INTERNSHIP REPORT

ON

AN OVERVIEW OF DESCO 'S DISTRIBUTION, OPERATION, MAINTENANCE AND CUSTOMER CARE

By

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2005-3-80-001
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2006-1-80-033

Submitted to the

Department of Electrical and Electronic Engineering
Faculty of Sciences and Engineering
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in partial fulfillment of the requirements for the degree of
Bachelor of Science in Electrical and Electronic Engineering
(B.Sc. in EEE)

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Approved By

Academic Advisor	Academic Advisor	Department Chairperson
Sharmin Ara	Dr. Khairul Alam	Dr. Anisul Haque

DESCO
POWER IS YOURS
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August 01, 2011
Memo No: DESCO/Trg. & Dev/2011/ 303

To Whom It May Concern

This is to state that Mr. Md. Sohab Sayeed (Student ID: 2005-3-80-001) student of Electrical and Electronic Engineering program (B.SC) in East West University Bangladesh, has successfully completed Twenty (20) days Industrial Training from 02/05/2011 to 30/05/2011 in DESCO and complied all the requisites of Training & Development, HRM Division, DESCO.

I wish him all the success in his career.

Engr. Akharul Islam
Manager (Training & Development)
HRM Division.

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Acknowledgment

We would like to first acknowledge the consistent patience and perseverance of our Department Chairperson, Prof. Dr. Anisul Haque and for approving our request for undertaking this learning internship at DESCO. Secondly, we are eternally grateful to our Internship advisors Prof. Dr. Khairul Alam and Sharmin Ara. Their constant guidance and constructive criticism helped to bring this report into fruition. We would also like to acknowledge, ever so gratefully, to the employees and staff of DESCO who helped us with relentless knowledge throughout the process.

Executive Summary

Electricity is the ultimate tool for modernization. It created it, sustains and will hence propel its borders past present limitations. Proper supply of electricity has a positive impact on GDP of a country. In Bangladesh, there is always a deficit of electricity production. At the moment, only 60% of our entire populations are getting electricity. People, who are getting electric lines, are also facing a great deal of load shedding. After the liberation war, every government tried to improve power sectors but the struggle with meeting the demands of the electrical consumption still persists. The most pressing problem in the power sector has been with the distribution system, which is characterized by heavy system loss and poor collection performance. Dhaka Electric Supply Company Ltd. (DESCO) was created in 1996 under company Act 1994 as a public Limited company to improve better revenue collection and better consumer service.

DESCO purchases electricity from Bangladesh Power Development Board (BPDB) which then transmits the electricity from the Power plants to DESCO's receiving sub-stations through the National Grid. Power Grid Company Bangladesh Limited (PGCB) is in-charge of the National Grid. DESCO distributes electricity to the consumers through its own distribution network and collects revenue against the electricity usage.

We have done our internship at DESCO, a distribution company and during our tenure as inters we have seen and learnt all necessary modes of operations of DESCO including the Distribution networks, Customer service, Administration, IT department, Grid and Substation maintenance, Control room operations etc. We have tried to cover all the operations of DESCO during our 100 hours internship.

Internship Schedule

Date & Time	Location	Topics	Coordinator / Facilitator	Remarks	Working Time	Hours
2/5/11	Training & Development Division, DESCO HQ Banani	Welcome Speech & Introduction to DESCO	S.M Zamil Haque Manager Training & Development	On Desk	9am to 4 pm	6
3/5/11	Administration , Division, DESCO HQ Banani	Administrative activities of DESCO	Md. Taufique Abdullah Manager Administration Md. Alamgir Manager, Finance	On Desk	9 am to 5pm	7
4/5/11	Pallabi S&D Division, DESCO	Commercial Operation , Disconnection & One Point Service Center, System Server Operation	Engr. Md. Raihan Arefin DM (C/O) Ms. SHabnam Mina Jr. Asst. Mang.	On Desk & Practical	9 am to 5 pm	7
5/5//11	Pallabi S&D Division, DESCO	Reconnection, Metering, Billing, Collection, New Connection & IT Section	Ms. Shabnam Mina Jr, Asst. Mang. Shahenewaz Begum Jr. Asst Mang Engr Habibul Hasan Chowdhury, Asst. Mang. IT	On Desk & Practical	9 am to 5 pm	7

8/5/11	Kafrul S&D Division	Substation Operation , S&D System Operation, Load Sanction & Load Retention	Engr. Mirza Abu Naser Dep. Manager & Engr. Tanvir Ahmed Asst. Manager	Theoretical & Practical	9 am to 5 pm	7
9/5/11	Kafrul S&D Division	Load Management, Transformer repairing, Power Factor Monitoring & Upgrading	Engr. Tanvir Ahmed Asst. Manager	Theoretical & Practical	9 am to 5 pm	7
10/5/11	Kafrul S&D Division	Line maintenances, Faulty transformer detection	Engr. Tanvir Ahmed Asst. Manager	Theoretical & Practical	9 am to 5 pm	7
11/5/11	Kafrul S& D	New Transformer Installation, Route Planning for underground 33KV line	Engr. Tanvir Ahmed Asst. Manager	Practical	9 am to 11:30 am 1:30 to 7 pm	6.5
12/5/11	Kafrul S&D Division, Digun Grid	Substation Operation, Maintenance and Grid Substation Operation & Maintenance	Engr. Shawkat Ali & Engr. Tanvir Ahmed Asst. Manager	Practical On Ground	9 am to 6 pm	8
13/5/11	Kafrul S&D Division, Digun Grid	Line Maintenance	Engr. Tanvir Ahmed Asst. Manager	Practical	9 am to 5 pm	7
14/5/11	Kafrul S&D & Mirpur 12 Substation	Substation and Line	Engr. Tanvir Ahmed	Practical	9 am to 5 pm	7
17/5/11	Mirpur 12 Control Room	Control Room Operation, Maintenance & Load Shedding	Engr. Md. Rafiqul Alam Jr. Asst. Manger	Practical	8 am to 5 pm	8
18/5/11	DESCO HQ Banani	Technical Activities, Major Projects & Future Plans	Engr. Zulfiquar Tahmid Manager	On Desk	2 pm to 5 pm	3
20/5/11	Mirpur 12 Control Room Substation	Sunstation operation, tripping, controlling	Md. Abdul Mannan Jr. Asst. Manager	Practical	8 am to 5 pm	8
21/5/11	Mirpur Old & DOHS Substation	Substation and grid networkin	Engr. Imrul Kayes Sr. Engr.	Practical	9 am to 5 pm	7

Total Internship Hours = 102.5 hours

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 01

INTRODUCTION

1.1 Company Profile

1.1.1. Background

Electricity plays a vital role in the socio-economic development and poverty alleviation. It is considered as the driving force of all development activities. To alleviate poverty in the face of resource limitations and high population density, Bangladesh requires an economic growth rate of about 10% per annum (p.a.) to provide employment of its rapidly growing labor force that cannot be absorbed by agriculture. In order to achieve this growth rate, availability of a reasonably priced and reliable source of electricity is a prerequisite. Starting from a small base, the power sector in Bangladesh has grown significantly. The installed generation capacity has increased to about 5776 MW (as on October, 2010) from a meager 88 MW in 1971. Electricity generation grew at about 7.5% p.a. during last ten years, compared with average annual GDP growth rate of about 6.0 %. Notwithstanding the progress made to date, Bangladesh's per capita electricity generation of 236 KWh p.a. is still among the lowest in the world. About 42% of the population has access to electricity, which is low even compared to many developing countries.

