of advance metering technology, including automated meter reading, and/or use of pre-paid meters. Each option and technology comes with an associated cost and vulnerabilities; no single approach is fool-proof, although some are less problematic than others.

FESCO and its DISCO counterparts have employed checks and balances in the meter reading policies and procedures in an effort to ensure robust and trust-worthy metered data from FESCO consumers. Unfortunately, this is the area of commercial operations for which there is a high degree of distrust and anecdotal information regarding employee manipulation. It is important to note that, the purpose of this report is not to present evidence of fraudulent practices, nor to make unsubstantiated claims; the purpose of the report is to identify problems that affect DISCO performance, and to identify solutions to the problems that are noted.

The Commercial Procedures Manual requires routine verification of meter readings and bill deliveries as shown in Table 2.10 below.

**TABLE 2.10 METER AUDITING/VERIFICATION RESPONSIBILITIES.**

| | Percentage of meters/consumers to audit | | | | | | |
|---|---|---|---|---|---|---|---|
| **Responsible Officer** | **General** | **Industrial > 40KW** | **Industrial < 40KW** | **Tubewells > 40KW** | **Tubewells < 40KW** | **Load >500KW** | **Unspecified** |
| Line Superintendent in charge | 5% | 15% | | 15% | | | |
| Meter Reading Section Supervisor | 20 per week | 15% | | 15% | | | |
| Sub Division Officer | 5 meters per day | 2% | | 2% | | | |
| Executive Engineer | | | 10% | | 10% | | 2 meters per day |
| Superintending Engineer | | | | | | 15% | 1 SDO, 1 XEN 3 meters |

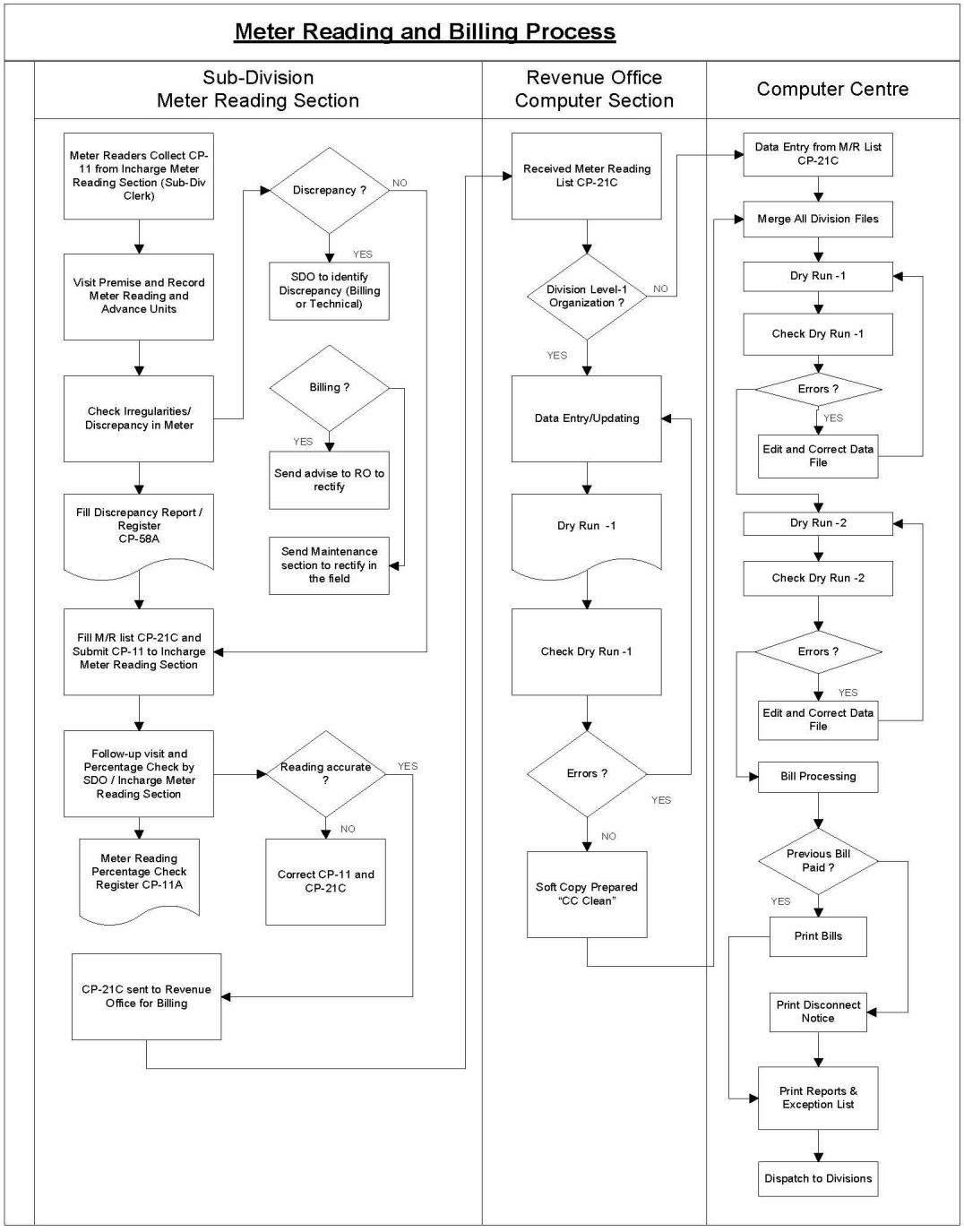
While these measures have been designed into the FESCO/DISCO system, interviews with FESCO commercial staff and record sampling indicate that in fact, there is little or no evidence that these procedures are actually followed. Division staff interviewed stated that 1,000 to 2,000 meter readings are reviewed each month (about 5-8%). FESCO commercial management and employees indicate that there is insufficient time to perform the randomized evaluations of meter reading accuracy; and, review of meter reader event logs revealed that meter readers are not consistently identifying problems with meters.

This would indicate that meter reading verification/auditing functions should be assigned to a work unit with a specific mandate to undertake these duties.

Figure 3.2 below illustrates the meter reading, data processing, and billing processes as described by FESCO commercial staff, and verified by the PDIP team. As the diagram shows, the meter readers are

responsible for meter inspection to note if there are problems with the meter enclosure, signs of meter tampering, meter stoppage, or other problems. The diagram also shows that the Sub-Division Officer is also responsible for performing random checks of meter reading values – to verify if there are issues with particular meter readers. Thus, there are formal checks in place to detect meter inaccuracy, as well as to detect meter reading fraud.

**FIGURE 3.2 METER READING AND BILLING CYCLE (GENERAL CONSUMERS) PROCESS DIAGRAM**



FESCO designs meter reading into a series of batches. Given that there are 20-23 working days per month, FESCO divides consumers into 20-25 batches for purposes of meter reading, bill printing and delivery. This allows for continuous bill processing. The benchmark is for the bill to be given to the customer 10 days after the meter reading.

FESCO uses 20 batches to manage the meter reading and billing cycle for general consumers. These batches are read by the regular meter readers. The additional batches are primarily for industrial, tube wells and other consumers equipped with demand meters that are read by the subdivision officer or the division executive engineer. These batches also contain domestic and commercial consumers.

The reading list for each batch is supposed to include consumers on the same feeder. However, this is not the always the case. FESCO commercial officers stated that exceptions are made where feeders intersect; it is more convenient for the reader to read the meters on adjacent feeders when the meter readers are already in close proximity to them. When possible, the size of the batch is based on the number of readers and the "yardstick" of 2,000 meter reads per month. However, because FESCO has been adding a significant number of new consumers (over 100,000 in the past 12 months), the batch size is the total general consumers divided by 20 working days. The batch is then divided by the number of readers to create the daily route size; so many meters may not be read every month.

The billing center has the aim of printing meter reading lists 5-7 days prior to the scheduled meter reading date. The lists are delivered to the division office and then distributed to the subdivision offices. Because the lists are prepared in so far advance of the actual reading date, new connections go unread for multiple months. The lists may reach the meter readers 3-5 days after the reading date. However, the readers do not use the reading list while reading the meters. Readings are recording in a "Kalamzu book" and then transferred to the reading list at the end of the day.

The reading lists contain the consumer number, his tariff code, the previous read and the consumption for the same month in the previous year. When transferring the current reading from the Kalamzu book to the meter reading list, the reader also calculates the consumption. If the consumption is out of line with the previous year's consumption, the current reading maybe adjusted. It was not uncommon to find cross-outs and overwrites on the reading list. The purpose of calculating the consumption is to prepare a check for the data entry of the readings. The process of meter reading and preparing the meter list may take 2-3 days.

The date of the meter reading used for billing purposes is the date scheduled for the meter reading. Readings may actually occur 2-3 days before to 2-3 days after this scheduled date.

### Bill Preparation

The meter reading lists from each subdivision are passed to the division's revenue office. The transfer process usually requires another day or so. The revenue office enters the readings for all subdivisions under its control. Each revenue office is managed by two data entry clerks and a supervisor who enter all consumer data for transfer to the computer center in addition to the readings. The clerks work in shifts in order to get all data entered in a timely manner. Data entry for 6,000 meter reads requires a full day for the revenue office team, so if one reader is behind schedule, the entire batch is delayed. Once the data entry has been completed, the total consumption for the batch is compared to the sum of the subdivisions batches as determined by the reading lists. The data is then transferred to the billing computer center either by email or delivered to the center by flash drive. Data entry of readings for MDI consumers (consumers with demand indicators) is done at the computer center

If closing for the previous month has not been completed, bill processing will be delayed. If all batches with the same number have not been received from all circles served by the center, bill processing may also be delayed. Not every division sends electronic data files and the data must be entered or digitized by the computer center. Therefore, it may take 9-10 days to process meter reading data for a batch assuming there are no delays in receiving the raw data and data entry.

The issue date on the bill is not always the date that the bill is printed. For the month of November, the scheduled issue date was frequently 2-3 days prior to the actual date of bill preparation. However, the due date on the bill is calculated from the issue date—normally 10 days from the issue date. No matter what

date the bill is printed, the issue date and thus the due date are the scheduled dates. The schedule allows 2-3 days from the print date for delivery to the revenue office.

The billing program that is being used by FESCO was written in COBOL in the late 1960's. Since the code was originally written, revisions have been introduced to improve functionality for maintaining customer balances. Printing of bills and reports is done in SEQUEL. The database is designed exclusively for electricity billing activity; however the COBOL program will not allow FESCO to include other revenues and security deposits in the bill.

The billing program was first developed by WAPDA. WAPDA originally programmed controls to ensure the integrity of the program and the data it contained. The program is now controlled by the DISCOs and many of the controls are no longer in use. There has not been a transactional audit since the transfer.

There are 25 billing centers distributed throughout the eight DISCOs. A DISCO may have 1 to 5 centers; FESCO has 3. Customer service centers are connected to the system via the web so that duplicate bills can be produced. However, bill adjustments must go through the revenue offices.

There are 17 revenue audit teams. They audit 100% of the industrial, tube wells and commercial billings with maximum demand indicators (MDI). The teams also audit approximately 5% of the general consumers' bills. It takes 2-3 months to audit a revenue office. Since there are 21 offices, and 16 regular audit teams, each office is being audited about 6 months per year.

The audit is basically a comparison of documents to the billing database. Only under billings are reported. In November 911 under billings worth Rs 18,627,026, were detected mostly due to the incorrect estimates for defective meters or wrong application of tariff. Of the 2782 findings for the year, 46 have been dropped, 734 have been billed (Rs 8,178,744) and 150 have been recovered (Rs 1,048,090).

The FESCO bill format requires modification. The current format is difficult for the consumer to determine if adjustments for previous months have been posted to his account, how the arrears (past due balance) amount was determined, or the amount on which taxes are calculated. For transparency, the bill should begin with the previous month's balance, and then show all transactions for the current period and then the balance that is now due.

### Bill Delivery

The due date should be calculated from the bill print date with an allowance for delivery days. The consumer should have at least 7 days from receipt of the bill to complete payment to FESCO. However, the due date is usually the target date prescribed by standard FESCO revenue practices, without taking into account the frequent delays that occur. As a result, inadequate time is allowed for bill delivery; there are cases wherein bills have been delivered on or even after the due date.

The billing timeframe is very tight. Delays in the any part of the billing cycle will result in delays of delivery of bills to the revenue office where the bills are sorted and delivered to each subdivision. The schedule assumes one day for delivery after receipt in the revenue office.

Usually, DISCO personnel are responsible for bill delivery but the process is outsourced in some cases. Bills are hand delivered to urban consumers. Because transportation is not provided, the bills for the rural areas are left at a single location, and the consumers are responsible for collecting bills from pre-defined central locations. This introduces another source of risk to the bill delivery process.

### Bill Adjustments

Bills can be adjusted if required at the customer service centers. If the adjustment is for less than 500 kWh, the CSR has the authority to make adjustments immediately. Adjustments in excess of 500 kWh require verification by field personnel.

When bills delivery is not timely consumers request an extension of one to five days. If a consumer makes a request for partial payment of a bill, the CSR may authorize installments of two to three payments, provided the amount is less than Rs. 10,000. Due to the fact that meter readings are, on occasion, estimated rather than read, actual readings in subsequent months can have the result of pushing

some consumers into a higher tariff block. The consumer's bill may be segregated into several periods to lower the total bill allowing the consumer to avoid the higher slab rates.

The consumer services center has pre-printed forms for the most common adjustments—extensions of due date and installments. The installments apply only to the outstanding arrears. The consumer must pay the current charges and the first installment. The deferred amounts may be charged a mark up at the prevailing bank rate (currently 14% apr).

Adjustments to consumer bills can be made and approved at any center, but it must be returned to consumer's revenue office for data entry. The problem that may arise is the time required to deliver the adjustment to the consumer's revenue office and the time the adjustment is actually entered into the computer. The data entry for the adjustment is sent to the computer center in the same batch that contains the meter readings for the month. If there is a substantial time lag, the consumer may have to return to the billing center for another billing adjustment. In other words, the back office procedures do not follow through with actually adjusting the consumer records.

### Payments

Payments to FESCO can be made at any banks that have teller arrangements with FESCO, at local post offices, at NADRA kiosks, or electronically. The FESCO computer centers receive 30-35% of the payments through NADRA. The rest are from banks and Post Offices.

As payments are received, the pay points prepare a scroll documenting the customer account and the amount paid. If the banks have online facilities the customer information may be transferred electronically. For those pay points without online facilities, scrolls and payment stubs are physically transferred to the revenue office. The revenue office reconciles the number of stubs and scroll entries; this process usually takes only one business day. If the bank forwards the scrolls and the payment stubs daily, it takes three days from the date the consumer makes his payment until it is received by the computer center. Personnel at the computer center will scan the payment stubs and reconcile the amounts to the scrolls.

Pay points will not accept payment amounts less than the amount indicated on the printed bill. If the bill has been adjusted by the utility, the billed amount is adjusted, with the adjustment written on the bill. However, since bills are bar coded, adjustments require manual intervention when scanning the stub for data entry. The actual due date is included in the bar code. While scanning at receipt, the computer will adjust the amount billed for the late penalty. If this does not agree with scroll, the scroll amount takes precedence.

The money, net of collection fees, is usually transferred to FESCO's collection account daily. The timing of fund transfer is dependent upon the agreement with FESCO and the pay points. FESCO closely tracks the receipts of scrolls and funds. If not received per the agreement, a letter is sent to the bank manager inquiring why the remittances were not timely received.

Daily postings to the consumer accounts are balanced with the bank scrolls (receipt logs) by the data entry personnel. Banks provide a weekly statement of amounts collected. The revenue office of the division will reconcile the statement with the office copies of the bank scroll transmittal documents.

### Disconnection/Reconnection

The billing/collection program automatically prepares a list of delinquent consumers who are subject to disconnection through an Equipment Removal order for all consumers who have not paid their outstanding balances within the grace period. The list is reviewed and edited by the billing supervisor and the revenue officer. The revenue officer has the authority to selectively delete consumers from the list, and the Equipment Orders for disconnection are thereafter cancelled. The actual disconnect list is manually prepared because of the time lag between the computer preparation and adjustments for payments received.

The list and the equipment orders to be executed and the cancelled orders are sent to the revenue officer. The orders are sent to the technical department to be executed. On a periodic basis, the revenue officer is required to review the status of equipment orders to ensure that services have been disconnected.

When equipment orders are executed, FESCO technicians remove meters and services from the customer's premise, all of which is deposited and stored in the subdivision warehouse.