The power sector in Bangladesh faced numerous problems characterized by lack of supply capacity, frequent power cuts, unacceptable quality of supply, and poor financial and operational performance of the sector entities. The customer service is not praiseworthy. There have been a number of reforms in the power sector in Bangladesh since her independence, but most of these reforms failed to bring desired improvements in the power sector. The most pressing problem in the power sector has been with the distribution system, which is characterized by heavy system seldom got the priority in reform initiatives.

DESCO was constituted to provide uninterrupted & stable power supply, better consumer service, improve system loss and accordingly DESCO starting its operational activity since

September 24, 1998 by taking over of Mirpur area from DESA. Following are the initial activity of DESCO which includes:

(1) Operation & Maintenance of Sub-Stations & Lines;
(2) Commercial functions i.e. billing, consumer accounting, disconnection & re-connection of consumers, testing & installation of consumer meters etc.; and
(3) Planning, Design and installation of Sub-stations & lines etc.

The service territory of DESCO is as follows where the above services provided:

Phase 1:
Mirpur area bounded by Rokeya Sarani and low lying area in between Mirpur and Cantonment in the East, Agargaon road in the South, Mirpur Road and Turag river in the West and low lying areas in the North. The proposed area is shown in Fig 1.1. The area covered under the 151 kV phase was taken over by DESCO on September 24, 1998 from DESA.

Phase 2:
Gulshan Circle including Mirpur Area bounded by Balu River in the east, Turag River in the west and Turag and Balu River in the North and Mirpur Road, Agargaon Road, Rokeya Sarani, Progoti Sarani, New Airport Road, Maymenshing Road, Mohakhali Jeel, Rampura Jheel connected with Balu River in the South . The additional area covered under the 2nd phase was taken over by DESCO on April 09, 2003 from DESA.

Recruitment for Phases:

DESCO recruited its employees through open advertisement. The qualification and experience requirement were fixing up according to the requirement for performing their duties and responsibilities against the respective post. Mainly those who have sufficient experience in the field of utility organization are selected on a merit basis. They were employed on long-term contracted basis under the DESCO's service rules approved by its Board of Directors.

Project Financing

It is suggested that DESCO initially be financed on a debt equity ratio of 50:50. This conservative leveraging has been suggested since DESCO being a new organization handling a fairly complex project in a not-so-successful area in the power sector. Hence investor confidence was initially low.

Out of the total Project cost of Taka 126.06 crores, the foreign exchange portion amounts to Taka 80.60 crores (65%) and the local cost portion Taka 45.45 crores (35%). The Asian Development Bank financed under the Loan No. 1505-BAN (SF): Ninth Power Project (DESCO Component for Mirpur area) in first phase and under the Loan No. 1731-BAN (OCR) they were again financed for Dhaka Power System Upgrade Project: Tenth Power Project Loan for Gulshan area. Local costs, which would constitute about 30% (thirty percent) of the total project cost, will be met from the equity part of DESCQ's finances. Arrangement will be made for arranging funding for remaining part of the project from other donors.

Principle of Tariff Setting

Being a commercial organization, DESCO charges for electricity it distributes on a "cost plus performance based return" principle to cover its capital costs, operation costs as well as to target a post tax return of 15 percent on its equity. It is therefore proposed that, till the recommendations of the tariff study to be conducted with World Bank financing are available, DESCO charge a "cost - plus-fixed- return" tariff from its consumers.

1.1.2.Dhaka Electric Supply Company Ltd.

- Formed on : November 03, 1996
- Operates under : Company Act 1994
- Authorized capital : 5000 Million (Taka)
- Paid-up Capital : 1271 Million (Taka)
- Shareholder : DESA (OFF-LOADING in Process)

1.1.3.Territory

The area under service of Company is about 220 square kilometers which comprises the areas bounded by the Mirpur Road, Agargaon Road, Rokeya Sarani, Progati Sarani, New Airport Road, Mymenshing Road, Mohakhali Jheel, Rampura Jheel connected with the Balu River in the South and East and the Turag River in the West and areas under Tongi Pourashava in the North. Recently "Purbachal Model Town" a Rajuk project, situated on the east side of the Balu River and adjacent to Dakshinkhan area, has also been included under the operational area of DESCO.

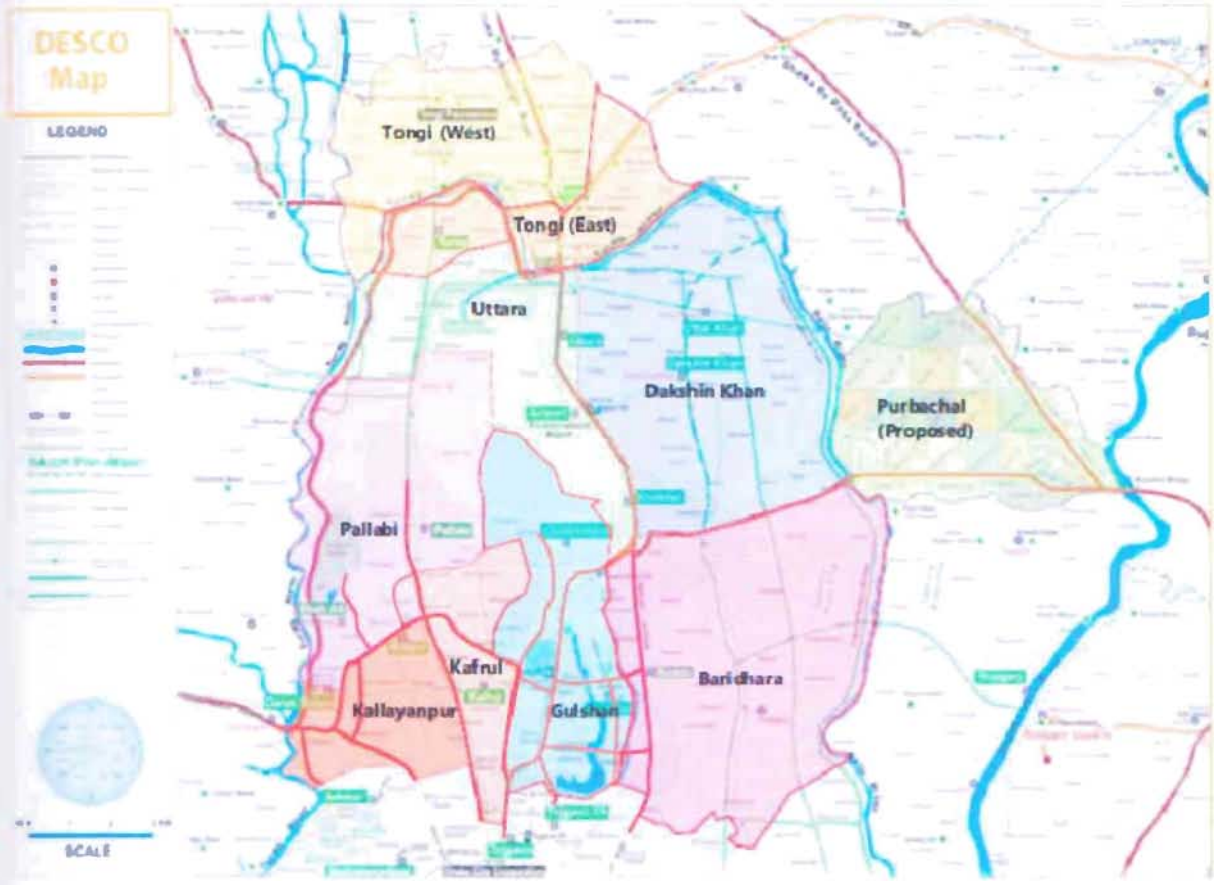


Figure 1.1 : Territory of DESCO

Source: Dhaka Electric Supply Company Limited

1.1.4 Overall Structure of DESCO

Reference: Figure 1.2 (see below)

DESCO board consists of nine Directors under the Managing Director. The Technical Director manages Engineering and system control which is basically divided by two parts:

i. System Engineering and Design

ii. System Control and Protection.

The Director of Finance manages

i. Finance

ii. Accounts and

iii. Procurement

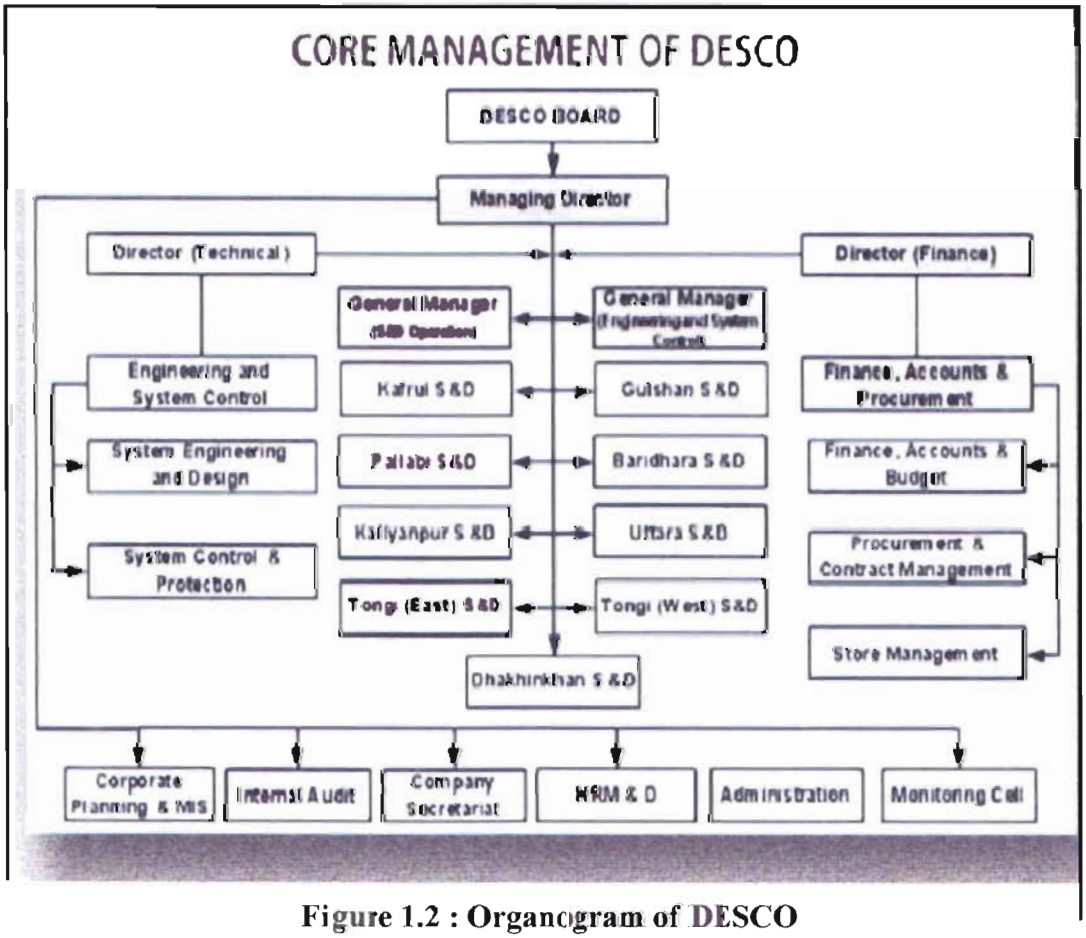


Figure 1.2 : Organogram of DESCO

Source: Dhaka Electric Supply Company Limited

1.1.5.Mission and Vision of DESCO

Vision: Distribute uninterrupted quality electricity using most dependable technologies to the satisfaction of the consumers and to make the company a role model in electric distribution system in the region.

Mission: To be a sustainable and consistent organization in Power Sector, DESCO is working with following missions

- Better Customer Service.
- Provide reliable and uninterrupted power supply to the valued customers.
- Reduce system loss.
- Increase revenue earning to become a profitable business entity.
- Self sufficient in every avenue.
- Better working environment.

1.1.6.Major Works of DESCO

i. Supplying electricity to consumers.
ii. Collecting revenue against electricity usage.
iii. Maintain all the lines, appliances related etc. in the newly developed area and
iv. Existing area fulfill the ever rising demand of electricity.

1.1.7.Supply Chain of DESCO

DESCO purchases electricity from Bangladesh Power Development Board (BPDB), authority responsible to generate electricity. Electricity is transmitted from the Power plants to DESCO's receiving sub-stations through the National Grid. Power Grid Company Bangladesh Limited (PGCB) is in-charge of the National Grid and they receive wheeling charge for transmission of electricity through the National Grid. DESCO distributes electricity to the consumers through its own distribution network and collects revenue against the electricity usage.

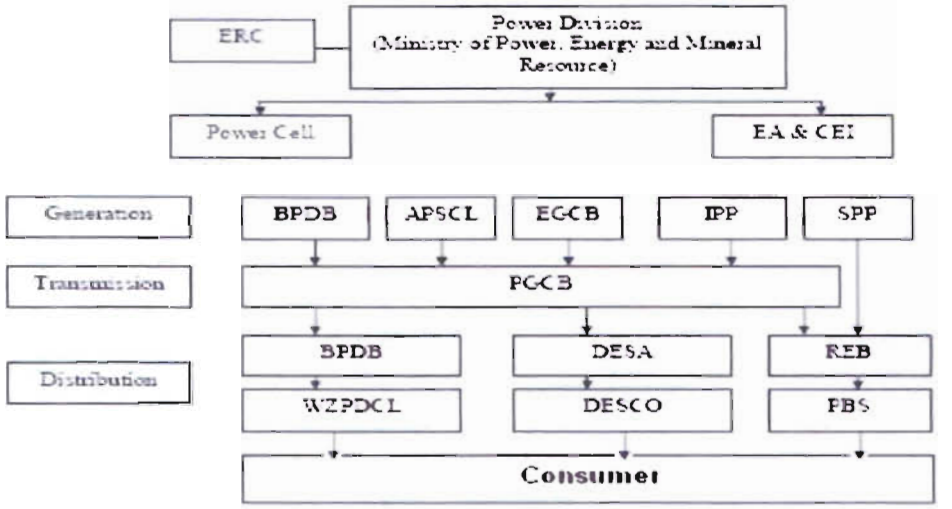


Figure 1.3 : Supply Chain of DESCO

Owner & Regulator

Owner and Regulator is the Power Division, Ministry of Power, Energy & Mineral Resources.

Generation

i. Bangladesh Power Development Board (BPDB)
ii. Rural Electrification Board (REB)
iii. Ashuganj Power station co. Ltd (APSCL)
iv. Electricity Generation Company of Bangladesh Ltd. (EGCBL)
v. Independent Power Producer (IPP)
vi. Small Power Producer (SPP)

Transmission

Power Grid Company of Bangladesh Ltd. (PGCB)

Distribution

i. Bangladesh Power Development Board
ii. Dhaka Power Distribution Company Limited (DPDC)
iii. Dhaka Electric Supply Company Ltd. (DESCO)
iv. Rural Electrification Board through Rural Electric Co-operatives, Palli Biddyut Samities (PBS)
v. West Zone Power Distribution Co. Ltd (WZPDCL).