If the consumer pays all amounts due within one year, service and meter are re-installed. After one year the equipment is returned to division stores. Should the consumer pay his bill after one year but before three years have passed, the consumer may be reconnected, but the consumer is required to pay for a new service connection. The consumer is credited with the depreciated value of the equipment removed, but must pay for a new service and meter. After three years, the consumer is required to pay a new current security deposit and the full equipment costs.

### Customer Service

Consumers may lodge complaints at any of the Customer Service centers and at the subdivision offices. The complaints are registered in log books according to the type of complaint. The customer service personnel have the authority to adjust consumer bills up to 500 units (kWh) and to provide up to 5 installments for bills less than 10,000 rupees.

Customer service personnel need to be made aware of the actual procedures of the FESCO. The procedures are not applied consistently. As an example, the installment complaint form clearly states that the installments are allowed to recover the outstanding arrears. A review of one bill shows that the amount paid the previous month was less than the current charges. Another consumer was required to pay all current charges and his arrearage was bifurcated.

At the local levels, there are no dedicated customer service representatives. Complaints are handled by the SDO and XEN. If the complaint requires an adjustment to the customer's bill, the change is entered onto the bill and the customer is free to go pay his bill. Most items entered as a bill complaint is the consumer's request for a duplicate bill.

The majority of complaints relate to supply failures. However, the record keeping methodology is such that is difficult to determine the number and cause of complaints. Various reports provide conflicting numbers.

### Commercial department organization

The FESCO Chief Executive Officer (CEO) responds to the board of directors and is responsible for representing the company in the greater Faisalabad community. He manages all headquarter functions, and oversees field operations that are managed by Circle Superintendent Engineers (SEs). Divisions in turn are managed by Executive Engineers (XEN); and Sub-divisions are managed by Sub-Divisional Officers (SDO).

The Customer Services directorate is managed by Manager Commercial/Director Customer Services (CSD), who reports directly to the CEO; the Manager of MIS reports functionally to Manager of Customer services, and administratively to CEO.

The Deputy Commercial Manager (DCM) is posted at circle level and reports functionally to CEO but administratively reports to the Superintendent Engineer (SE) of circle. The Deputy Manager (MIS) is posted at the circle computer center, and reports functionally to DCM but administratively reports to the SE of circle.

The revenue officer posted in revenue office at division level reports functionally to circle DCM but administratively reports to the XEN of division.

The revenue office is headed by the revenue officer and is organized in 4 main sections as follows:

- Accounts Section: headed by the Divisional accountant responsible for managing the cash book, reconciliation of weekly bank statement with the cash book, reconciliation of the debtors control accounts. The divisional accountant also has responsibility for accounting matters under procedures laid down in the divisional accountant Manual.

- General section: headed by commercial Superintendent responsible for receiving duplicate copies of certain specified application forms and other connection documents from the sub-divisional Offices, maintaining connection application registers and files for each consumer.

- Billing control section: responsible for controlling meter reading and data delivery to computer center; ensuring that billing is correct; making adjustments to inaccurate or incorrect bills; issuing disconnection notices, preparing certain management reports and statistics, bill dispatch.

- Debtor's control section: responsible for controlling the computer prepared debtors ledger, balancing ledgers, carrying out debt recovery action, debtors control reports and statistics.

The following section summarizes a review of the value of changes to FESCO commercial practices

### Analysis of Changes in Revenue Cycle Practices

During the month of October, Rs. 6,066 million were collected. If the collection period were reduced by just 10 days, Rs. 16 Million could be generated assuming an annual interest rate of 10%. Potential savings accrued from improved meter readings are yet more substantial, and if there were a better mechanism matching new connections with an increase in customers billed. Consumers are not billed when the billing center fails to receive notice that a consumer has been connected or reconnected. In many cases, the consumer is billed after a period of delays, and the utility makes concessions by allowing installments or even forgiving a portion of the bill.

The revenue system could work more effectively if the practices and procedures were implemented with greater discipline. FESCO performs routine inspections of subdivisions noting conditions of the workplace, procedural compliance, and various statistics. There is no standard format or indications of corrective actions. Many of the registers were not produced or were noted as incomplete. There have been complaints that work cannot be done because the staff is too busy filling out the registers.

However, it is the undocumented transactions (aka administrative losses) that are worrisome. The calculation of technical losses and energy accounting would allow a better reconciliation of deliveries and amounts billed. Comparing losses of the current period to prior periods is not an accounting of energy. It just perpetuates the previous error.

Because there is much reliance on the meter reader in the revenue cycle, more rigorous controls and oversight are required of the meter reading cycle. It is impossible to assert effective transaction control if there is collusion between the meter reader and other parties in the revenue cycle. Although there are procedures in place that would provide some of the needed oversight, the procedures are not adequately observed nor performed in a timely manner. FESCO does a few meter reading checks and compares the readings with the readings recorded in the Kalamzu books. However, manipulation can occur while preparing the reading lists used for billing purposes. The preparation of meter reading lists can be eliminated altogether through a change in technology – or by a combination of changes such as automated meter reading with handheld devices.

Distribution losses may be hidden by adjusting consumption of selected meter reading upwards. The addition of consumption to various consumers can be used to manipulate revenue and allow managers to meet performance targets. Some of this manipulation may be uncovered during data entry. But with the addition of automated meter reading, the data is uploaded to the billing program eliminating the need to manually enter the data.

Meter routes should be organized around metered transformers and all of those meters should be read on the same day. A reconciliation of energy needs to be made to for each transformer to determine the reasonableness of the energy billed. If it is not reasonable, there may be theft, meters were missed or recorded incorrectly, or there may be a problem with the system.

To prevent newly connected/reconnected going unbilled for several periods, logs of prepared service orders and status should be kept and reported. Service orders should be in duplicate and copies sent to the revenue office, who should be responsible to follow up when the order has not be cleared within a reasonable time. When a meter is reported as defective it should be replaced immediately. If the utility had its own meter lab, it would be possible to fix it, recalibrate it and place it back to stores to be reused.

If it is not economical to repair the meter, it should be dismantled for spare parts that may be used in future repairs.

When the service connection order is prepared, the consumer should be established and entered into the meter reading list and the reader's Kalamzu book. The reader should track the progress of the installation while reading meters and would be in the position to note the meter number and the current reading during the first cycle that the consumer is connected. The consumer's billing data can be pre-listed and the consumer will be ready to be billed once the connection is completed.

If the customer can be given a reasonable level of service, he may not find it necessary to procure electricity through nefarious means. FESCO will have better control of its system, dangerous situations may be eliminated, and satisfied consumers are more likely to pay their bill regardless of the "outlandish" tariff rates.

### Meter Maintenance

Meter surveillance is done by the M&T (metering and testing) teams, but the primary responsibility rests with the meter reader. Industrial meters are checked by an M&T team every 6 months. The testing procedure is performed in the presence of the industrial consumer. Other meters will be tested if a consumer requests a test or the utility employee reports an abnormality in consumption or there appears to be physical damage. If the meter slows gradually with age, it will very likely go undetected. Moreover, many meters are located on poles or high on the outside walls of the premises, the meters are above eye level. It is doubtful that those meters are actually read and any damage or abnormality would go unnoticed.

Taking into consideration field observations of meter reader management, location of meters, and the state of many of the meters, it is doubtful that all meters are read and inspected each month. In theory, meter readers should inspect the meters during the reading process and report any abnormalities and damage to the meter each month. However, there was scant evidence of meter status reports in FESCO revenue offices.

Meter replacement is done if the meter is reported as defective. The meter discrepancy report, and log of defective meters, is updated by the meter reader; defective meter logs may not be kept in some subdivisions. The logs that were reviewed revealed that the entries are not numerous and most were declared to be working by the line superintendent after the M&T team checked the meter. It may take several months to replace defective meters. At the end of November, 9844 meters were declared defective, 7584 for 2 to 6 months and 82 for 7 to 12 months.

Meter serials numbers not routinely recorded when new meters are received from the manufacturer. Meters are "managed" at the sub-division level. When meters are installed, the serial number is recorded in the Kalamzu book, and in the consumer's computer file.

### Advanced Metering

To improve the billing process, automated meter reading (AMR) meters should be installed not only on the premises but also at delivery points. AMR meters will eliminate transcription errors and reading errors; manipulation of readings on behalf of consumers or management. The data can be loaded directly into the computer system. AMR meters result in real time consumption data provided directly to the utility commercial system. Consumer usage can be monitored from a remote point of access (such as the commercial office).

Pre-payment meters may be used to allow consumers to purchase energy before using it. The basic principle of the prepayment system is that customers estimate how much energy they require before they consume it, and buy payment tokens (electronic or hard copy) beforehand from a vendor. The prepayment meter is then credited with the value of purchased credit. After the prepaid credit has been consumed, the meter automatically disconnects until additional credit is purchased and programmed into the meter. While there are advantages to the consumer (no more overbilling, control of the amount and timing of payment, ability to monitor consumption, etc.), these advantages will have to be communicated to consumers to sell the program to them. There are obvious financial advantages for the utility, of course.

### Meter Reading and Bill Delivery Practices

Although meter readers are assigned less than 200 meter reads per day, many are not able to read the full complement of meters. They are required to provide their own transportation without reimbursement. The result is that many "readings" may be estimated or simply falsified. This is a serious problem for the DISCO and for the consumer.

FESCO declares that meters readers are being rotated. Some subdivisions rotate readers on a monthly basis; others every six months. Rotations may be in form only, as readers may exchange reading lists once out of the office.

Meter lists and routes are not defined for individual feeders, which complicates energy accounting. Trade unions monopolize areas allowing employees to retain designated routes within specific subdivisions. This leads to a lack of objective meter reader control that in other countries has resulted in developing and sustaining personal income streams through fraudulent meter reading practices. In cases where meter readers are not rotated or constricted by trade union representatives, this has led to a lack of transparency, accountability and the required level of checks and balances that is needed for program integrity.

Bill distribution is performed in the urban areas on a house by house basis, while in the rural areas bills are left at a central location. Since bill delivery requires that the employee provide his own transportation, this leads to less than adequate delivery practices in many cases. This problem leads to delayed delivery wherein consumers receive bills with a shortened period to complete the payment process. Because the bill preparation process is often delayed, the delivery of bills is delayed.

### Theft Control

With a less-than-ideal meter reader rotation, opportunities for collusion with the consumers are numerous. Practices that can result from collusion include falsifying meter readings (recording low or high consumption as needed), and/or declaring the meter defective so that estimated bills which would be lower than the actual consumption. Because the time required to replace the defective meters is lengthy, invalid meter readings could continue for some months. Collusion could also result in reporting lower consumption levels to ensure that the consumer to be billed at the lower slab rates.

There are numerous checks prescribed in the NEPRA guidelines, and adopted by the DISCOs to audit meter readings, but field reports indicate that these procedures are not followed. XENs and SDOs claim they are too busy to make time for meter reading audit procedures.

Meter readings submitted for billing purposes are reportedly influenced by the management of the divisions and subdivisions in order to meet revenue and loss targets. Some consumers are overcharged because of excess readings to compensate for the under billed consumers. Readings are frequently adjusted to manipulate the slab tariffs to create revenues. Over a period of a few months, the actual meter readings will be correct, but the consumer has been charged at the higher rates which are not fully compensated when the consumption is lowered.

### Meter Integrity and Meter Reading Practices

When a meter is declared to be defective, the consumer is billed on the average consumption of the last 11 months. Because it is the meter reader that declares a meter defective, it is possible for collusion between the reader and the consumer, especially during the peak season of summer. Therefore, the reader declares the meter defective and the consumer is billed on the lower estimated consumption. Since it takes 3-4 months for the meter to be replaced, the air conditioning season is over before the consumer is billed on actual consumption.

With meters located 7-10 feet above the ground, it makes it difficult to detect meter tampering. The quality of service installations is problematic; many of the meters are poorly installed. Employees sometimes have to use the tools and small parts (screws, etc.) furnished by the customer. The meters may be loose, crooked, etc. and so it would be difficult to state that someone has tampered with the meter.

### Customer Information System

Presently, FESCO distribution system practices are characterized by manual and cumbersome processes, inadequate controls, insufficient commercial focus, limited transparency and lack of reliable information.

As a result, commercial operations are highly inefficient with substantial revenue leakages and poor customer orientation. The use of information technology to improve efficiency and effectiveness is inadequate. Several standalone applications are limiting ability to effectively interface and integrate either with other applications or with potential applications to be deployed in the future. Although the level of deployment of IT varies significantly from one DISCO to another, the key applications have been in multilevel aggregation of data or large-scale data processing. In other words, IT is being used as a tool to address a specific issue or two at a time and not as a long-term, holistic strategy.

The following are some examples of inefficiencies:

- A number of new connections are pending even after paying the capital cost and security amount because there is no material available in store. Availability of service materials is not confirmed prior to issuing the Demand Notice. An integrated materials management and work order module would allow FESCO to order materials when needed, and connect consumers on a timelier basis.
- FESCO does not have digital records of paid demand notices.
- Applications for new connections are managed manually (a number of hands and desks are involved), without any level of automation.
- Late submission of consumer consumption data to the computer center for billing new connection results in delayed billings and revenue recovery
- The commercial processes are reasonably well designed, but the lack of electronic technology creates significant delays, and moreover, opens tremendous vulnerabilities that can be relatively easily exploited
- The customer services activities are not automated. One significant problem lies in the fact that the customer account records cannot be updated real time, i.e. customer bill is revised manually but in many cases the same amount appears as an arrear in the next month's bill.
- Delayed billing due to non distributed billing/data processing system increases bill processing and bill collection cycles, i.e. computer center waits for data of all sub-division of all division of 4 circles before processing.
- Only one month's billing information is available on computer master file, historical data is off-line, i.e., in tape cartridges. Thus no trend analysis/drilling to find the gray area of business could be performed.
- Delayed cash processing/posting (more than 10 days in some cases) delays the cash reconciliation process. Also management gets information very late.
- Delay by banks in remitting money to Company's account due to cash collection policy.
- No historical computerized record of service complaints.
- No computerized system for transmission loss calculation.
- Field staff is engaged in a number of duplicate activities, i.e. maintenance of documents/registers at many levels, copying information from one form/register to another form/register etc.
- Unwillingness/non cooperation by non-IT users to use new technologies is a key hindrance towards improvement in customer/utility relationship.

## 2.5 HUMAN RESOURCE ASSESSMENT

### 2.5.1 Overview

Management and staff interviews held at FESCO, have led to the conclusion that, while FESCO appears to have made significant progress in retailing electric power to its customers, it still faces significant challenges to modernize its HR policies, procedures, and overall HR functionality. It has yet to develop a strong and progressive corporate culture, in which management and staff have well-defined and clearly laid-out responsibilities, where management is endowed with adequate authority and have accepted and understood their accountability. For all intents and purposes, FESCO today employs a very close facsimile of the WAPDA's legacy in HR policies and procedures; it does not reflect the values and attributes of a modern, independent, and well-managed electric distribution utility. Results of the interview process showed that management is not clear whether it reports to the Board of Directors, to PEPCO, or to the Ministry of Water and Power. Partly because of this, governmental (external) as well as internal political pressures are commonly and effectively exerted on FESCO senior management – which is itself selected by PEPCO, not by the Board of Directors.

### 2.5.2 Summary of Key Findings

The following are key findings of the PDIP review of human resources management.

- The challenges facing the human resource infrastructure are serious and entrenched, because DISCOs have been subject to both internal and external manipulation – by political sponsors, government agencies, trade unions, and by employees themselves.
- FESCO has yet to develop a strong and progressive corporate culture, in which management and staff have well-defined and clear responsibilities, and where management is endowed with adequate authority and all employees have accepted and understand their accountability
- Results of the interview process indicate that management is unclear as to whether it reports to the Board of Directors, to PEPCO, or to the MWP. Partly because of this, outside governmental as well as political pressures are commonly and effectively exerted on FESCO senior management – which is itself selected by PEPCO, not by the Board of Directors.
- There is a lack of transparency in hiring and career advancement within the Company. Clear and transparent HR-related rules and regulations are lacking, without the necessary checks and balances in the system to foster an atmosphere of fairness and impartiality with respect to the annual performance review process.
- The compensation system makes no distinction between "performers" and "non-performers" nor does the system reward high risk jobs, such as linemen.
- DISCO salaries, including FESCO's, are artificially low as an result of continued adherence to WAPDA salary scales, but while this may result in savings to DISCO operating cost, this is in fact artificial savings; one cannot expect employees who are perennially underpaid to function at high levels of performance. In other countries, low compensation levels have been linked not only with poor performance, but also with tendencies to engage in corrupt work practices.
- The operational audit revealed that FESCO has not yet completed updating job descriptions for key FESCO management and staff positions. Rather, the position descriptions for senior management remain the Area Electricity Board position descriptions. These documents lack clear and specific descriptions of roles and responsibilities; descriptions of required educational background and professional experience; descriptions of core competencies; and a description of the scope of authority and responsibility.
- While FESCO provides capacity and safety training at a central training center, the linemen trainees are trained with tools that are not commonly provided to line workers. The line workers are, in general, not provided basic line tools and equipment required to perform corrective maintenance and line operations in a safe and effective fashion.