1.1.8.Distribution System Loss

DESCO acts as an electricity distribution company in the power supply chain. So distribution system loss is the big factor for it. System loss means the percentage change in the energy sales and energy purchase. From the beginning DESCO remains the only company that draws profit to the Bangladesh government. The main reason of that DESCO is showing constant improvement in reducing system loss. At the beginning, in 1997-98 the system loss was approximately 46.67% but in 2011 it is reduced to 8.80%, which is lowest among all the electricity distribution companies of Bangladesh.

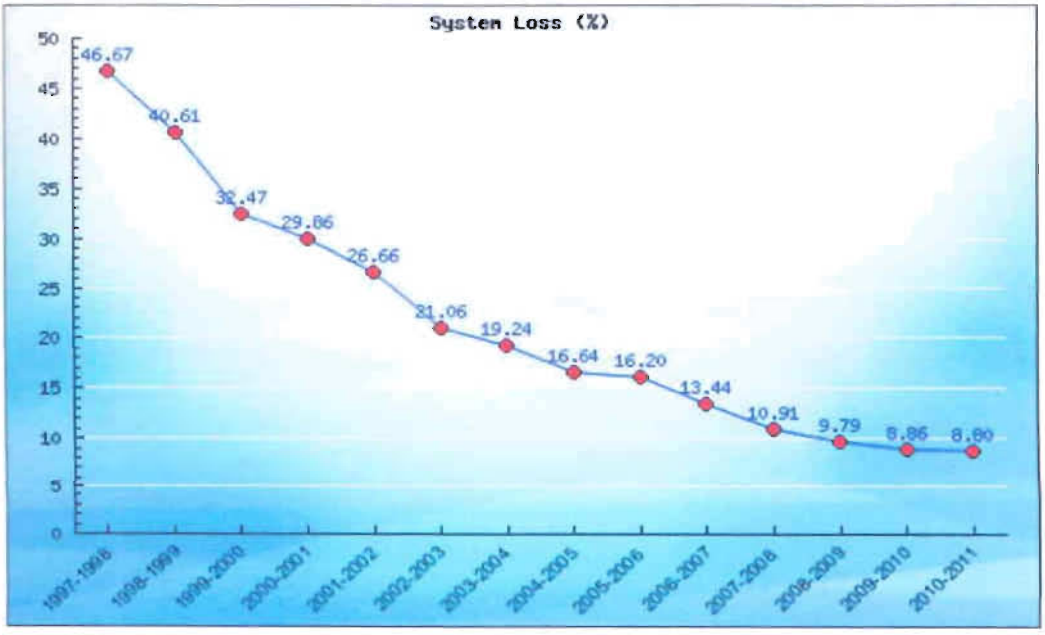


Figure 1.4 : Fiscal year wise system loss (up to May 2011)

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited to ADB

1.1.9.Consumer Mix

According to the Annual Report of year 2010 the consumer mix of DESCO is given below Figure 1.5.

Category	Consumer Number	(%)
Residential	393639	88.23
Industrial	5979	01.34
Commercial	36957	08.28
Other	9554	02.15

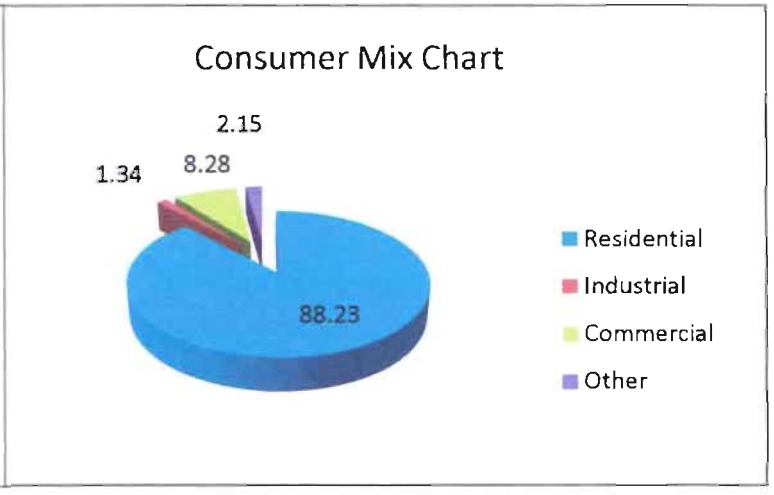


Figure 1.5 : Consumer mix of DESCO based on the annual report of 2010

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited to ADB

1.1.10. Consumption pattern

According to the Annual Report of year 2010 the consumption pattern of DESCO is given below in Figure 1.6.

Category	Consumption (MkWh)	(%)
Residential	1315.766	49.21
Industrial	1016.295	38.02
Commercial	258.421	09.67
Other	83.205	03.10

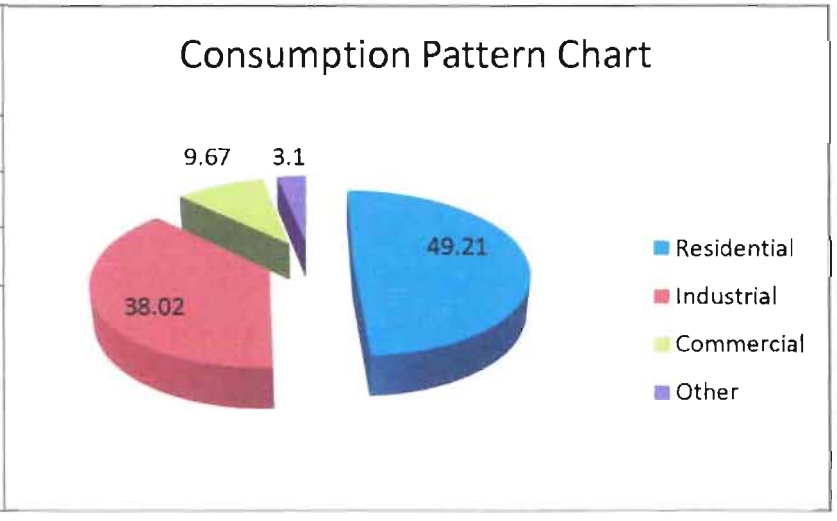


Figure 1.6 : Consumption Pattern of DESCO based on the annual report of 2010

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited to ADB

1.1.11. Energy purchase rate and selling rate of DESCO

- Purchase rate from PDB: 2.62 TK/KWH
- Wheeling Charge to PGCB: 0.05 TK/ KWH

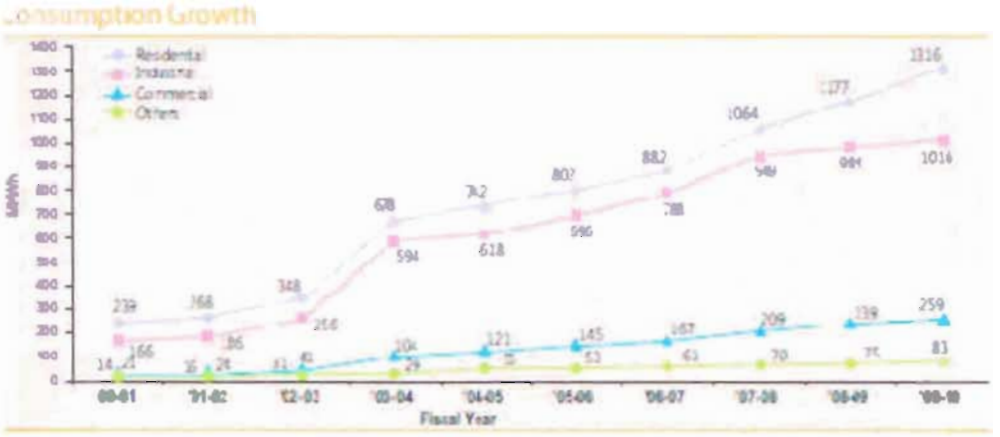


Figure 1.7 : Consumption Growth Pattern of DESCO based on the annual report of 2010

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited

Table 1.1 : General information of DESCO

Sl. No.	Particulars	Present status	Project upto2013
1	Source line(33 KV)	293 KM	350 KM
2	Distribution line(11 KV)	3066 KM	3652 KM
3	No. of Substation(33/11 KV)	22 Nos	31 Nos
4	Installed capacity	770/1078 MVA	1240/1736 MVA
5	Max demand	581 MW	830 MW
6	Load factor	66.05 %	
7	Distribution Transformer(11/0.4 KV)	4830 Nos	6047 Nos
8	No. of feeder	212 Nos	310 Nos
9	132/33 KV Grid S/S	07 Nos	10 Nos
10	System loss	7.34 %	6.5 %
11	Sales and Distribution Division	9	17

Figure 1.8 : Parameterization of categories of DESCO based on the annual report of 2010

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited

1.2 Objective of the Internship

The general objective of the internship was to have a thorough understanding of the different branches of operation of DESCO. Some other specific objectives include:

1. To explore the main operational activities of DESCO.
2. To survey the distribution system of DESCO.
3. To know the success and failure of DESCO in doing its operational activities.
4. To discover the already taken initiatives of DESCO to improve overall performance.

1.3. Scope & Methodology

This study was undertaken aiming to know about the distribution system and operational activities of DESCO. The scope of this study includes reviewing the technical, commercial and customer service quality of DESCO and identifying tolls and techniques used by DESCO to achieve remarkable performance level.

1.3.1.Nature of the study

The study was both qualitative and quantitative as it focused mainly on information provided by the different departments of DESCO and some other agencies-related to Power Sector. In addition, the files provided to Asian Development Project (ADP) and for the creation of the annual reports of DESCO were taken into consideration.

1.3.2.Data Collection

Both primary and secondary data sources had been used in preparing this report.

(i) Primary Source

Primary data is basically collected from conversations with the key employee of DESCO and due to the practical experience on field during the industrial training period at DESCO.

(ii) Secondary Source

Secondary data had been gathered from (Management Information System) MIS division, Finance and Accounts Division, Company Secretariat and Planning Division of DESCO; newsletters of Bangladesh Power Development Board (PDB), Power Cell and Ministry of Power, annual reports of DESCO and website of DESCO and books of different authors.

The internship at DESCO included a total seven students. According to the course advisors the total participants were divided into three teams

The areas that were covered as a result in this report are explained by the following web:

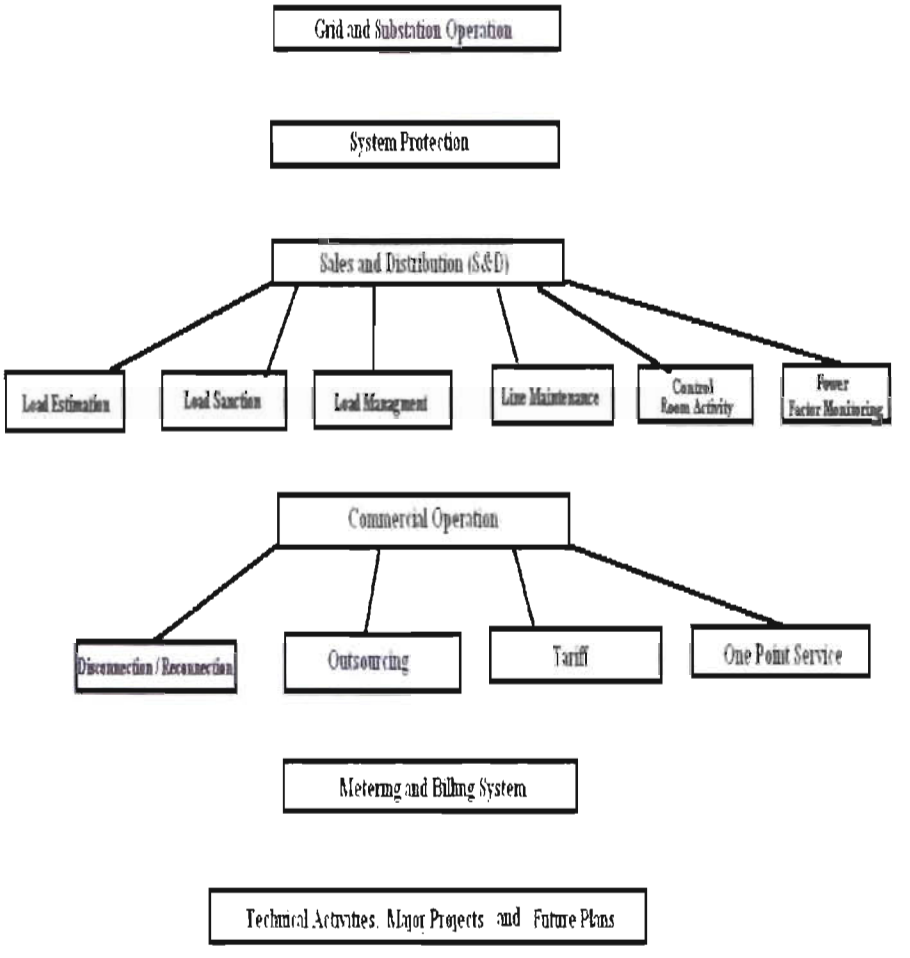


Figure 1.9 : Topics covered in the report

Chapter 2

Grid Network & Substation

2.1 Introduction:

An electrical grid consist of transmission line is a vast, interconnected network for delivering electricity from suppliers to consumers. Those lines when interconnected with each other, become high-voltage transmission networks called grid. [1]

It consists of three main components:

1. Generating plants : That generate electricity from combustible fuels (coal, natural gas, biomass) or non-combustible fuels (wind, solar, nuclear, hydro power).

2. Transmission lines : That carries electricity from power plants to demand centers.

3. Transformers : That either steps up or down the voltage suitable for distribution.

In the power industry, electrical grid is a term used for an electricity network which includes the following three distinct operations:

1. Electricity Generation :

   Generating plants are usually located near a source of fuel, and away from heavily populated areas. The capacity of the plant closely related to the demand for electricity. The generated voltage is stepped up to a higher voltage-at which it gets connected to the transmission network.

2. Electric Power Transmission :

   The transmission network will move (wheel) the power long distances-often across state lines, and sometimes across international boundaries until it reaches its wholesale customer (usually the company that owns the local distribution network).

3. Electricity Distribution :

Upon arrival at the substation, the voltage will be stepped down from a transmission level voltage to a distribution level voltage. As it exits the substation, it enters the distribution wiring. Finally, upon arrival at the service location, the power is stepped down again from the distribution voltage to the required service voltage(s).