- Health coverage for employees and their dependents is poorly structured and imposes considerable hardships on employees.
- FESCO senior management has a vision, but the vision has not been effectively communicated to mid-level management and staff. It is therefore not well understood by employees.
- Recruitment of talented staff persons is hampered by the lack of effective position descriptions, comparatively low wage scales, and willful interference in hiring decisions.
- FESCO does not employ a corporate performance management system. Instead it uses the standard GOP annual performance review program that is not based upon goal setting and objective evaluation of performance.
- FESCO has not yet developed an employee handbook.
- The Company does not have a comprehensive training and development action plan and generally lacks training or capacity building programs. Training that is offered is mostly aimed at allowing employees to advance within the DISCO system, as opposed to skill development. Training facilities are ill-equipped, with instructors who have themselves not been retrained in many years, and with training manuals that have not been updated in two decades or more. The training program also lacks post-training impact evaluation to judge effectiveness.

### 2.5.3 Analysis and Discussion

Historic WAPDA hiring and promotion processes still prevail in FESCO, as they do in all DISCOs. That is, there exists a lack of transparency in hiring and career advancement process, with career advancement based upon seniority rather than performance, and hiring often dictated by external agencies such as the Ministry of Water and Power and PEPCO. Clear and transparent HR-related and other rules and regulations have not yet been established, nor have the necessary checks and balances required to foster an atmosphere of fairness and impartiality with respect to the annual performance review process. The corporate culture of FESCO has not evolved to reflect a modern, independent electric distribution utility. Employees appear to be locked in a historic WAPDA or public sector mindset, where once employed, an employee continues to be employed and even gets promoted based on seniority, with scant regard to performance.

As in other DISCOs, FESCO faces the challenges of commercializing energy distribution over large areas, managing capital resources to finance system expansion and maintenance, upgrading its billing and receipts structure, etc. This requires professional HR, management, technical and a variety of other skills and experience.

In the past two to three decades, where there has been substantial expansion in the system, there has been little change in the internal infrastructure, policies and procedures. The organizational structure is inherited from the WAPDA years, with little regard to aligning FESCO to the changed business, engineering and financial environment.

FESCO lacks a clear, proactive and structured training and capacity building program. This shortcoming needs to be addressed on a priority basis. Moreover, the company has not yet engendered a customer oriented approach to build trust and confidence in its consumers.

#### Modern HR Practices

Throughout FESCO, staff at all levels, stressed the need for fair and transparent HR practices. The need is for an HR management system that is based upon accurate and up-to-date job descriptions, key performance indicators, and fair and rigorous appraisals. This is necessary to establish the foundation of a progressive business entity. According to our assessment, the absence of a proper HR management system is the root cause of problems at FESCO. Corrective actions need to be taken in this area and other areas like commercial, engineering and financial in order to get the desired results.

FESCO has job descriptions for all positions, however these are old and out-dated and there is a need for a comprehensive review and modification process in order to incorporate main job functions responsibilities and performance indicators.

A modern HR system complete with newly defined policies and procedures would include the following attributes and characteristics:

1. Position descriptions, clearly indicating the main job functions, key responsibilities, performance indicators, educational requirements and training certifications for all positions in the Company.
2. A fair and transparent hiring process that allows the HR department to recruit staff in an objective manner, without any external or internal influence and interference.
3. A merit based career and progression structure and policy which defines the prerequisites for promotion, and which should be applicable to all positions.
4. A progressive and competitive compensation and benefits package, independent of government compensation levels, and adjusted to reflect market rates for all professional and skilled positions.
5. A newly defined health policy that provides increased flexibility to employees, allowing them to seek and receive health care beyond the WAPDA-centric health facilities.

### Analysis of Manpower

Long-term performance improvement will require significant changes in human resource management, and human resource capabilities. A review of manpower statistics was undertaken to begin to understand how resources are allocated, and how well-prepared FESCO employees are to meet the requirements of their positions. Table 2.11 below summarizes FESCO manpower statistics. It indicates shows that only 6% of FESCO staff have completed university; about 56% of the workforce is virtually illiterate, and less than 1% are females.

**TABLE 2.11 MANPOWER STATISTICS**

| Manpower Distribution | Strength |
|---|---|
| **TOTAL** | **17,244** |
| Total Officers | 338 |
| Total Officials | 16,906 |
| Regular Employees | 15,368 |
| Contractual Employees | 1,815 |
| Daily wages Employees | 61 |
| University graduates | 1,062 |
| Secondary education | 6,554 |
| Primary & complimentary | 2,875 |
| Others | 6,753 |
| Female | 104 |
| Male | 17,140 |

Source: FESCO HR Department Data as December, 2011.
* Updated information with reference to PEPCO DISCO Performance Statistics, June 30th, 2010, due to manpower sizing, attrition etc.

Table 2.12 shows that an enormous number – approximately 57%, are not properly categorized by occupational streams (those shown as "Others (schools, civil works, etc.)", and are not employed in the core utility business. This leads to the conclusion that FESCO has either not assigned employees to

positions relevant to meet its needs, or that it has become an employment center that pays for services that are not required. Thus, it is highly likely that many services could be effectively out-sourced.

A detailed study will be necessary to carry out long term manpower planning, with the objectives of having an educated employee workforce, officers having business and management skills, and for addressing the gender imbalance.

**TABLE 2.12 DISTRIBUTION OF EMPLOYEES BY DEPARTMENT**

| Employees by Department | Strength |
|---|---|
| Executives/ Directors | 258 |
| Human Resource Department | 47 |
| Finance Department | 237 |
| Operation department | 4,331 |
| Commercial & Sales Department | 434 |
| Administrative Department | 1,169 |
| IT/ MIS Department | 222 |
| Construction Department | 18 |
| Training Department | 64 |
| Audit Department | 92 |
| Security department | 533 |
| Others (store, school, civil, other) | 9,839 |
| **Total** | **17,244** |

Table 2.13 below provides a snap-shot of FESCO employee time in service. This shows that 62% of the employees have been in service for more than 11 years. This shows that a significant number of FESCO employees have been in the legacy WAPDA organization for many years, and that the challenge of changing the corporate culture will be significant. The demographic distribution shows that, a reduction strategy will not be able to rely on attrition through retirement alone and, that other strategies will need to be considered when reductions in force are contemplated.

**TABLE 2.13 FESCO EMPLOYEE SERVICE PERIOD**

| Year Of Service | Strength | Age bracket (Years) | Strength |
|---|---|---|---|
| 0-5 years | 6,006 | 30 and below | 2,472 |
| 5-10 years | 2,218 | 30-40 | 4,107 |
| 10-20 years | 1,590 | 40-45 Years | 4,761 |
| Over 20 years | 7,430 | 45-50 years | 3,210 |
| | | Over 50 years | 2,694 |
| **Total** | **17,244** | **Total** | **17,244** |

## Compensation Analysis

A detailed market survey will be required to evaluate market-competitive levels of compensation for FESCO employees. The data collected and evaluated thus far indicates that salaries and benefits are far below reasonable levels needed to retain valued employees.

DISCO regular employees are compensated through legacy WAPDA "basic pay scales" (BPS), a standard compensation package of the Government of Pakistan. Salary-related benefits, such as allowances, bonuses and increments are also treated under the same system. Under the system, there is no distinction between "performers" and non-performers". The system does not reward high performers, or jobs with high risk, such as linemen, who prefer to move to other positions or ask for early retirement.

An exception may occur when an employee is hired as a "contract employee" - occasionally hired as DISCO directors (e.g., directors of HR, Legal or Finance). The pay package for contract employees is considerably higher than formal FESCO employees and is not constrained by the Government Basic Pay Scales (BPS). The Director, Finance was hired on this basis and draws a salary that is considerably higher than salary paid to the CEO.

Private sector employees are paid several times more than FESCO employees. For example, the CEO of NESPAK earns approximately four times as much as the FESCO CEO (see Table 2.13). An even more striking comparison is that, a newly graduated engineer hired in the private sector would draw a salary equivalent to that of the CEO.

To arrive at a more definitive answer to the question of desired compensation package in a private sector entity, there will be a need for a market-based survey, with a much broader scope, and presumably carried out by a professional HR firm. However, such a compensation and benefits package will be possible only when the Company is freed from government's control.

**TABLE 2.14. COMPARISON OF FESCO AND OTHER INSTITUTIONAL SALARY LEVELS.**

| DISCO | | NEPRA | | NESPAK | | PTCL | | Level |
|---|---|---|---|---|---|---|---|---|
| | Rs'000 | | Rs'000 | | Rs'000 | | Rs'000 | |
| CEO | 135 | Chairman | 382 | CEO | | President | | CEO |
| Director / Chief Engineer | 111 | Director General | 338 | Executive VP | 278 | Executive VP | 425 | Director |
| Manager / Superintend Engineer | 87 | Director | 265 | General Manager | 217 | General Manager | 287 | Manager |
| Deputy Manager / Executive Manager | 71 | Deputy Director | 203 | Principal Engineer | 114 | Senior Manager | 170 | Assistant Manager |
| Assistant Manager / Sub Div Manager | 60 | Assistant Director | 140 | Junior Engineer | 84 | Assistant Manager | 90 | Executive |

## Organization

The organizational structure employed by FESCO and other DISCOs is designed to employ distribution circles as large geographic management units that are managed as full service utilities – less engineering planning. Circles are managed by Superintending Engineers (SEs) who are empowered with responsibility to manage all operational activities except planning and engineering functions, which are managed at the FESCO HQ level. That is, commercial functions (meter reading, bill processing, and bill delivery); line operations, connections and disconnections are all supervised by the SE and his staff at the

circle, division and sub-division levels. Payments are made by consumers to designated pay points; DISCO employees do not handle payments from consumers.

This arrangement creates an internal conflict within the distribution circle; since commercial operations are the cash register, so to speak, of any utility, the commercial department should not report to the operations department. The operations department manages the operation and maintenance of physical assets, focusing on power quality and reliability. The commercial operations measure the success of the operation department and therefore must be independent and are best managed by managers and staff that have the educational and experiential background, as well as the institutional objectives aimed at optimizing distinct objective functions. Commercial activities have the objective of effectively managing the process of connecting and/or disconnecting services; metering energy consumption; recording consumption data; billing consumers for energy consumed and other services provided; and, collecting receivables from consumers. Distribution system operations focus on operating and maintaining the distribution system infrastructure, including recording bulk energy transfers into and out of substations; performing substation and line maintenance; and, management of minor system expansion activities.

FESCO's present organizational structure has commercial personnel reporting to engineering managers, circle managers reporting to the CEO; and far too many managers reporting to the CEO. The CEO, whose principal responsibility is to ensure that the DISCO is moving towards progressively effective and sustainable operation, should not be saddled with administrative responsibilities that create a distraction from the chief goals of the DISCO—financial sustainability. Under the present structure, the CEO has far too many direct reports, including all senior operating staff. That is, engineering planning, DISCO operations, DISCO commercial functionality, DISCO administration, and DISCO financial management should be managed on a day-to-day basis by highly competent managers without CEO involvement, other than to set objectives and to review progress towards these higher level achievements.

### Human Resources Organization and Management

In additional to functionality challenges, the human resource department is faced with organizational issues. First and foremost, the HR Director has a dual responsibility to oversee human resource activities, but also to act in the role of FESCO Secretary, which is an administrative position that should report to the Board of Directors.

The Manager, Labor & Litigation currently reports to the Director, HR/Administration, while the legal counsel should report directly to the CEO. In fact, it is proposed that this function should be up-graded to Legal & Corporate Affairs.

All HR functions are currently managed in the FESCO home office; there are no HR representatives at the circle level of FESCO. FESCO relies upon administrative staff to manage human resource issues at the circle level, but these employees have no training or expertise to conduct human resource training activities or to advise employees on their rights and obligations to the company.

FESCO has not yet established a human resource information system that would allow them to digitaize all HR data, reports, personnel files, performance management programs, etc. This has become an essential feature of modern human resource management functions – and it is completely absent in

### Health and Safety

The records of the previous three years show that FESCO has a poor record of safety in its operations. This is attributed to a lack of implementation of safety procedures and unavailability of safety clothing and equipment. The accidents met by the public are explained by FESCO as accidents occurring during unauthorized hooking to the LT lines by outsiders, who either do this by themselves or in collusion with the utility linemen staff. The rate of such accidents is quite high.

Safety training does not meet the needs of line workers as evidenced by the high number of injuries and accidents in recent years at FESCO. FESCO has not developed a safety program with safety policies and procedures that govern linemen working conditions, provide ongoing training, an incident reporting system to record and evaluate all workplace injuries, and enforcement practices and procedures for safety in line construction, maintenance, and system operations.

Safety is not given its due importance with respect to either FESCO employees or its consumers. Safety training to advise consumers on the proper use of electric power – and the risks involved in inappropriate contact with power systems – has not been adequately addressed. FESCO has not yet sufficiently developed and deployed safety awareness programs.

A safety program will require a significant investment in training, protective clothing, tools, and program monitoring. It will require a cultural shift in the workplace, all aimed at dramatically reducing accidents and deaths. In addition, FESCO employees would benefit from a diversification of health care options moving away from the WAPDA health facilities as the primary provider of services, to increased options to provide primary care for employees and family members.

The health coverage for the employees and dependents is poorly structured and involves considerable difficulties for employees. There is a lack of choice for employees or their dependents to obtain medical care (out-patient and in-hospital) of their choice. Employees and dependents are forced to use the WAPDA central hospital in Lahore or a peripheral health care center, requiring considerable travel, or which do not possess the facility or required services. Alternatives, such as better health care through insurance, or paying a fixed proportion of salary for outdoor treatment, have not been evaluated or brought up for serious consideration.

### Vision and Internal Communications

The senior management of FESCO has a vision, but the vision is neither well communicated nor understood by employees at the lower level. The FESCO organizational structure should include management units with clearly defined objectives and linkages, each serving the goals of the Company, contributing to its growth, and the plans in order to make this into an autonomous entity. In particular, a Health and Safety Directorate needs to be established, with higher levels of responsibilities; the Company Secretary office should be separate and not under HR; it could also be entrusted to handle corporate and legal affairs; the training and staff development should be upgraded with clear lines of duties and responsibilities, aligning staff training needs with those of the Company. It will also be useful to establish a strategy and business and manpower planning unit, to look into medium and long term plans and anticipated changes, aligning the Company progression into an autonomous utility entity.

### Recruitment

Effective recruitment begins with well-defined position descriptions specifying core competencies, experience, level of responsibility and authority, and compensation levels. Once these attributes are defined, the human resource department can advertise for candidates to fill vacancies both within and outside of the Company.

As mentioned above, the position descriptions even for the most important jobs in FESCO are not well defined, and not specify core competencies, required educational background or level of responsibility. The position descriptions are too general to be used effectively to guide the recruitment process.

The compensation package is certainly well-known within Pakistan, but it is not competitive with similar private sector jobs. It is certainly not an inducement to attract well-qualified candidates to assume key roles within FESCO.

Lastly, the recruitment process itself is often short-circuited by direct appointments made by PEPCO and/or the Ministry of Water and Power. This practice violates the concept of an independent electric distribution utility, and forced FESCO and other DISCOs to absorb professionals into positions for which they are likely not well suited. A more objective, independent, and transparent process is required to support operational improvement and DISCO independence in the future.

The policy of reserving 30% of published vacancies for employees' dependents has a direct negative impact on the type and quality of candidates that are selected. In 2009-2010, 248 or 18% out of a total 1,356 new recruits were based on this quota. It is imperative that fair and transparent policies and procedures are adopted to put a curb on both these menaces.

**Performance Management System:** FESCO does not employ a corporate performance management system. In 2009, FESCO (as other DISCOs) changed the annual evaluation system from the Annual

Confidential Reports (ACRs) to Performance Evaluation Reports (PERs). The ACRs were confidential, in that even the rated employee was not privy to evaluation. The PER, which is essentially the standard annual performance review program proposed by PEPCO, uses a different format, but essentially has the same weaknesses: it lacks goal-setting and an objective evaluation of performance. The evaluation, unless it is a negative one, is seldom shared with the employee.

A robust performance program needs to start with well-defined position descriptions that establish the performance expectations of employees, the core competencies, reporting requirements, and professional demeanor that is expected of each employee. The process should include goal setting, discussion between the employee and supervisor at the outset of the year, and an objective review and evaluation process, midyear and at the year end. For all intents and purposes, advancement is based almost entirely on seniority – not on achievement, so there is little incentive for employees to improve skills and to generally invest themselves in their jobs.

### HR Policies and Procedures

**F**ESCO has not developed a consolidated and easily accessible set of HR policies and procedures manuals for staff and management. From recruitment to termination, clear cut rules and procedures are required. In place of policies and procedures that serve FESCO needs as a large and growing corporate entity, FESCO has continued to employ legacy WAPDA HR policies that reward longevity and seniority, rather than high performance and dedication to FESCO's mission. Many of the legacy HR policies and procedures date back to the early 1980s, and in some cases have little relevance to high functioning electric distribution utilities. The longest serving HR Department staff is usually the one who knows almost all rules and even how and where to find them. Staff, particularly from outside the HR department are, therefore, greatly disadvantaged, because they are dependent upon the Department even for small things, such as leave regulations, etc. In such a scenario, fair HR operations that are transparent and equitable don't take place. Where policies or procedures do exist, there is an inadequate implementation, leaving the door open to influences, both internal and external.

### Employee Handbook

FESCO has not yet developed an employee handbook, a concise document providing essential guidance to employees on policies and procedures – the do's and don'ts to help guide employees. Ideally, such a handbook should be on the web, in booklet form and in both English and in Urdu.

### Employee Health Coverage

The health coverage for the employees and dependents is poorly structured and involves considerable difficulties for employees. There is a lack of choice for employees or their dependents to obtain medical care (out-patient and in-hospital) of their choice. Employees and dependents are forced to use the WAPDA central hospital or a peripheral health care center at the Circle level, requiring considerable travel for the employees or their eligible dependents. These centers are ill-equipped, poorly staffed with unqualified health care practitioners, and often do not possess the facility or required services. Alternatives, such as better health care through insurance, or paying a fixed proportion of salary for outdoor treatment, have not been evaluated or brought up for serious consideration.

### Training and Capacity Building

Like the regional training centers (RTCs) at many DISCOs, the FESCO RTC in Faisalabad requires substantial rehabilitation, both in terms of the building and training materials. Based on discussions with training staff at Faisalabad and visits to the facilities, it is clear that training tools, manuals, other aids, are no adequate to meet the growing needs of FESCO. For instance, linemen are trained with tools that are not commonly available or provided to the line workers. The line workers are, in general, not provided basic line tools and equipment required to perform corrective maintenance and line operations in a safe and effective manner.

FESCO does not have a comprehensive training and development action plan and generally lacks training or capacity building programs. The training that is offered is mostly targeted to allow employees to advance within the organization, i.e. it prepares employees for promotions. Training is not really oriented towards substantive skill development. FESCO has not designed or implemented an effective needs assessment plan which is needed in order to design future training programs. The training facilities are ill

equipped, with instructors who have not been retrained in many years, and with training manuals that were developed in the 1980s (under a USAID program) and have since not been updated. The training program also lacks a program to perform post training impact evaluation.

While a complete training needs assessment will be needed for FESCO to provide a detailed identification of specific training needs, the PDIP team has identified essential training needs that should be addressed at the earliest possible date. These include, but may not be limited to the following:

***Commercial training:***

1. *Meter reader training.* This training should focus on familiarizing meter readers with new metering technologies; training meter readers to use handheld electronic meter reading devices; training meter readers to identify and record meter faults, meter tampering, and meter maintenance requirements; and ensuring that meter readers are properly oriented in carefully recording and transcribing data.
2. *Improving basic computer skills for commercial staff.* This would dovetail with ERP implementation, to ensure that commercial staff understand how to specifically manage new levels of responsibility using ERP screens, troubleshooting functions, modifying customer information, printing modified bills, and other basic tasks associated with an advanced commercial customer information and billing program.
3. *Customer service training.* This would orient commercial staff to think of and treat customers as valued clients.

***Engineering & Operations training:***

1. *Safety management program.* Establish a safety management program, and provide basic and advanced safety training to DISCO linemen and line superintendents.
2. *Work planning management.* Train line crews in how to work more effectively to complete tasks in a timely manner. Concurrently, train line crew supervisors in how to manage crews more effectively.
3. *Area planning and mapping.* While the long term goal for engineering staff will be to develop and deploy GIS systems, in the interim, FESCO staff could and should develop improved manual mapping and planning tools.
4. *Line design.* FESCO and other DISCOs don't really design distribution line. Rather, they use rules of thumb as a proxy for engineering design practices and procedures. This results in high cost, and often inappropriate line design.
5. *Metering theory and practice.* This would focus on training engineering staff on a variety of metering options, meter types, and metering applications.

***Finance & Accounting:***

1. *ERP training.* In financial functions, human resource functions, and material management functions of the new ERP system. While the vendor will provide very basic training on the new ERP system, there will be a need for more detailed training across a number of essential application modules.
2. *Internal audit training.* FESCO internal auditors focus on only one of several internal audit obligations as outlined in the internal audit manual – identifying low/inaccurate meter reading. Internal audit obligations are far broader than only focusing on meter reading.
3. *Updating accounting manual.* Training accounting staff in accounting best practices as specified in the revised accounting manual. Provide training in compliance with chart of accounts.

Human Resource ***Management***

1. *Basic computer competency training*. MS Office applications, management of the HR data base. Human resource staff needs to improve basic computer skills to manage modern human resource software.
2. *Human resource planning and forecasting training*. This is a more specialized training aimed at improving overall capacity of the HR department to undertake manpower planning and assessing training needs.
3. *Annual performance evaluation program design and training*. To familiarize the employees and staff in performance evaluation program.
4. *Capacity building for trainers*. This is an important training of trainers program.

## 2.6 COMMUNICATIONS AND OUTREACH ASSESSMENT

### 2.6.1 Overview

FESCO is a leading electricity distribution company with a large base of internal and external stakeholders. It serves a large customer base through a vast network of sub-divisions, divisions and circle offices. As a corporate entity, FESCO stands at a crucial transition point. Despite making considerable efforts to assume the role of a service-delivery organization, it continues to face a wide range of problems, including the growing electricity demand-supply gap.

The Company has an active Public Relations (PR) department dealing with the media for relevant information sharing. Chronic power outages and tariff increases have severely challenged the utility in the last few years. As a result, despite unceasing efforts, it has not been able to earn consumer confidence and satisfaction, which further erodes its corporate image. The role of well-thought out and well-designed communications and outreach to foster a progressive corporate culture within FESCO with efficient and timely communication for corporate effectiveness, cannot be ignored.

This section analyzes the context of internal, external and corporate communications, as well as related capabilities, within FESCO, and provides recommendations for priority areas.

### 2.6.2 Summary of Key Findings

The following are key findings of FESCO's communications and outreach:

- **Internal Protocols and Practices of Communication:** The organizational culture still follows outdated and rigid practices of internal communication. This slows down the process of transition to a modern, service delivery organization limiting progressive growth.
- **Corporate Communications and Consumer Outreach:** External communications and public outreach has been extremely restricted and limited to just a few activities which has resulted in a failure to build a corporate image and to be able to win over customers' trust and satisfaction.
- **Public Relations Department:** The Public Relations department's role is limited to media monitoring and liaison for corporate information only. It has no decision-making authority and no budget to execute any mass awareness activities. As such, FESCO only undertakes external communication at local media level and that too, in a very limited capacity.
- **Low IT Penetration:** Still following a culture of files and memos, IT penetration at FESCO is very low. Even the management is mostly not computer-literate. Usage of modern communications technology and across-the-board training for such tools was observed inevitable for a corporate shift to a more efficient, prompt and clear communication.
- **Media Mix and Products:** FESCO's outreach remains limited to press releases, shut down, procurement notices and the occasional energy conservation awareness message. The website is not maintained or upgraded. The potential of the web portal has not been explored or utilized. There is no annual calendar of outreach activities whether internal or external.

- Customer-Centric Communications: FESCO's customer services centers are not either customer or gender friendly. They are operated by mostly ad-hoc staff which substitute at these centers and have no training in handling customers or their complaints. Complaint records are handled manually and there is no digitization for fast, efficient response.

### 2.6.3 Analysis and Discussion

In a large organization like FESCO, which employs over 17,000 people in over 150 different job categories with its operations spread over eight districts, it is a daunting task to ensure fast, regular and comprehensive communication in the ranks of its own employees. The task assumes more significance due to the fact that existing communications and outreach practices are characteristic of a typical public sector organization, which relies on rigid protocols of restricted availability and access to information, with internal resistance to new modes of communication. The culture of formal communication in FESCO relies solely on letters and memos forwarded through inter-office files, personal delivery, fax and post mail. Electronic mail culture is not prevalent and the penetration of computer-based communications technology is dismally low.

While the leadership at FESCO is cognizant of the potential role of communications and consumer outreach, it is unable to take tangible actions to this end due to the incessant stress pertaining to the issues of governance, managerial capacity, resource constraints and persistent shortfall of electricity. Moreover, despite being mandated as an independent distribution company, FESCO continues to derive much of its management and communications authority from PEPCO and MWP, which further puts a constraint on its ability to exercise independent control over mass media campaigns.

With due affirmation of the above-mentioned constraints, the communications and outreach assessment was conducted to review the efficiency and effectiveness of both the internal and external communications of FESCO. The results are discussed as under.

#### Internal Communication Process, Protocols and Practices

Internal communication is based on the norms of a public sector organization. Office letters and inter-office memos with traditional protocols are the most common internal communication tool. These letters are usually delivered in person within head office and through normal post, fax or special messengers in the city and outside city. Circular notices and departmental and inter-departmental meetings are also common tools of internal communication.

The overall communication had an entrenched flavor of government correspondence which usually emphasized on tedious and unnecessary paper pushing apparently to complete one's own file. Clarity, creativity and decisive communication are the ultimate causalities as a result of such practices.

The penetration of computers was found dismally low. The sanctioned strength was determined some 30 years ago when computers were not in use. Earlier, stenographers and typists used to assist in preparing internal correspondence and record keeping. Now that computers are used in most cases as replacements of typewriters, stenographers had become redundant as prime correspondence operators and were now working as personal assistants to their respective managers. It was reported that most of them have not been re-trained in computer skills.

It was reported that the management in general was not fluent or computer-literate. Hence, computer literate "lineman cadre" personnel are being used on ad-hoc basis to assist the management on routine correspondence. It was observed during the discussions that proficiency in English was not very good; it was poor in case of subordinate staff. Hence, the quality of communication was very basic and lacked depth and vigor.

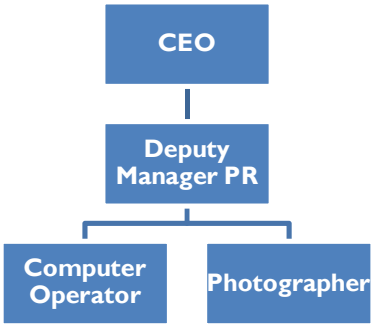
Sufficient and reliable database of employees, rules and regulations and operations was not available for ready reference and easy access through computers. This forced the employees to rely on traditional "file culture" which hindered prompt and clear communication in most cases.

There were few outreach activities reported; most are related to the staff getting together on special occasions, usually for farewells of retiring employees or participation in a staff welfare related event. No

other outreach activities were reported like events, commemorations, seminars, family gatherings, staff functions, open houses, etc.

### The Public Relations Department

The Public Relations department at FESCO is responsible for external communications and outreach activities. It is headed by a Deputy Manager assisted by two staff members - a computer operator and a photographer.




The Public Relations (PR) Department is not reflected as an independent department in the organizational chart. In practice, it is a support department and reports directly to the Chief Executive Officer (CEO) and serves as the main point of contact with the media. The Public Relations (PR) department is focused primarily on external communications, and has limited interaction with other departments. The main functions of the PR department include:

1. To scan over 15 national and regional newspapers daily regarding coverage of FESCO and the power sector and prepare a summary for the CEO.
2. To respond to the media with clarifications, if desired by the CEO.
3. To prepare and issue press releases about FESCO's activities, public notices, procurement notices, shut down announcements, etc.
4. To liaise with local press and electronic media for clarifications and media coverage.
5. To respond to any media query appearing on national TV channels or press (within a timeframe of 40 minutes in case of TV channels).
6. To maintain liaison with PEPCO for corporate and external communication activities, media queries, preparation of new media campaigns and press issues relating to the Press Information Department (PID).
7. To liaise with the designated advertising agency – Midas (Pvt.) Limited - for preparation of press and electronic media campaigns as well as media response.
8. To manage the compilation and publication of a monthly newsletter to project corporate activities.
9. To liaise with the local printing presses/ production houses to manage printing jobs.
10. To liaise with other departments to arrange material and manage printing of Annual Report.
11. To manage development and printing of promotional and information material like posters, leaflets, etc.
12. To arrange outreach activities including seminars, events, radio talk shows and press briefings on corporate and power related issues.
13. To undertake any other activity related to media, development and printing of material.

**The PR Process and Practices:** FESCO only undertakes external communication at the local media level. The main media products are press releases, monthly newsletters, annual reports, announcements of shut downs and procurement (tender) notices. Main outreach activities include occasional seminars on energy conservation, press talk shows, radio shows and management of collaborative events.

The PR department liaises with local media for corporate coverage, clarifications and handling bad press which is a fairly common phenomenon with a few local journalists who resort to blackmailing tactics for vested interests.

The department also creates a daily media report for the CEO and responds to media stories and issues, as necessary. The department is mandated to prepare and issue the press release as per the brief (usually verbal) of the CEO or any other departmental head if required. The annual budget allocated to PR activities is six million rupees. FESCO contributes its own share to PEPCO for national media campaigns. It was reported that FESCO paid over Rs. 130 million during 2009-2010 as its share to PEPCO on account of various press and electronic media campaigns.

### Review of Existing and Previous Communications and Outreach Campaigns

The PR department uses a media mix which includes newspapers, TV channels (mostly confined to cable advertising) and radio. The local press is the most common medium used, followed by radio. As TV advertisement campaigns are managed by PEPCO, the PR department is restricted from managing independent coverage in most cases.

The PR department creates and implements media coverage to highlight information such as power shut downs, or to promote energy conservation issues through radio as well as communicate other enforced actions. However, the level and frequency of this type of communication and media outreach is neither significant nor appropriate to make a real impact in the media. Press releases are issued for media response or information and promotion of FESCO-related issues on a need basis. A calendar of media campaign and activities is not prepared as a regular activity.

The past press releases referred to FESCO's activities, power shut down clarifications, development plans, safety plans and employee's welfare issues. A few posters and leaflets were printed during the last few years on safety and energy conservation. Very few outreach activities were observed, which included energy conservation seminars at educational institutions and radio talk shows.

### External and Corporate Communications and Outreach Strategies

As the electricity demand-supply gap widens, it becomes critical for FESCO to provide reliable and timely information to the consumer. As a priority, promoting its role to the greater public contributes to building consumer perception and trust in the utility's ability to serve a large territory of electricity consumers. However, it was observed that external communication at FESCO is not proactive. The outreach activities were few and need-based. These included a series of seminars on energy conservation with collaboration of some leading educational institutions and the media. A few posters and leaflets were produced on safety and energy conservation.

The availability of budget was reported as one of the constraints in consumer outreach as PEPCO enjoys overriding authority in carrying out media outreach for consumers and claims maximum share of the publicity budget of FESCO. This further inhibits FESCO to promote its services to the consumers, eroding its corporate image.

### Customer Complaint Centers and the State of Communication with Consumers

FESCO has a main customer service center at its head office and customer complaint centers at circle, division and subdivision level. It was observed that staff handling customer complaints in person, or designated at the helpline number are not trained in customer handling and etiquettes of customer-centric communication. It was also reported that dedicated staff was not allocated at circle, division and sub division levels. Such staff belonged to field operations and was made duty-bound to attend customer complaint centers for a designated time period.