In Bangladesh usually a power plant generates 15.6 KV and 11KV voltage. This voltage is not suitable for transmission because of energy loss in long distance transmission line. To avoid this loss, the voltage level is raised up to 230KV or 132KV. In the second and third distribution hub the voltage level is lowered to 132 KV from 230KV and 33 KV from 132KV.

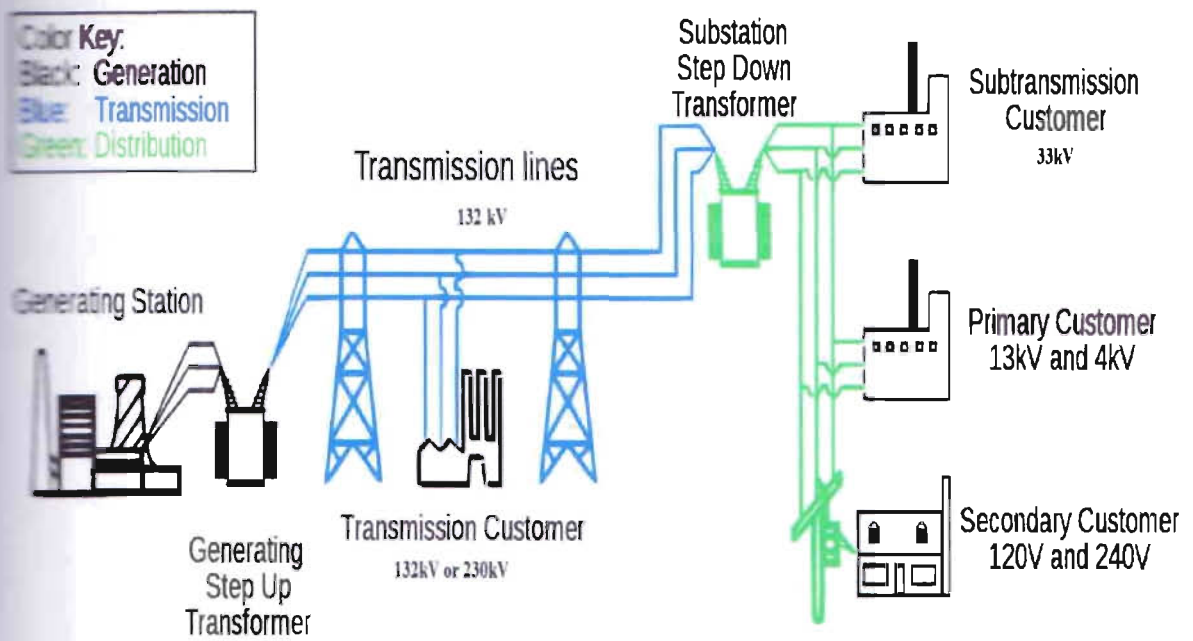


Figure 2.1: Diagram of an electrical grid network system.[1]

In DESCO there are three grid substations:

1. Kallyanpur grid (Digun grid)
2. Uttara grid
3. Bashundhara grid.

We got an opportunity to visit Digun grid which is in the Cantonment area of Mirpur.

Fig: 2.2 Grid substation of Kallyanpur grid (Digun grid)

2.1.1 Brief Description of the Components of Grid Substation and their Operation:

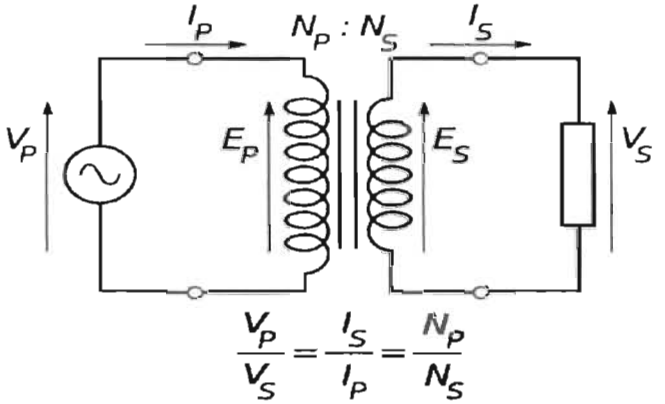
In Digun grid substation the generating equipments are,

1. Power Transformer(132/33 KV, 50/75 MVA).
2. Current transformer (CT) (88:1).
3. Potential transformer (PT) (134/37.5 KVA).
4. Circuit Breaker(SF6).
5. Isolator/ Disconnector.
6. Bus Bar.
7. Control relay panel.
8. Lighting Arrestor (LA).
9. Auxiliary transformer(33/0.4 KV, 500 KVA).
10. DC distribution panel.

Brief description of the components and their operations are given below,

2.1.2 Power Transformer:

A transformer is a device that transfers electrical energy from one circuit to another through inductive coupled conductors of transformer's coils. If load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. In an ideal transformer the induced voltage in the secondary winding (Vs) is in proportion to the primary voltage (Vp) and is given by the ratio of the number of turns in the secondary (Ns) to the number of turns in the primary (Np) as,



By appropriate selection of the ratio of turns, a transformer allows an alternating current (AC) voltage to be stepped up by making Ns greater than Np or stepped down by making Ns less than Np. [5]

Figure 2.3: Power Transformer in Kafrul substation

Transformers can be classified in Different Ways:

i. By power capacity: from a fraction of a volt-ampere (VA) to over a thousand MVA;

ii. By frequency range: power, audio or radio frequency:

iii. By voltage range: from a few volts to hundreds of kilovolts;

iv. By cooling type: air cooled, oil filled, fan cooled, or water cooler;

v. By application: such as power supply, impedance matching, output voltage and current stabilizer, or circuit isolation;

vi. By end purpose: distribution, rectifier, amplifier output;

vii. By winding turns ratio: step-up, step-down, isolating (equal or near-equal ratio), and variable.

Grid transformers:

In grid substation, step- down power transformer is used to transforms 132 KV to 33 KV and transmitted to the substation part. In Bangladesh most of this power transformers are of oil immerge type transformers. Usually in grid, 50 to 75 MVA ranged transformers are used.

Figure 2.4: 132/33KV transformer in Digun grid substation.

Oil -type grid transformers:

Oil filled transformers are those transformers which filled with a highly refined mineral oil that insulates internal live parts of the transformer. It also prevents corona and manages temperature control inside the transformer for the prevention of equipment and machinery overheating during the operation of large job applications. The oil inside the transformer is of non-combustible properties, making these transformers very safe and allowing them to operate for longer periods of time.

The main parts of oil type transformer are described below.

Tank Section:

The size of a transformer tank depends on the ratings of transformer. The length of tank can be large or small, which is an important issue for a transformer. The raw material of the tank is steel sheet.

Transformer Oil:

The transformer oil provides high dielectric strength to the coils and core which are submerged. This allows the transformers to be more compact and cost efficient. This type of transformer can withstand far more voltage across connections inside the transformer tank than that of an air type transformer. But with time, due to heat and contaminants, the oil degrades beyond normal operation ability. In this circumstance, the oil cannot retain high dielectric strength when exposed to air or moisture because the dielectric strength declines with absorption of moisture and oxygen.

Oil Level Indicator:

Oil level indicator indicates the oil level in the conservator and gives too low or too high indications by the contacts on it.

Primary and Secondary Windings:

The transformer consists of two coils called "windings" which are wrapped around a core. The transformer operates when a source of ac voltage is connected to one of the windings and a load device is connected to the other. The winding that is connected to the source is called the primary winding (low tension side). The winding that is connected to the load is called the secondary winding (high tension side).