A record of complaints is maintained manually and a follow up to coordinate with other departments ensures that complaints are closed promptly. Such manual data can be digitized for maintaining a

convenient database and subsequent data-analysis for better customer complaint handling. Customer complaint centers are not sufficiently automated for fast and efficient complaint handling.

Customer complaint centers do not have sufficient information material such as posters, brochures and flyers, explaining the process of complaint handling, chain of supervising officers and customer service guidelines for incoming customers.

### Current State of IT being Used for External and Internal Communication

The use of computers for internal and external communications is quite low. It was reported that around 200 computers were in use - that translates into a penetration of less than 0.5% per person in a company of 17,000 employees. It was observed that even these computers were mainly used for data processing and typing. Approximately 150 computer passwords were issued for connectivity to the database managed by Information Services department. A few dozen e-mail addresses are in use with apparently minimal usage for official communication.

The current web page is an example of a potentially powerful communications tool that is not adequately maintained to achieve full effectiveness. The current web interface is static, non-interactive and not geared towards user-friendliness. While trying to open the site, four times out of five, it showed a notice of "this site is a potential threat to your computer". The IT/MIS department updates the relevant information on the website on ad hoc basis. However, no dedicated webmaster is tasked with comprehensive oversight and management of the website, so the information posted is not regularly updated.

### Customer Services and Complaint Handling with a Gender Perspective

The customer service centers were not gender-sensitive. There was no separate counter designated for women, no separate seating arrangement, no dedicated female staff in the centers and no separate toilets were provided. However, it was reported that women complainants were dealt with on a priority basis as a corporate practice and cultural norm.

# 3 CONCLUSIONS AND RECOMMENDATIONS

## 3.1 GOVERNANCE

The Board of Directors does not function effectively as a corporate board. The CEO, for example, is appointed by PEPCO rather than by the Board of Directors (BOD). The newly reconstituted BOD will need both governance and electric utility training. The newly defined board of directors will require training to prepare them for the challenge of governing FESCO in the changing utility environment in Pakistan, and to advise board members of their roles and responsibilities vis-à-vis the Ministry of Water and Power, NEPRA, and other stakeholders in the power sector.

The BOD should be formally established as the independent governing body with ultimate decision-making authority and, in general, empowered to (1) set the company's policy, objectives, and overall direction, (2) adopt bylaws, (3) name members of the advisory, executive, finance, and other committees, (4) hire, monitor, evaluate, and fire the managing director and senior executives, (5) determine and pay the dividend, and (6) issue additional shares.

## 3.2 ORGANIZATION

The FESCO organizational structure, as noted in the previous chapter, is organized in a geographic fashion establishing distinct business units operating with relative autonomy from central management. This arrangement does not support effective commercial management and the checks and balances required to improve meter reading, billing, energy auditing, and collections. PDIP recommends an organizational structure that is designed along functional lines, with departments that include:

1. General and administration encompassing accounting, human resource management, warehouse management, facilities management, procurement, and fleet management
2. Commercial management, including meter security and theft control (aka revenue protection); division commercial operations offices, under which will be located billing, meter reading, meter installation/replacement, connections/disconnections; and customer services
3. Finance that will supervise long-range finance and cash management
4. Operations and maintenance, overseeing FESCO transmission operations (transmission lines and substations); and, distribution operation and maintenance
5. Engineering and planning, that will supervise line construction; system planning, and mapping and records

This structure, should it be adopted, will allow the CEO to focus on strategic issues, leaving day-to-day operational management to experienced and trusted senior management. Moreover, all commercial operational management would be consolidated within the commercial department, while all engineering planning, design and construction activities would be managed by the engineering department manager. All administrative functions, including HR, accounting, procurement, and facilities management would be organized under a single administrative department. A copy of the revised organizational chart is shown in Figure 3.1 below.

### 3.2.1 Organizational Enhancements for FESCO

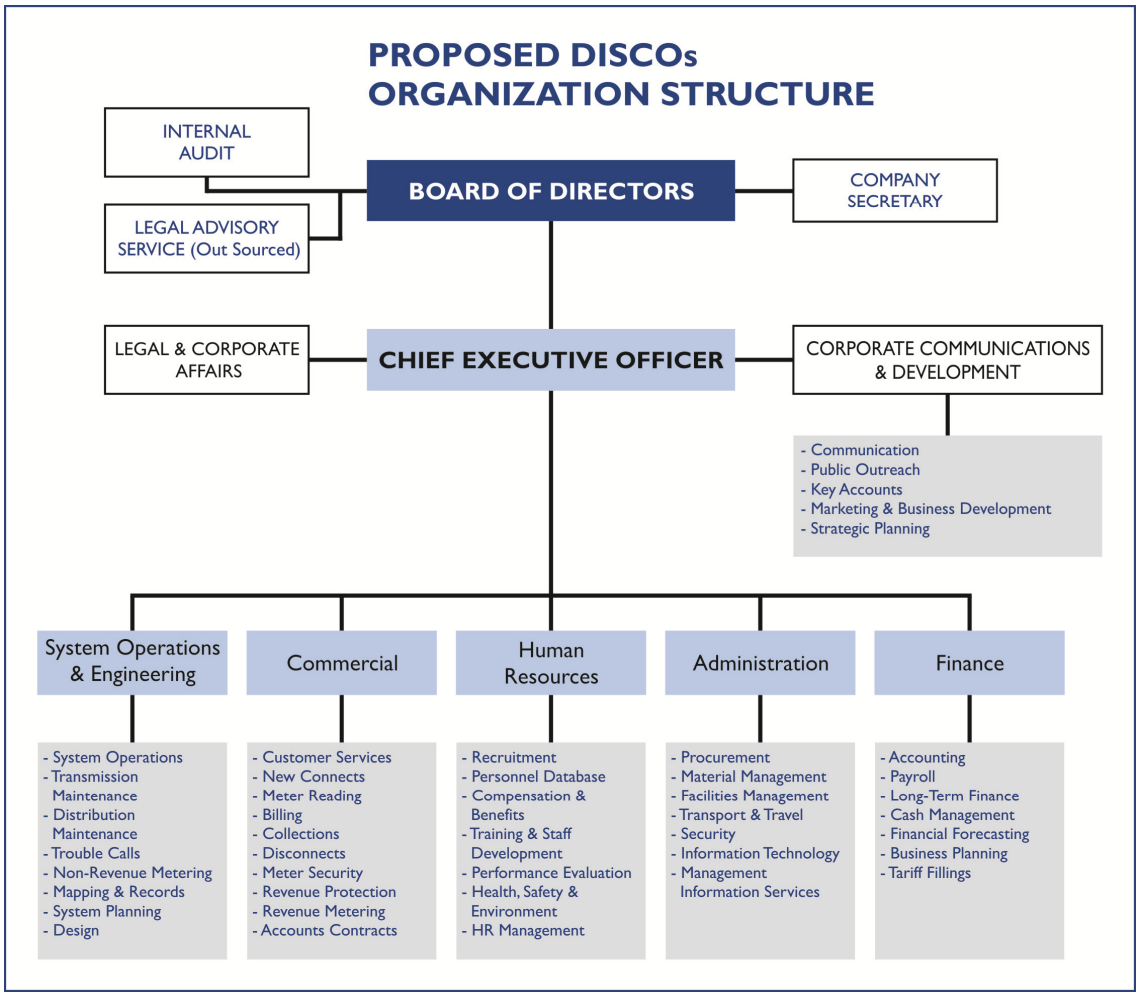
After careful review of the organizational structure and the inherent weaknesses, the team has proposed a revision, whereby a number of weaknesses in the current structure are removed.

In the representative organization chart, as per attached, the number of units reporting to the CEO is reduced from the current 10 to 7. The units reporting to the CEO will be (Systems Operations and Engineering, Commercial, Human Resources, Administration, Finance, Legal & Corporate Affairs and Corporate Communications and Development). The proposed structure provides scope for progression

to employees and now adds functional responsibilities which were previously completely missing. Additionally:

- The Internal Audit function is reporting to the Board of Directors (instead of the CEO, as previously)
- A separate unit, Director, Legal & Corporate Affairs is proposed, which will report directly to the CEO. This will be separate from the Company Secretary's position which will support the BOD and reports to it, instead of the CEO.
- Health and Safety will come under Human Resources, and needs to be given importance by upgrading it to a directorate. Similarly, Training and Staff Development will be brought under Human Resources.
- A new unit for Marketing & Business Development is proposed, which will be responsible for developing a business strategy and medium and long-term business plans for the company, and business development. The unit will be required to have considerable interaction with all departments and specifically with the proposed corporate communication and development unit., which will look after the organizational structure, anticipate changes in work and functional requirements, and accordingly, in coordination with HR Operation, develop core group and job specific functions, etc.
- A new unit for Administration is proposed, that will look after procurements, material management, facilities management, transport and travel logistics, and security. Additionally, IT and MIS will be brought under this unit.
- A Corporate Communication and Development unit is proposed. The unit will be responsible for internal and external communications and out-reach programs. The unit will also look into developing a corporate identity, business communication, and in coordination with MIS, develop and maintain FESCO's web site.
- Finance will retain its existing functions, while Tariff Filings is brought under the finance unit; as that is the current practice at most DISCOs.
- A consolidated System Operations and Engineering unit is proposed, which will have all operations, maintenance and trouble-shooting functions. Additionally, a Mapping & Records directorate is proposed to work with the existing System Planning department to prepare and maintain system wide maps.
- A new commercial unit is proposed, in which the commercial staff at the sub division will not report directly to the operations staff. Additionally a new directorate of Meter Security is proposed that will be tasked with ensuring the security and safety of the metering installations.

**FIGURE 3.1 FESCO ORGANIZATIONAL STRUCTURE.**



## 3.3 ENGINEERING

The Engineering Results section of this report presented the process whereby the PDIP engineering team prepared an evaluation of FESCO's distribution management system, and the results of a mapping and loss assessment effort. This section will present the conclusions of the PDIP engineering team resulting from their observations and calculations, as well as recommendations for opportunities for improvement.

### 3.3.1 Transmission Network

The PDIP team did not carry out any specific analyses of the transmission network, as it was clear that the major problems were in distribution. Adequate planning practices appear to be in place to ensure that the transmission network is appropriately expanded.

### 3.3.2 Planning Processes

FESCO's planning management clearly understands the need for integrated distribution planning as a means of arriving at an optimum distribution network design. The two prerequisites for integrated planning are accurate geographical maps and analysis software that is easy to use and can incorporate geographic input. The FESCO planning department has put considerable effort into the development of system maps based on Survey of Pakistan 1:50,000 quadrangle sheets and subsequent system scanning and conversion to AutoCad. This is an admirable undertaking and has fully mapped some substation service areas. The system is consistent with the analysis software used, Feeder Analysis, which requires manual input of data in any case.

A more efficient mapping method would be the use of GPS units to locate facilities in the field followed by transfer of the information to a geographic information system (GIS). This would make the information available for direct transfer to more sophisticated analysis software that can directly accept digital input. Ironically, FESCO has three ArcGIS software sets and keys and could undertake a GIS mapping effort with little more than some additional training. FESCO has made a significant investment in computers and a large format plotter, all of which would be of use in a GIS system, so there is no need to consider early obsolescence of any existing equipment. Advanced analysis would require the purchase of a new analysis software package, but this cost is small in relation to what has already been expended on the existing system. FESCO could therefore have a fully up-to-date mapping and analysis system at a low cost.

FESCO has also already developed staff resources capable of using a new system. Although they have not received training on ArcGIS, they are competent professionals with the ability to adapt to a GIS environment, and to make use of advanced analysis tools.

### 3.3.3 Standards and Specifications

The updating of standards and specifications is handled by NTDC's Design and Standards Section. WAPDA construction standards have generally served FESCO well and there does not appear to be any immediate need to undertake significant alternations in the standards, with two exceptions:

1. Transformer standards require review in the current environment of high cost power. The Section has issued a revised standard calling for a 27% reduction in maximum allowable losses for transformers, but much more can be done to lower transformer losses. In dense systems such as Faisalabad City, transformer losses account for half of total technical loss, and even the revised standards allow almost twice the losses as can be achieved with more modern technologies. Wound core and amorphous core technologies need to be explored.

2. Open conductor LT is an invitation to theft, as well as a source of consumer outages. FESCO should consider standardizing multiplex or ABC types of LT construction, as opposed to the ad-hoc solution of occasional use of covered conductor in a standard open wire configuration.

### 3.3.4 Procurement Effectiveness

The PDIP team observed that the procurement process followed by FESCO fails to take advantage of the principal opportunity for reducing the costs of materials, and that is the economies of scale. FESCO

procures a large amount of goods annually, which should give considerable leverage in obtaining favorable pricing. However the procurement process breaks this relatively large quantity of procurement into over 100 separate solicitations, largely diluting the benefits that could be obtained. FESCO is still using the legacy WAPDA category system which tends to break procurements in to a large number of individual solicitations. When WAPDA was a government agency, this was necessary to ensure that all vendors received some portion of the orders, but now that FESCO is corporatized, it is less appropriate. The need to handle such a large number of solicitations also introduces a considerable overhead burden on the utility.

A byproduct of breaking the procurements into small parts is to discourage international suppliers who can often source material from a number of countries and offer better pricing and higher quality. Again, this may have been appropriate when WAPDA was a government agency and it was a policy to encourage local suppliers, but any action that limits the size of the bidding pool increases cost and tends to reduce quality.

While there is no absolute method for determining the ideal size of a solicitation, it is likely that FESCO's need for materials could be satisfied by 8-10 procurements a year, two each for poles, hardware and accessories, cable and conductors, and transformers. Special purpose solicitations may be necessary for turnkey items such as substations, but even these should be few and large. It may even be possible for sharing of procurements between DISCOs allowing for increasing the size of procurements to levels that would be really attractive to international vendors.

Another observation is that the Procurement Division does not seem to have the ability to purchase small quantities of materials to make up shortages. Since most vendors are national, there should be no difficulty in procuring small lots of specific items necessary to fill a project material list, but this is not currently being done. The use of solicitations for all procurements is no doubt a legacy of WAPDA's government history, but a corporation needs more agility than can be provided by an insistence on solicitations as the sole opportunity for material procurement. The use of larger, fewer solicitations to procure the majority of the required material at low cost can be combined with flexibility for purchasing of small quantities on the local market when needed to provide a more efficient procurement system.

### 3.3.5 Construction Quality

Construction at FESCO is carried out almost entirely by employees, making no use of contractors for anything but erection of concrete poles. The usual argument for maintaining a large construction staff is that it is necessary to ensure quality construction, and it is true that construction quality in FESCO is generally good. However, the PDIP team determined that the FESCO construction department is entirely self-policing, that is, there is no cadre of staff identified as construction inspectors, nor does the department contract for external inspection services aimed at quality control. As a consequence it is difficult to ensure quality of work, with some crews doing a reasonable job and others not.

One practice of the construction department that does cause failure in service, as reflected in the frequency of maintenance calls, is the failure to use connectors on jumpers and other joints. It is clear that at one time, FESCO construct cadres did use connectors, but no new installations have them. All joints appear to be made with wrapped or "served" aluminum strands. No matter how neatly this is done, it is bad practice and will result in a failure of the joint, especially if it is a high current LT joint. The standard connector specified by the WAPDA construction standards is a two bolt aluminum parallel groove connector, which is admittedly expensive. However, parallel groove compression connectors are cheap and simple to install with hand operated tooling, and provide far superior connections with much lower resistance than wrapped joints.

### 3.3.6 Operations

The operations subdivisions at FESCO are responsible for many things, but those upon which they place the most emphasis are commercial operations such as meter installation, meter reading, and disconnection of defaulters, and continuity of service tasks such as repair of faults.

The PDIP engineering team found that the subdivisions management to be generally well organized and disciplined. Procedures exist for almost all tasks, and subdivision staff were diligently attempting to

comply, particularly with such record keeping tasks as measurement of transformer loading and rebalancing. Their success is reflected in the generally low level of transformer overloading identified during the mapping and sampling process.

The PDIP engineering team did find that the subdivisions are both overstaffed and under equipped for their assigned tasks. It was commonly stated that roughly half the linemen are not able to climb, while lack of equipment reduces the ability of ground bound assistant linemen to be of any assistance. Thus even large crews are limited to watching a single lineman on a pole or in a tree and are not productive. Tools, both hand tools and heavier equipment are in poor condition, and are inadequate in quantity. There are no tools such as blocks and tackle for lifting, handlines for transferring items up the pole, or wire handling tools such as grips and come-alongs for tensioning conductors. Tree trimming equipment consists of an ax, while trimming shears and pruning hooks are mainly ornamental and too dull and weak to be of value. Transport is limited and most jobs are handled by the lineman traveling on their own motorbike.

In addition, safety emphasis is very limited with no recurrent training, no safety meetings, and no safety program for enforcement of safety rules. Protective equipment such as safety belts and grounding sets are of poor design that do not serve the required purpose. The result is a startlingly high fatality rate among linemen and unwillingness on the part of assistant linemen to undertake the tasks of climbing linemen. Linemen fatalities are blamed by management on a refusal to wear protective equipment, but the PDIP team finds this an unconvincing argument at best. Safety programs must have enforcement provisions, but it is the responsibility of management to provide appropriate equipment and recurrent instruction in its use and care.

### 3.3.7 Meter Security

The PDIP team found that the security of the meter itself has improved in recent years with the advent of electronic meters that cannot be opened by normal means even when the seals are removed. Innovative power thieves have succeeded in violating these meters, but there is no question that they are more resistant to tampering than the older electromechanical meters. However, the primary threat to meter security is not the meter itself, but continues to be the service drop and the connections to the meter, which are completely unsecured, as well as the LT network which is still composed of bare conductors. FESCO has taken no steps toward providing improved security for exposed connections and service conductors and for conversion of vulnerable LT to covered conductors.

Another concern is the existing fleet of electromechanical meters, numbering in the millions that are still in service on the system. These meters were in most cases not highly accurate to begin with and age has not improved their performance. These meters have not been calibrated since installation, and while it is certainly in the utility's long term interest to replace them, to the extent that they can be brought to a reasonable level of accuracy through inspection and testing, they can improve the commercial loss situation.

### 3.3.8 Technical Losses and Loss Segregation

The PDIP team carried out a mapping and modeling effort on a sample of the feeders, transformers, and LT networks in the FESCO system with the objective of determining the level of technical loss. The sample chosen was representative of the system as a whole and so its losses can be taken as a proxy for the technical loss of the overall system. The technical losses in the distribution system for FESCO were found to be 7.1%, broken down as follows:

- Conductor Loss 3.67%
- Transformer Loss 2.1%
- LT Network Loss 1.0%
- Service drop loss 0.4%

This estimate for total technical loss of 7.1% was confirmed using a benchmarking technique that is independent of any system modeling, and so is likely to be a valid estimate for overall distribution system technical loss.

This level of technical loss can be compared to the total distribution network loss of approximately 9.7%, indicating that commercial losses are on the order of 2.6%. This shows that FESCO has had considerable success in limiting non-technical loss and that FESCO's major challenge in loss reduction is in the area of technical loss, although important opportunities still exist in reduction of commercial loss.

### 3.3.9 Opportunities in Loss Reduction

The opportunities for loss reduction in FESCO are technical, although there are opportunities for reduction of non-technical loss as well.

#### Mapping and Planning Improvements

- *Generation of a detailed* load forecast. Load forecasting, when driven by demographic and economic information, can help identify areas where attention is required

- Use of GIS for mapping. Introduction of GIS for mapping will speed the process of generating useful maps and eliminate much of the manual labor involved in the current process. Use of GIS will allow the automated transfer of system information to advance planning software, speeding the production of integrated plans and allowing the planning staff to identify areas in which interventions are required for loss reduction.

- Application of advance planning software. Advanced planning software that accepts digital input from GIS databases and has a graphical output can speed consideration of alternative system designs and assist in developing integrated distribution plans. Use of such software will allow for consideration of potential problems before they result in high losses or poor service quality.

#### HT Improvements

FESCO's average feeder length is almost 50km, which means that the system is somewhat rural. HT improvements are of interest mainly on rural feeders, where, due to their longer length, there is more conductor loss. Opportunities are:

- Application of capacitors. The installation of capacitors that could improve power factor on the sampled feeders would reduce losses on the longer sample feeders.

- Selective reconductoring. The majority of the high conductor loss is to be found in the first 10% of feeder length, where the load is heaviest. Replacement of the commonly used Dog conductor with Osprey would reduce losses by 50% in these segments of line without the need for bifurcation or addition of new breaker positions.

- Development of improved transformer specifications. That would dramatically reduce transformer losses. Transformer losses reflect 30% of FESCO's technical loss, and technologies exist to cut even the current new specification losses substantially.

- Review of long feeders (over 60km in total length) on the basis of voltage drop rather than thermal capacity. The current method of identifying problems only when conductor loading exceeds 300 amps is inappropriate for long rural lines. These circuits have already entered into voltage problems and high losses long before reaching the 300amp threshold.

- Application of compression connectors for most taps and other joints. So as to eliminate jumper burnouts. Points at which sectionalizing is done would be retrofitted with bolt-on connectors to facilitate disconnection. Replacement of wrapped joints would reduce callouts for jumper failures and improve service quality, though the impact on losses would be small.

### LT Improvements

- Preparation of a census of consumer locations. So that consumers can be linked to the transformers that serve them in the CIS. This would allow for improved transformer load management as well as providing an opportunity for evaluating losses on a transformer by transformer basis, using portable measuring instruments to correlate transformer loading and sales.

- Selective replacement of open wire LT line with multiplex or ABC. To reduce vulnerability of the system to casual hooking. A side benefit of this action would be a reduction in the incidence of transformer damage due to short circuits occurring on the open wire LT.

- Relocation of transformers. So that they feed the center of an LT sector rather than the end. This would reduce losses on the affected LT sector by 50%. The incidence of end-feeding is uncertain.

- Retrofitting of compression connectors for jumpers and other high current joints, and improvement of the connections to the LV bushings of transformers. The present system of wrapped joints produces a significant level of callouts for overheated joints, which though not a loss issue, do affect consumer service quality.

### Metering Improvements

- Introduce an electromechanical meter testing program. That is oriented toward ensuring accuracy of electromechanical meters until they can be replaced with electronic units. This would be combined with an accelerated program for changing electromechanical to electronic meters.

- Evaluate options for improving the security of meter installations. By using connection boxes and neutral concentric cable as opposed to unguarded open installations. The customer cannot be given access to meter bottom connections or the installation will have no security at all. A neutral concentric cable encloses the cable in a grounded sheath so that any attempt to penetrate the cable with a sharp item such as a nail or an awl will cause a short circuit and defeat the attempt at penetration.

- Investigate the use of socket type meters. Which provide greater security for meter connections, and which have larger high current connections, allowing them to be applied for direct reading up to 320 amps. This would reduce the number of CT type meters that have to be installed, removing the CT accuracy as an issue.

- Replace most of the current stock of CTs in use in industrial metering boxes with either direct reading meters or higher quality CTs. There have been a number of instances of CT failure, which of course compromises the meter reading.

- Work with meter manufacturers to improve the security of indirect meters (CT and CT/PT installations). The current crop of electronic indirect meters can be reprogrammed from an optical port to alter the meter multiplier. This creates a vulnerability to any person with the correct software and the optical programming wand, all of which can be obtained at low cost in various markets.

## 3.4 FINANCIAL MANAGEMENT

While FESCO collections are reportedly at 82% of commercialized energy sales, there remains an on-going problem with government collections. Reported government collections were only 51% of energy sales to government clients in FY 2010. Given FESCO's role as a quasi government agency, it has proven impossible for FESCO to treat government clients on an equal commercial level as other clients. If a government client does not pay, FESCO is slow, and in some cases unwilling to take the measures needed to collect from these clients.

As reported in the Results chapter of this report, FESCO has a reasonably effective arrangement with the banking system and other local payment to collect funds from its consumers. This arrangement ensures

that collections are managed effectively and relatively efficiently. However, there are two issues with the collection system that is being used. First, many collection points – including some banks – retain customer payments to FESCO for much longer than they should. The pay points should transfer funds on a daily basis, but many retain the receipts for as long as a week. Approximately 80% of cash receipts are received on the same day they are paid to pay points at the FESCO principal bank account. Approximately 10% of cash receipts are received through offline banking transactions which involve a 2-3 day delay in getting to FESCO's account. The remaining 10% are receipts from post offices which may take a week. Remittance of these funds from FESCO to the CPPA in payment of purchased power is important, and creates a significant loss from the perspective of the CPPA.

One of FESCO's greatest needs is an effective implementation of an enterprise resource planning (ERP) system which integrates multiple systems throughout the organization. The ERP will provide the means to integrate business, human resources, engineering, asset management, work plan management, and operations into an electronic environment that can be used real time in all phases of FESCO operations. Enterprise systems offer the opportunity to convert manual business and distribution operating systems to electronic, computerized management systems. The ERP software system interface will allow other applications to be integrated with Oracle based system applications and permit full system interface with all applications. This will be important as FESCO transitions into customer information and billing system, geographical information systems (GIS) and application.

Enterprise systems allow electric utilities to employ financial and management controls that would otherwise be absent. Full implementation for an ERP at FESCO, for example, will allow an internal control audit to identify vulnerabilities in accounting and work flow management, and to address these vulnerabilities through improved controls and management processes.

FESCO needs to expand and enhance internal audit practice and procedures that were established in 1985, and have not been updated since then. The legacy WAPDA audit manual is too narrow in scope to effectively audit FESCO financial and functionally activities, and will not be sufficient to perform auditing procedures in an ERP environment.

It is interesting to note that, the internal audit division has only partially complied with the scope defined in the existing audit manual, that states, "Internal Audit Division has to insure that rules and orders framed/adopted by the Authority from time to time in connection with execution of works, pay and allowances, stores, etc. and for maintenance of various accounts, books, etc. are followed by all WAPDA formations/offices and the defects and irregularities noticed in such accounts/ books are rectified as far as possible.." At present, the internal audit only functions as a financial control in the review and certification of consumer electricity billings. The internal audit function performs three types of audit, a revenue audit, primarily related to electricity billings, a financial audit, primarily transaction based to verify amounts received and amounts billed are appropriate and a fixed asset audit which traces physical assets to recorded assets and recorded assets to physical assets.

The FESCO accounting manual has not been revised since 1985; like the audit manual, there is an immediate need to revise the update and improve the accounting manual. Once NEPRA defines the chart of accounts, the manual will need to be normalized to comply with NEPRA requirements.

There were a number of instances of government involvement noted which constrained and hampered the operations of FESCO. These include the following:

- PEPCO has currently placed a ban on the purchase of new vehicles when one third of the vehicle fleet is 20 years of age or older.
- Major vehicle repairs are required to be performed by the WAPDA base workshop which is generally 20% higher than the cost of having the repair performed in the private market unless a no objection certification (NOC) exception is issued.
- In 2008 four DISCOs, which included FESCO, was asked to obtain loans to pay for government shortfall in power costs which was incurred by all DISCOs.

- All DISCO investment projects are required to be filed with the Planning Commission (PC), Central Development Working Party (CDWP) and Executive Committee of National Economic Council (ECNEC) for approval regardless of funding status. This is a very burdensome process.

FESCO has significant financial exposure due to lack of insurance coverage on its facilities. Only grid stations and certain new vehicles are covered.

### 3.4.1 Finance and Accounting Recommendations

- FESCO should update accounting and internal audit manuals in line with the movement to modernize FESCO, to increase the internal auditing scope to more effectively serve the needs of the board of directors, and to adjust to the new ERP environment.

- Evaluate means of improving transfers from pay points to FESCO bank accounts.

- Complete implementation of the ERP platform, with expanded applications to serve all finance and accounting needs in line with control, management, and financial reporting to the FESCO board of directors, NEPRA, and the Ministry of Water and Power as needed.

- Establish in-house expertise to support ERP functionality, train FESCO management and staff, and develop new applications.

- FESCO should purchase a ten year financial forecast model, and appropriate training, for its business planning purposes.

- Obtain insurance coverage for buildings, equipment, inventories, and such other assets as deemed necessary to eliminate exposure to significant financial loss.

FESCO suffers from a lack of reliable access to long term capital. Because of its wholly owned government status, banks are reluctant to lend significant amounts unless ordered to do so by the government. A classic example is the order by the MWP in 2008 for FESCO and a number of other solvent DISCOs to obtain loans to support the government's own shortfalls in financing power costs for other, less solvent DISCOs. In the face of such risks, it is no surprise that FESCO's only source of large scale financing capital is the government. Often the proceeds of loans from the World Bank or Asian Development Bank , such government financing is not reliable or predictable, nor is it's availability dependent on the financial strength of the DISCO itself, thus reducing the requirement for internal fiscal discipline. The shortage of reliable, reasonably priced investment capital has a significant impact throughout the organization, reducing the emphasis on long range planning, in favor of make-do arrangements. Such a dependence on government financing must end if the utility is to be able to reliably carry out its obligations to its consumers and function as a true corporate entity.

## 3.5 COMMERCIAL MANAGEMENT

Commercial policies are defined in a logical fashion, but are not effectively practiced. Moreover, the policies and procedures have not kept pace with changes in technology; rather than using electronic data collection and transfer, FESCO relies on manual recording, transcription, and data transfer processes. These need to be changed at the earliest possible date by electronic data collection and processing, reducing potential for manual adjustments and interventions that results in loss of commercial integrity.

The meter reading practices currently employed are subject to influence by operations management. Given that the goals of network operations and management are distinct from the goals of the commercial department, there is a need to realign reporting requirements and oversight of the commercial staff.

As mentioned in the opening remarks of this chapter, there is an urgent need to introduce more modern, advanced technology into commercial management of FESCO. Use of AMR meters; prepayment metering technology; handheld meter reading technology, and other advanced communication and metering technology would eliminate reading and transcription errors, and reduce vulnerability to meter employee and consumer manipulation of metering data. Use of AMR meters on industrial clients and

transformers would make energy accounting more readily available, and would support work planning and analysis of the distribution infrastructure.

### 3.5.1 Adequacy of error detection practices

The line superintendent, the reading section supervisor and the SDO are required by the *Commercial Procedures* to check a prescribed number of meter readings and bills delivered to ensure that "losses are brought down to a bare minimum and bills are delivered to the consumers." The XEN is also charged to physically check site readings and distribution of bills. SE not only is required to check readings, he is also required to review the meter reading auditing checks by the SDO and XEN. FESCO management and staff readily stated that these practices are not followed as required by FESCO policy.

Without an objective and periodic review of meter reader performance, meter reading personnel can manipulate (and reportedly do manipulate) consumption data for the purpose of increase revenues by taking advantage of the slab tariff structure. Over a period of a few months the readings can be corrected to actual, but the revenue is not adjusted for the over-billing. Because auditing procedures are not followed, collusion between employees and selected consumers will not be detected.

Since the billing software has been turned over to DISCO management, transaction audits have been discontinued. Transaction audits are designed to identify changes to the consumer database, such as consumer status and tariff class changes. Changes are audited against authorizing documentation that is required to authorize changes. Without transaction audits, DISCO staff may make changes to the data base without fear of detection. Audits are common in most well-managed electric distribution utilities.

### 3.5.2 Billing cycle and energy accounting

Streamlining the billing cycle will result in financial benefits to FESCO and/or to CPPA. Improving billing cycle efficiency will result in accelerating collections, allowing FESCO to generate short-term interest dividends, or to allow CPPA to reduce interest and penalty charges that may accrue from delays in payment to generation companies.

FESCO billing, collection and financial transfer procedures are common business practices for a manual system that could made more be effective for recorded transactions if followed. Adding new technology and revising the procedures for the additions would streamline the billing cycle and reduce errors.

Establishing a method to more accurately account for energy sales by feeder or distribution transformer would yield additional value, and could result in reduction of non-technical losses. Energy accounting could be accomplished by a number of methods. Use of AMR meters as revenue meters, or at delivery points would allow FESCO to accurately monitor consumption via electronic, real-time means. Energy accounting could also be accomplished by using conventional electronic meters on distribution transformers, although this would be subject to the integrity of meter reading process. However, if subdivision management were to focus on areas where losses are highest, making a concerted effort to audit meter readings at delivery points, this would support an effective loss reduction program. An effective energy accounting initiative would not only result in lower administrative losses, it would also result in higher billings leading to more income to the DISCO.

### 3.5.3 Improved consumer service

Although attempts are being made to improve consumer service, the programs have not yet proven to be very effective. Communication with consumers has been very limited. To report a supply failure, telephone numbers of the XEN and SDO are printed on the consumer bill; there is no number for billing complaints. Moreover, complaint resolutions have lagged, given that DISCO consumer service personnel are not always available or perhaps do not make sufficient efforts to clear consumer complaints. Without question, a more aggressive program will be required.