Terminal:

In an oil or liquid type transformer, terminal means bringing the electrical connection from inside of the tank to outside of the tank.

Transformer Bushings:

The bushing is a blank insulator. It works as a bridge for a conductor to pass along its centre and connect at both ends to other equipment. It is made of wet-process fired porcelain, and coated with a semiconducting glaze. This helps to assist in equalizing the electrical stress along the length of the bushing. The two most common types of bushings used on transformers as main lead entrances are,

i. Solid porcelain bushings on smaller transformers.

ii. Oil-filled condenser bushings on larger transformers.

Solid porcelain bushings consist of high-grade porcelain cylinders. High voltage bushings are generally oil-filled condenser type. A central conductor is attached with condenser. This type of condenser have wound with alternating layers of paper insulation and tin foil and filled with insulating oil. This results in a path from the conductor to the grounded tank, consisting of a series of condensers. Equal voltage drops is required between each condenser layer which is provided by the layers. [3]

Tap Changer and Tap Switch:

Tap changing means the changing of voltage by a switch. Generally for tap changing, the taps are providing in HT coil. To vary voltage level in both High Tension and Low Tension side, tapping is provided in the transformer. Sometimes taps are made from HT coil; sometimes an extra coil is used for taps.

There are two types of tap changing options. These are:

i. On load tap changing.

ii. Off load tap changing.

Our supervisor told us that motor driven mechanism is used for on-load tap changer. This control can either be done locally on the transformer or remotely from the control room. The operation of off-load tap changers can either be done on the cover or on the sidewall of the transformer by a manual drive mechanism. To ensure proper pressure and good contact, all the moving contacts of tap changer are spring loaded. Higher capacity transformers, especially those above 3000 KVA ratings, can be supplied with On Load Tap Changer along with necessary controls to make it suitable for manual, local electrical or remote electrical operation.

Figure 2.5: Physical View of Tap Changer.

Cooling System:

We saw in transformers the cooling has a special importance to ensure safe operation and to increase the lifetime of the transformer. The heat generated in the transformers is dissipated at the cooling unit with the help of oil. The simplest and mostly used cooling systems are ONAN (Oil natural and air natural), ONAF (Oil natural and air forced) and OFAF (Oil forced and air forced) cooling systems, in which cooling air is blown to the radiators by fans. [3]

Figure 2.6: Cooling system

Dehydrating Breathers:

The dehydrating breather removes practically all moisture from the air which flows through it into the conservator when the transformer is cooling down. It is used in liquid cooled transformers. It helps prevent any reduction of the dielectric strength of the insulation due to moisture. It also removes any formation of condensation in the conservator. Dehydrating breather also increases the operational integrity of the transformer. [4]

Mode of Operation of Dehydrating Breathers:

The volume of the dehydrating breathers depends on the temperature of the insulating liquid in the transformer tank. This dependency causes a corresponding quantity of air to be drawn in through the breath hole in the bottom part. On its way to the conservator, the air passes through the oil trap and subsequently through the drying crystals which removes the moisture from it. The oil trap prevents the drying crystals getting in contact with the damp atmosphere and also filters the inflowing air. If the temperature rises, air is expelled from the conservator and flows through the dehydrating breather in the opposite direction.

Drying Agent of Dehydrating Breathers:

The drying crystals are minimum 3mm in size, have a color indicator and are of pure aluminum silicate which has very good absorption properties. In the activated condition they have an orange crystalline appearance. Drying crystals absorb moisture and the color changes to colorless, beginning at the bottom and spreading progressively to the top.

Conservator:

The conservator is filled with oil and contains an expandable bladder or diaphragm between the oil and air to prevent air from contacting the oil. It is connected by piping to the main transformer tank.

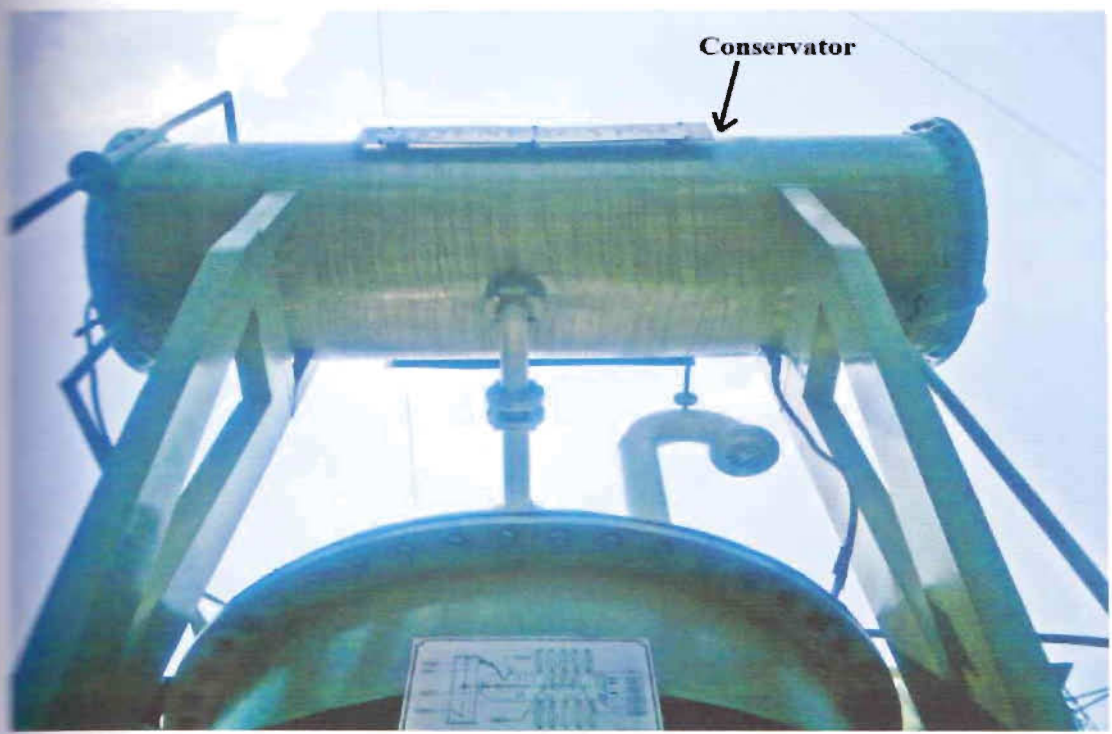


Figure 2.7: Conservator with Bladder.

With the variation of temperature air enters and exits the space above the bladder/ diaphragm as the oil level in the main tank goes up and down. Air typically enters and exits through a desiccant-type air dryer. The main parts of the system are the expansion tank, bladder or diaphragm, breather, vent valves, liquid-level gauge and alarm switch. Vent valves are used to vent air from the system when filling the unit with oil. A liquid-level gauge indicates the need for adding or removing transformer oil to maintain the proper oil level and permit flexing of the diaphragm.[3]

Gas Insulation Relay:

The transformers are equipped with various protection and control instruments for the operational security. Gases which are produced in the transformer are collected in the Bucholz relay. Depending on the volume of gas, it gives an alarm or control signal. Pressure relief device replies to the sudden pressure increase that may occur by an arc in the oil of the transformer and gives tripping signal to the contacts on it.

Silica Gel:

Silica gel is used to absorb moisture. During the injection of oil into the transformer some air also enters or exists in the conservator depending on expansion and extraction of the oil. Silica gel is used to absorb the moisture from that air. Normally the color of silica gel is pink, but with the absorption of moisture it changes color.

Figure 2.8: Silica gel

Those were the basic description of transformer equipments.