Subdivision personnel assigned consumer service duties are also assigned other duties, attending to complaint resolution part time. Depending upon the nature of the complaint, the consumer service personnel have limited authority to clear complaints, leading to the need for the consumer to making repeated visits to the consumer service center to resolve issues that may arise.

### 3.5.4 Recommendations

In order to achieve improved commercial performance, a number of interventions will be required that are related to one another. Improvements in metering technology from electro-mechanical meters to electronic meters will have little effect, for example, unless organizational and procedural changes are made in the meter reading auditing process to detect fraud or manipulation of the data. Implementation of a Customer Information System (CIS) will require new accounting, data collection and transfer, and billing procedures. Best practices require that a consumer census be taken to populate the CIS database with accurate information.

The following recommendations, if implemented in a systematic and coordinated fashion, will result in increased revenue recovery, improved commercial efficiency, and more effective consumer service:

1. Consumer census to verify/add consumers
2. Installation of a CIS
3. Reorganization of corporate structure so that all commercial activities report to the Director of Consumer Services
4. Update metering, using advanced metering technology where appropriate, and evaluate use of meters on selected distribution transformers
5. Reorganize meter routes
6. Implement energy accounting
7. Design more comprehensive customer service and consumer awareness programs
8. Enforce meter reading audits and meter inspection program
9. Establish systematic meter repair, testing, and calibration

## 3.6 HUMAN RESOURCES

HR policies and procedures have remained stagnant for the past two to three decades, and currently these do not support FESCO needs to attract and retain highly skilled, dedicated, and engaged employees. Staff at almost all levels have repeatedly stressed the need for change and intervention in this area.

While some capital investment will be required, the team feels that substantial investment in time is essential. It will need to be ensured that FESCO is fully involved in the development of policies and procedures, so that changes are readily accepted.

While there is much work to do to design and define new human resources policies and procedures that are responsive to FESCO needs, changing the policies and procedures will require a modest investment of time and funds in comparison to other, more capital and effort-intensive interventions. These changes, if accepted and implemented, will require a substantial buy-in from FESCO management and staff. Some of the changes will be back-office in scope, such as redefining position descriptions, a comprehensive compensation study, and hiring and advancement policies. Others will require a high degree of retraining, communication with management and staff, as well as some fundamental changes in corporate culture.

The principal changes that are necessary have to do with the compensation package, the hiring and promotion program, and the performance management program. As mentioned in the previous chapter, the fundamental changes will need to occur in redefining position descriptions, position requirements, lines of authority, and other, related factors. Concurrently with an upward adjustment in the salary structure, there will likely be a need to sustain staff reductions through outsourcing and attrition. Significant reductions will be required to bring FESCO in line with best practices, but this issue will require and will receive significant additional analysis before final decision are made.

Increasing the salary levels to bring them at par to market levels will not by itself change the work ethic and culture. There will be a need to actively engage in a new relationship with FESCO management and

board priorities, whereby employees know, appreciate and accept the new corporate culture, where good performance becomes a clear criterion for recognition.

### 3.6.1 Recommendations

1. Develop performance management program, together with revised position descriptions, setting goals and objectives for all staff positions; and establish mid-year and annual evaluation review process, measuring employee performance, and rewarding employees based upon performance.

2. Modify the recruiting policy to ensure an objective, transparent and unbiased recruitment process.

3. Revise the compensation and benefits system and package, making it attractive and competitive; a detailed market study will be required to devise a new package, and also choosing an effective methodology, whereby the new package is introduced in the DISCO. For instance, the new higher package is offered only to those employees, who opt to accept the new terms and conditions of employment, including performance, etc.

4. Develop training and development culture, programs, and upgrade current training facilities (Regional and Circle Training Centers). This will have the effect of making training attractive and more highly valued by the employees.

5. Introduce more advanced information technology for use in human resource management, as well as in training facilities.

6. Review and revise FESCO's benefit plan, including the employee health plan to increase flexibility and choice of health care providers and facilities. Evaluate the introduction of a health care insurance policy.

7. Evaluate staffing levels vis-à-vis international best practices. Develop staffing plan to reduce staffing levels in conjunction with outsourcing and reduction through attrition program. A review of the total work force shows that a large number of employees are in non-core functions, areas, which could easily be out-sourced.

8. Establish a robust lineman safety program that provides structure, incentives, and discipline for all linemen employees. Ensure that linemen are provided and required to use proper clothing and safety gear while performing construction and maintenance tasks. It will be the DISCO's social responsibility that the safety message is extended to the public / customers, through an out-reach program.

## 3.7 COMMUNICATIONS AND OUTREACH

The existing state of communications and outreach in FESCO is the outcome of the survival of rigid public sector practices, relying on traditional tools of communication and strict protocols. Furthermore, adaptation to information technology appears very slow and ceremonial. A mindset of restricted sharing of information and reluctance to develop information database survives all around.

The PR Department does not play a proactive role in external communications. The fact remains that FESCO does not have a formal communications plan to comprehensively address the internal, external and public communications needs. The following recommendations are outlined:

- An integrated FESCO-specific communications strategy should be designed, outlining key objectives, target audience, messaging framework, along with a comprehensive action plan and a supporting budget to sustain effective communications and outreach.

- The PR Department should be strengthened to provide with enhanced decision-making role and regular budget which should enable it to plan and execute mass media campaigns at the local level. The job descriptions of the communications staff need to be revised and adequately integrated into the amended organizational chart of FESCO.

- An annual calendar of developing communications products and implementing supporting outreach activities should be developed setting priorities and providing clear guidelines for the creation and dissemination of information materials. Issues of Corporate Social Responsibility (CSR) and brand equity should be regularly promoted in the local mass media through a series of planned public outreach activities. FESCO's reliance on PEPCO must be reduced to make it an empowered department.

- The development of an intranet including database of public domain at FESCO should be promoted and encouraged and made accessible electronically to all managerial staff. This data may include information about engineering, operations, customer service, rules and regulations, and employees-related data. Managerial staff must be encouraged to use the database avoiding the current position of extracting the routine data through a tedious process of inter-departmental communication.

- Penetration of information and communication technology at FESCO needs to be planned in a way to ensure that all managerial staff is provided desktop or laptop computers, imparted training of basic IT skills, and networked within and inter-departments, and mandated to use e-mail as the prime communication tool. This will further help in developing ERP-readiness among the staff at FESCO. All managerial staff must be provided e-mail addresses and assured networking.

- FESCO web page should be re-vamped for more comprehensive content display. The web site should be made interactive and updated regularly. A fortnightly or monthly e-newsletter must be developed to keep the customers aware of FESCO's activities.

- Outreach activities should include the active engagement of various groups of consumers like industrial, agricultural, commercial and domestic to promote dialogue on CSR and FESCO-related issues of tariff, safety, electricity theft, energy conservation, upgrading of system, constraints, etc. Seminars, public dialogue, press shows, radio talk shows, collaborative events are a few examples of activities to be carried out on a regular planned basis.

- Dedicated and trained staff should be deputed at various customer service centers to abandon the current practice of depending on field duty staff. Gender-sensitivity in such centers must be ensured by providing separate windows, wherever possible, along with separate seating arrangement and public utility services for incoming women to lodge their complaints. Female staff should be recruited in the dedicated work force up to circle level customer service centers.

- Team building retreats and related activities such as annual luncheons, etc., are to be institutionalized to improve the effectiveness and efficiencies, internal communications, and staff morale.

- Staff should be imparted training in communications soft skills, including business communication, interpersonal communication, reporting techniques and corporate relations.

- A periodic post-communication monitoring and evaluation practice should be in place for improvement and development of a continuous communications and outreach program.

# A. APPENDIX: AUDIT METHODOLOGY

## A.1 OVERVIEW OF DATA COLLECTION AND PROCESS ASSESSMENT

The operational PDIP audit process was designed to facilitate data collection and to evaluate engineering, financial, commercial, human resource information and data in collaboration with DISCO management. The objective of this activity was to evaluate performance efficiency by means of performance and process analyses, and by collecting information through one-on-one interviews with DISCO management and employees. The PDIP team not only collected data, but also reviewed and evaluated management practices and processes. For example, a key performance process for all electric distribution utilities involved the commercial cycle – the means by which meters are read, bills are processed and delivered, revenues are collected, and delinquency notices are delivered. For a program whose goal is to measure commercial, financial, administrative, and technical performance, review of key processes like the revenue collection cycle is extremely important.

The operational audit for the DISCO followed an identical process to audits undertaken in the other seven DISCOs. The process collected and evaluated data for four areas of electric distribution operations, including:

1. DISCO governance
2. Organizational review
3. Engineering
4. Financial management
5. Commercial management
6. Human resource management

Comparison of performance indices for a particular utility with those of highly functioning electric distribution utilities highlights the functional areas that require improvement, while comparison of best practices will allow the PDIP team to identify high impact performance interventions.

## A.2 GOVERNANCE

In addition to reviewing DISCO operational activities, the PDIP team l reviewed the DISCO governing board policies, procedures, and practices. With increased emphasis being placed on providing a governance structure with a higher degree of operational independence to the DISCOs, it was essential to evaluate the changes that would be needed to better support board composition, qualifications, training, and other characteristics.

Towards this end, the PDIP team reviewed the following documents and board actions:

1. DISCO by-laws that establish board selection processes, scope of authority, and overall board responsibilities
2. Review of board policy and procedures manual, if available
3. Review and analysis of board composition focusing on the issue of ensuring independent governance and adequate local representation on the board
4. Review of board member appointment process, board member terms, and process of removal (if warranted)
5. Board member qualification requirements

6. Training/orientation provisions for new board members
7. Periodicity of board meetings, and provisions for extraordinary board meetings
8. Board member fee structure – are board members reasonably compensated for their participation?

The purpose of this review was to present an analysis of the changes required to improve board composition, functionality, and preparedness to undertake DISCO governance.

## A.3 ORGANIZATIONAL ASSESSMENT

The PDIP team reviewed the management and organizational structure of each DISCO with the goal of assessing the efficacy of the institutional capacity to effectively manage its human resources, physical assets, and business systems based upon the organizational structure. The review included an evaluation of the following organizational issues:

1. Analysis of organizational design & structure
2. Review of DISCO departments and divisions
3. Review of key managerial positions and position descriptions
4. Assessment of managerial and functional competencies
5. Review organizational chart, recommend revisions

## A.4 ENGINEERING OPERATIONAL AUDIT

The engineering assessment reviewed four components:

- Transmission issues.
- Distribution system management.
- Segregation of technical and commercial losses.
- Distribution standards.

### A.4.1 Transmission Review

The transmission review consisted mainly of an evaluation of the contribution of transmission losses to overall system losses. In the event that transmission losses did not constitute a significant component of overall system loss, the evaluation was truncated. In most cases, the transmission networks of the DISCOs are quite robust and are not a source of problems and therefore this segment of the evaluation is very limited.

### A.4.2 Distribution System Management

Evaluation of distribution system management consisted of a series of interviews with staff from the Planning and Design, Construction, Operations, and Procurement departments. During these interviews the DISCO staff responded to the team's questions and provided insight into the technical operations of the utility. These interviews were inevitably colored by the attitudes of the interviewees, as well as the misunderstandings of the interviewers, and should be taken as indicative rather than absolute truth.

Typical questions explored by the engineering team included:

- Status and currency of system maps
- Processes used for distribution system planning
- Methods for procurement, adequacy and availability of materials
- Adherence to standards in construction and a visual review of quality of construction

- Meter security and vulnerability to tampering
- Operations practices and adherence to established policies and procedures
- Adequacy of lineman safety programs and equipment

### A.4.3 Segregation of System Losses

The third component involved a mapping exercise and power-flow assessment in which the team attempted to use a sampling technique to segregate distribution losses between technical and commercial, and between the various components of technical loss. The team selected 11kV feeders that are, in the aggregate representative of all the DISCO's feeders and therefore indicative of the level of technical loss of the entire company. An even smaller subset of low voltage (LT) networks were surveyed in detail with the objective of identifying the contribution of LT systems to the DISCO corporate technical losses.

In preparation for this portion of the task, the team reviewed transmission and distribution-system performance data to the extent available. Data in the review included:

1. Power delivered to each feeder by month for FY 2010 (July-June).
2. Commercial sales data by feeder, as available for each month of FY 2010.
3. Length of 11 kV feeders and laterals – by substation, as available.
4. Engineering standards, including standard conductor size for all voltage levels, maximum circuit lengths for medium voltage (11 kV) and low voltage (400 volt) distribution circuits.
5. Standard for service entrance, meter installation for each customer category.

The engineering team then selected a group of feeders from the record that, as a whole, represented the principle characteristics of the DISCO; that is, sales distribution between domestic, commercial and industrial consumers, as well as average feeder length.

Each DISCO has up to, and in some cases more than 1000 11kV feeders, so it is necessary to establish sampling criteria as follows:

- Feeders were selected by a random number process so that each feeder had as much chance of being selected as any other to enhance the potential that the set of feeders was truly representative of the system as a whole.
- Average feeder length of sample population was close to the average feeder length of the overall feeder population..
- Distribution of sales in kWh/year between domestic, commercial, industrial, agricultural and other consumers for the population of sample feeders was close to that of the overall DISCO feeder population.
- The sample feeders had complete data, including total sales and feeder input data, total length. Feeders with data anomalies were excluded.
- Total feeder length was limited to 200km, which is the length of line that the PDIP GIS team can survey in the time period allocated.

Once the 11kV feeders were chosen, a total of no more than six LT networks were chosen for detailed analysis. Because data is limited for LT networks, it was necessary only to specify that the LT networks chosen be fed by the selected feeders. To the extent possible they were chosen randomly from the set of general service distribution transformers on the selected feeders.

#### 11kV Feeder Mapping and Analysis

Once selected the 11kV feeders were mapped using a rapid GIS technique that identifies only corner and intersection poles and poles with equipment installed on them. Observable data such as conductor size,

transformer capacity, and transformer status, whether general service or dedicated, was noted manually and transferred to an attribute database.

Once the circuit was mapped, the information was transferred to a Milsoft Windmil model. Milsoft Windmil is a standard distribution analysis software used widely in the US and Latin America. Windmil can model single or three phase loads, 60Hz or 50Hz systems and accepts user information on all conductors and transformer characteristics not in the default database. The majority of the conductors used at 11kV by the DISCO are Osprey and Dog, with some Panther and Rabbit, all of which are ACSR conductors. LT conductors are mainly Wasp and Ant, which are all aluminum conductors. Characteristics for these conductors was obtained from tables and incorporated into the database. Similarly, the DISCOs use a common specification that specifies transformers with maximum allowable levels of losses, a legacy of WAPDA procurement practices. The maximum allowable levels of loss have recently been changed, but none of the new units have been supplied yet. Transformer characteristics used in the model therefore correspond to legacy DISCO transformer values of no-load and load losses, as shown in the table below:

**LEGACY DISCO TRANSFORMER VALUES**

| KVA Rating | 10 | 15 | 25 | 50 | 100 | 200 | 400 | 630 |
|---|---|---|---|---|---|---|---|---|
| Impedance | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% | 4.0% |
| Core Loss (W) | 65 | 85 | 123 | 175 | 310 | 495 | 925 | 1350 |
| Load Loss (W) | 320 | 435 | 640 | 1170 | 2020 | 3410 | 5600 | 8150 |

It should be noted that these are the values specified in the WAPDA transformer specification DDS-84 for prototype transformers. The standard allows a +15% tolerance in the individual no-load and load loss values of individual production units and a +10% tolerance in total losses. No attempt was made to incorporate these tolerances into the model, but so it is likely that transformer losses are in reality slightly higher than those indicated.

While Milsoft can accept data on location-linked consumer loading, the time available for this project did permit data on actual loading to be used in the model. Instead, the feeder peak load was obtained from substation records and this known load allocated among the various transformers on the basis of transformer capacity, i.e. a transformer of 200kVA was allocated twice as much of the actual feeder demand as a 100kVA transformer.

Another matter that is important is the level of power factor to be used in the model. Substation meters record kWh and kVARH, from which power factor could be calculated, however, only circuit amperes and kWh readings are actually recorded by the substation operators. The engineering team obtained station log sheets from the period around the feeder peak. Estimated average hourly power factor was then computed by calculating kVA using logged amperes and an assumed bus voltage of 11.5kV and the differences between the hourly kWh meter readings to estimate kW.

Once the model, loading, and power factor were established the feeder power flow analysis was carried out. Losses were then developed for conductors and transformers on each feeder. Because of the assumption that the sample feeders represent the system as a whole the percentage losses attributable to conductor and transformers are assumed to apply not only to the sample feeders but to the entire system.

### LT Network Mapping and Analysis

Because not all the LT networks on a particular feeder can be mapped, the process of mapping for the LT networks differed from that used for the 11kV feeders. For the LT networks, the mapping included a consumer census of all the consumers fed by the LT network. In addition, a meter reader accompanied the survey team, carrying with him the meter read route book from June 2010, the month of assumed peak demand. It was therefore possible to obtain and record in the GIS database for the LT network the metered consumption for each consumer.

Since the majority of the consumers located on the LT networks are billed by kWh consumption only, it was necessary to convert the kWh data to demand (kW) for modeling. As no measurements of actual demand were available, it was necessary to estimate demand using only the average energy consumption of the consumers. In order to determine the peak demand in kW likely from consumers on each LT network during the month of June, the data on consumption was applied to the demand equation below. This equation was derived many years ago by the Rural Electrification Administration (REA) in the United States, and has been verified by NRECA as acceptably accurate for use in developing countries as well. The equation is as follows:

$$D = N*(1-.4N+(N^2+40)^{0.5})\ 0.005925*C^{0.885}$$

Where:

D= Monthly peak demand in kW for a particular group of consumers

N= Number of consumers in the group

C= Average monthly consumption per consumer in kWh/mo.

The demand value calculated by the equation was applied as the source demand for the particular LT network, at a power factor of 80%, and the demand allocated to the segments of the LT network in proportion to the kWh of the consumers connected to that segment. Losses computed from the model therefore correspond to the losses in the LT network conductors.

It was necessary to generalize these results so that they could be applied to all general use transformers on all the modeled feeders so as to obtain a system value for LT losses. A value of average loss in watts per kVA of transformer capacity was developed for this purpose.

### Service Drop Losses

Service drop losses can be calculated on the basis of the assumption that all domestic sales used single phase meters, while all commercial and direct reading industrial sales used three phase meters. In most DISCOs, an effort was made at some point in the past to move meters to the base of the pole as opposed to being mounted on the exterior of the residence. This had the effect of shortening the effective length of the service drop from the utility's standpoint, to something less than 10 meters. Examination of the system indicates that this process has not been completed in many urban areas, and the meters are still located on the exterior of the buildings. For this reason, the average service drop length has been assumed to be 12 meters. table below indicates the assumptions for the four types of consumer..

**CHARACTERISTICS OF SERVICE CONDUCTOR**

| Consumer Type | Service Wire | Cores | Service Type | Length M |
|---|---|---|---|---|
| Domestic | 7 x 0.052 | Two | 1 Ph | 12 |
| Commercial | 7 x 0.052 | Four | 3 Ph | 12 |
| Industrial | 19 x 0.052 | Four | 3 Ph | 12 |
| Agricultural | 19 x 0.083 | Four | 3 Ph | 12 |

Average service loading was determined using the REA equation described above to calculate the total demand of the consumers of each class on each of the modeled feeders. Knowing the number of consumers of each type on the feeder allowed for an average demand per consumer to be calculated. Three phase loads were assumed to be balanced.

### Calculation of Energy Losses

Once the components of demand loss were calculated, it was necessary to convert the values derived from demand loss on peak to average energy loss. Because losses are a function of the square of load, it was necessary to account for the variation in load during the course of a year. The standard way in which

this is handled is to determine a loss load factor based on the annual load factor of the system. The standard equation used in the US private utility industry is:

$$LLF = K(ALF)^2 + (1-K)(ALF)$$

Where:

LLF= Loss Load Factor, or the load factor of the on-peak losses

ALF= Average annual load factor for the element under consideration.

K = a constant determined by analysis of the load curve of the feeder and recognizing that losses vary inversely as the square of load.

Annual load factor was computed for each feeder on the basis of the data supplied by the DISCO and the loss load factor calculated according to the given equation. The factor "K" was determined by reviewing the substation log sheets for the two-week period around the system peak for the feeder, and determining the K factor by analysis The same feeder loss load factor was applied to all components of loss.

Once the components of energy loss for the sample were determined, consisting of conductor loss, transformer loss, LT network conductor loss, and service drop loss, it was possible to sum all the components to determine the technical losses for the sample and thus for the system as a whole. Any difference between the stated distribution losses of the DISCO and the technical losses calculated by this method constituted an estimate of non-technical loss.

Applying this equation to LESCO, results in the characteristics shown below:

**RESULTS OF LOAD VERSUS LOSS ANALYSIS**

| Total KM | Sales Density MWh/Km | Benchmark Loss % | Actual Distribution Loss % |
|---|---|---|---|
| 61,615 | 135.0 | 7.1% | 9.7% |

The results from the benchmark loss column of the table should be comparable with the technical losses computed by the sample technique.

### A.4.4 Distribution Standards

The fourth and final component, which was applicable to all DISCOs but was reported only for LESCO, consisted of a series of interviews with staff at the Distribution Standards group of the NTDC. The Distribution Standards group maintains the construction and design standards that are utilized by all DISCOs, as well as the technical specifications that govern all procurements. In addition, the team visited a single manufacturer of distribution transformers and meters in an effort to evaluate local resources for these important components.

## A.5 FINANCIAL MANAGEMENT AUDIT

In the preparatory period prior to beginning the operational audits, key financial parameters were identified to be included in the data collection and analysis process. The financial performance parameters that were evaluated include: financial reporting, internal control, cash receipts and disbursements, operational financing and investments and cost containment.

The financial management audit consisted of a combination of interviews, data collection and analysis of key financial data. The interviews with senior DISCO management were conducted to gain an understanding of DISCO policies, procedures, and operating practices. From these discussions, the PDIP audit team identified operational objectives, expected financial and controls, and also identified key areas of risk.

DISCO practices and procedures were evaluated for financial performance parameters. Variance between industry practice and DISCO performance were noted and reported. Procedures were used to test each financial control as a means of verifying the control mechanisms with the results documented in the DISCO assessment report.

The first operational audit undertaken at LESCO served as a vetting process for the above described plan. The financial audit team worked as a single unit at LESCO to ensure that all team members gained the experience and understanding of the assessment process, and to adjust the audit process for later DISCO audit processes.

Once the LESCO audit began, the finance team met with the LESCO CFO to discuss the audit plan and determine with which DISCO officers the PDIP team members should coordinate to perform required tasks. Financial management team members met at the end of each working day to discuss problems, make any necessary adjustments to the process and schedule the plan for the next day.

### Tools

The financial management team reviewed LESCO organizational policies and procedures, annual report, system of accounts, interviews with DISCO management and employee personnel. Templates were developed as a data gathering tool to populate various financial models were used for analysis. The financial management team coordinated with the commercial management team to ensure that information and data that was needed by both teams was shared and incorporated into the analysis and reporting process.

### Analyses

Analyses included an evaluation of financial management processes, management of banking functions, management of cash and receivables, internal control processes, and overall management of DISCO financial performance. Results of these analyses were presented in the form of data tables, performance ratios, and discussions of specific issues that did not lend themselves to objective numeric presentation.

### Presentation of Results

- Analysis of cash receipts and disbursements
- Operational financing
- Internal control
- Cost containment
- Financial reporting with financial performance indicators

## A.6 COMMERCIAL MANAGEMENT AUDIT

The focus of the commercial management audit was on the revenue cycle which included the registration of new consumers, meter reading practices, bill production and delivery, and the receipt of consumer payment information. Other activities such as the disconnection and reconnection process, bill adjustment procedures, and customer services were also reviewed. These examinations were made so as to identify opportunities to increase the efficiency and transparency of commercial activities and improve the financial performance of the DISCOs. Opportunities to improve financial performance included revisions to current procedures with technological enhancements or replacement of the billing system with a Customer Information System to better manage customer information with records of all customer interactions in addition to preparing bills. The commercial assessment team consisted of international and Pakistani consultants who have practical work experience with one or more electrical distribution companies, and have some understanding of utility commercial practices and procedures.

### Data Collection

Procedural data was collected through interviews and observations. The overall commercial process was ascertained from the Commercial Director. He was given the opportunity to discuss specific problem areas and activities that were deemed crucial to the revenue process. Procedural details for each activity

and the time required were obtained from the in-charge department heads. These procedures were verified by observing the actual practices at selected Revenue and District Offices and pay points.

The commercial team also collected billing/collection/consumer data from the billing system. Not only did this data serve as a baseline reference to gauge future results but was also used to provide an indication of the time to complete the revenue cycle. Other hard data collected during the interviews included the number of meter reading routes, the actual number of meters in a route, frequency of meter tests and calibration, customer billing complaints, and number of employees involved in the revenue cycle.

### Strategic Analysis

Once the data collection process was complete, the commercial management team members evaluated the data and DISCO commercial practices to determine what changes were needed to improve transparency, cost recovery and effectiveness of the commercial procedures and practices. Each step and stage of the revenue process was mapped indicating the flow of documentation, when approvals were obtained, decision points for corrective action, and the interaction between departments. These maps were reviewed for redundancies and possible internal control weakness such as a lack of segregation of duties or reconciliations. The maps were studied to determine if there was a more efficient flow of data or where interventions would be helpful in reducing costs, increasing revenues, and/or accelerating cash flows.

The interventions included a combination of investments in secondary distribution systems, transformers, services, and revenue meters; as well as changes in commercial system practices and procedures to improve DISCO metering and revenue recovery practices. The procedural changes required the addition of devices to eliminate transcription errors, to speed the data entry, and to increase internal controls. The Commercial Specialist also evaluated and made recommendations regarding the effectiveness and adequacy of commercial software (the CIS), with the aim of determining if a software solution that more effectively integrates commercial, accounting, human resource, work order, and other DISCO functions would be merited.

## A.7 HUMAN RESOURCE MANAGEMENT AUDIT

An integral part of the operational audits included an evaluation of human resource management and HR systems for each DISCO. The HR review evaluated DISCO organizational structure, analyzed performance management systems, evaluated compensation systems, reviewed selected management and staff positions, and performed a preliminary analysis of the training needs, specifically focusing on commercial needs and linemen training to improve the productivity and safety. The HR audit was led by the Organizational Specialist who was responsible for organizing and leading a team of Pakistani human resource and institutional management specialists.

The goal of the human resource management audit was to identify improvements needed in DISCO organizational structure and human resource management to result in an HR model that supports the long-term institutional needs of the DISCO. The HR model should support appropriate levels of compensation and benefits, and establish a work environment that provides the incentives needed to support a well-motivated work force. This model should support emerging process-centric culture, and a cost delivery model that appropriately balances customer service with effective service delivery. The DISCO organizational structure should support high quality electric service and high customer satisfaction, both of which are predicated on highly motivated and satisfied DISCO employees The assessment therefore focused on assessing not only organizational structure and key processes, but also on human resource management and management systems, HR functions and the HR organizational structure in which the HR functions operate, as well as the current roles of line managers and their staff managers.

The organizational team reviewed and evaluated the state of HR management system, functions, responsibilities, performance management systems, and compensation package. The evaluation compared the DISCO human resource management and management systems with best practices from within and beyond Pakistan, from which recommendations were made regarding how the policies, practices and procedures can be improved to enhance the productivity of each DISCO. The

organizational assessment team sed diagnostic tools to identify gaps in optimal DISCO personnel performance. Data was collected through interviews and surveys to take a baseline of current policies and practices; this was contrasted with best practices to define the actions that are necessary through the DISCO Performance Improvement Action Plans to result in significantly improved human resource policies, practices, and management systems

Data gathering included:

1. Internal interviews and surveys given to department managers and senior engineers
2. Interviews with Chief executives and senior management to evaluate company's Vision, Mission and Strategic Objectives
3. Identification of major functional skills and competencies
4. Surveys of staff from engineering, commercial management, system operations, and DISCO administration at the Division and Sub-division levels to include roles and responsibilities, adherence to existing DISCO procedures, including health and safety, and any other standard operating procedures that exist within the DISCOs.

Review of HR strategic and functional analysis included:

1. Assessment of company's vision, mission, goal and objectives and their linkage with departmental goals and objectives
2. Assessment of recruitment process
3. Evaluation of compensation and benefits
4. Evaluation of performance management system
5. Evaluating the integration of corporate communications and HR communications

Evaluation of training and capacity building needs included:

1. Development of training needs assessment survey form.
2. Completion of training needs survey by distributing needs assessment forms to functional heads to determine critical skills & competencies gaps. The same will be translated into a launch of urgent training program in pilot project
3. Identification of essential and immediate training needs for engineering, financial management, commercial management, and human resource functions.

## A.8 COMMUNICATIONS AND OUTREACH AUDIT

Communication and outreach is a direct expression of corporate culture and values of an organization. The key areas of communication as well as processes and tools employed to communicate, to a large extent, determine the corporate priorities for internal and external stakeholders. One of the major differentiating features of progressive organizations vis-a-vis status-quo driven organizations is practice of contemporary modes of communication, openness and scientific knowledge management for efficient and speedy decision-making for the larger good of the organization.

A communication and outreach assessment was conducted to have a diagnostic analysis of the state of internal and external communication and outreach. The analysis was intended to provide sufficient information to serve as a foundation for developing communication and outreach strategy leading to action plan, promoting better understanding and improved public opinion of the DISCO as an electricity distribution company.

The Communications Assessment included:

1. Review and analysis of existing internal and external communication and outreach strategy, organization chart of relevant departments and job descriptions of relevant staff.

2. Review of existing and previous communication and outreach campaigns, materials, media mix, budgets, communication briefs etc.
3. Visiting customer centers/ complaint centers to obtain first-hand information on ground communication with customers in terms of customer services and complaint handling style, clarity, processing time and delivery practices. The customer services and complaint handling were also reviewed with a gender perspective.
4. Review of internal communication process, feedback and follow-up status to assess the efficiency of internal communication.
5. Review of current state of information technology being used for external and internal communication.
6. Identifying training needs for the relevant staff
7. Assessing the current practice of using various communication tools/vehicles like web site, newsletters, emails, event management and other multilayered activities.

Drawing from the assessment results, the report describes various issues and identifies areas where action would be worthwhile. It offers a series of recommendations for high priority communication-related activities that could enhance the DISCO's effectiveness in communications and outreach, improve capacity of the communications-related staff and strengthen the effectiveness of its communications department.

Ultimately, the recommendations will contribute towards positioning the DISCO as a service-delivery and customer-centric corporate entity.

### Internal Communication

Internal Communication is related to the communication within the DISCO. It could be between individuals, between different departments or between individual and department. The assessment helped map internal communication process, feedback and follow-up status to assess suitability and efficiency of the existing system and procedures.

### External Communication and Outreach

The analysis of external communication determines the extent of activities carried out for corporate image building to serve as entry points for keeping a liaison between the organization and its relevant stakeholders, including extended audiences. Promotion of a strong corporate culture and coherent brand identity through appropriate choice of communications tools, processes, media mix, supporting budget and follow-ups are areas that deserve careful attention.

Outreach activities for target groups of stakeholders are an extension of corporate communication to ensure sustained visibility and perception of a positive corporate image.

The following methodology was employed to review and analyze the communication and outreach process and existing strategies of the DISCO:

### Key informants interviews:

In-depth interviews with the key informants in the DISCO were conducted using a semi-structured questionnaire. The questions asked were geared towards developing an understanding of existing practices, modes and means, efficiency and speed of communication, availability and access to information. Issues relating to existing penetration of Information and Communication Technology (ICT) and current practices of knowledge management were also discussed. Deliberations also focused on strategic efforts to develop corporate brand image with external stakeholders to spell out a coherent communication strategy for the company. The existing activities of outreach and potential of such activities was also discussed.

Besides key informant interviews, questionnaires were also filled in by relevant senior officers of the DISCO on corporate, external and internal communication and outreach activities of company.

### Focus group discussion:

A focus group discussion was held with managerial staff of relevant departments to discuss the cross-cutting issues of internal and external communication on similar lines as mentioned above to ascertain the feedback and comments from middle management level. Topics of discussions also included internal and external communication practices and readiness of staff to embrace contemporary communication culture.

### Documentary review:

Review and appraisal of relevant record and material available with Public Relations Department, MIS and Customer Services Department was undertaken, which included record of daily press cuttings, press releases, printing and publications of Public Relations Department. Similarly, practices and process of data collection, bills printing and various output reports were reviewed at MIS department. The registers maintained to record details of complaints of Customer Services were reviewed to understand the practices and efficiency of current system.

### Visit to the customer center:

The Customer Services Centre located at the DISCO head office was visited to understand the complaint handling process as well as gauge the level and quality of customer service.

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