2.1.3 Current Transformer (CT):

To measure electric current, a current transformer (CT) is used. Current transformer is of instrument transformers and its purpose is to make conjunction with ammeters over current relays etc. Its function is to step down current from high value to a low value. Their current ratio is substantially constant for given range of primary current and phase angle error is

within specified limits. The power Transformer is large compared to VA rating of current transformers. The main functions of current transformer's are:

i. To reduce the line current to a value which is suitable for standard measuring instruments, relays, etc.
ii. To isolate the measuring instruments namely meters, relays, etc from high voltage side of an installation.
iii. To protect measuring instruments against short circuit currents. To sense abnormalities in current and to give current signals to protective relays to isolate the defective system.

Current transformers must be further classified into two groups:

i. Protective CT used in association with relays, trip coils, pilot wires etc.
ii. Measuring CT used in conjunction with ammeter, wattmeter etc.

CT is typically described by its current ratio from primary to secondary.

The accuracy of a CT is directly related to a number of factors including:

i. Burden
ii. Burden class/saturation class
iii. Rating factor
iv. Load
v. External electromagnetic fields.

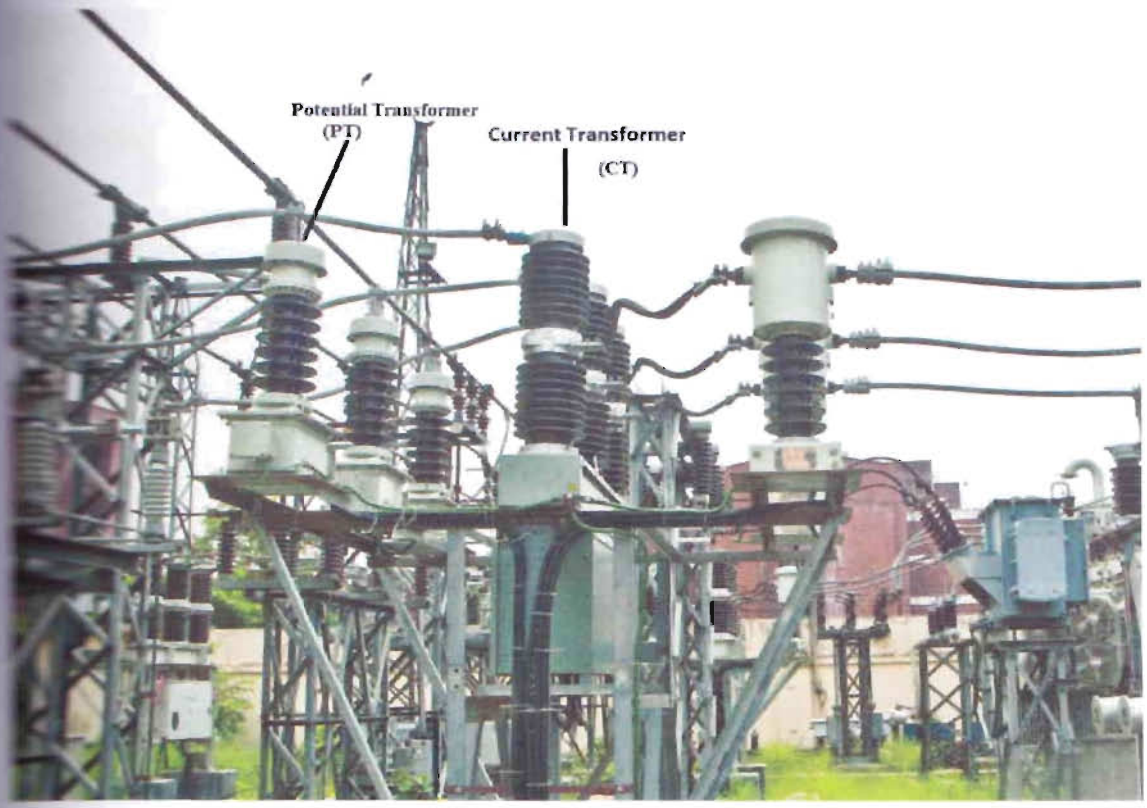


Figure 2.9: Current transformer (CT) and Potential Transformer (PT) at Digun 132/33KV substation.

2.1.4 Potential Transformer (PT):

For monitoring single-phase and three-phase power line voltages in power metering applications, a potential transformer (PT) is used. An instrument transformer is used for stepping down of voltage in measurement and monitoring circuits. If a voltage transformer is used, the circuits of voltmeters, frequency meters, electric meters, automatic control and monitoring devices can be isolated from high-voltage circuits; this makes possible the standardization of the rated voltage of monitoring and measurement apparatus, which is most commonly 100 volts (V). Basic functions of potential transformers are,

i. To reduce the line voltage to a value which is suitable for standard measuring instruments, relays, etc.
ii. To isolate the measuring instruments, meters, relays, etc. from high voltage side of an installation.
iii. To sense abnormalities in voltage and give voltage signals to protective relays to isolate the defective system.

PT may be single phase or three phase units; it is essential for voltage, directional, distance protection. The primary side of PT is connected to power circuit between phase and

ground. Potential transformers are usually rated 50 to 200 volt-amperes at 120 secondary volts. The secondary terminals should never be short circuited because a heavy current will result, which can damage the windings.[6]

2.1.5 Isolator:

Isolators are used to disconnect a component of electrical systems from the power source. An isolator switch is used to make sure that an electrical circuit can be completely de- energized for service or maintenance. Such switches are often found in electrical distribution and industrial applications where machinery must have its source of driving power removed for adjustment or repair. We experienced a situation where we needed to de-energized 11KV line of Mirpur National Cricket Stadium to remove a bird nest from the bus bar of Kallyanpur substation. We tripped off that feeder and then isolated the connection and waited ten minutes for an absolutely de-energized line. An electrical power distribution system requires switching for many reasons including fault isolation, transfer loads from one source to another, isolation of line segments for purpose of maintenance or new construction, in some instances for shedding loads. It is very dangerous to isolate electrical lines without tripping on the circuit breaker. Isolation process has to be done manually so if the circuit breaker is off and the isolation process is going on, there will be huge arcing. This will cause line damage and serious injuries. [6]

2.1.6 Bus Bar:

When a number of lines operating at the same voltage have to be directly connected to the system, bus-bars are used. It is made up of copper or aluminum bars (generally of rectangular X-section) and operates at constant voltage. Generally it consists of two bus-bars a "main" bus-bar and a "reverse" bus-bar. The incoming (main) and outgoing (reverse) lines are connected together to the bus-bar. However, in case of repair of main bus-bar or fault occusing on it, the continuity of supply to the circuit can be maintained by transforming it to the reserve bus-bar. For voltage exceeding 132 KV, a reverse bus-bar is frequently used. At the grid a reserve bus is kept as a backup of the main bus. The buses are connected in the substation and we found the similarity between bus bar and multi plug system for general use.

Figure 2.10 Bus bar system in Digun 132/33KV grid substation.

2.11 Lighting Arrestor (LA):

A lightning arrester is a device used on electrical power systems to protect the insulation on the system from the damaging effects of lightning.

Figure 7.11: Lighting Arrestors in Mirpur-14 Substation

The typical lightning arrester also known as surge arrester has a high voltage terminal and a ground terminal. When a lightning surge or switching surge travels down the power system to

the arrester, the current from the surge is diverted around the protected insulation in most cases to earth. LA is installed on many different pieces of equipment such as power poles and towers, power transformers, circuit breakers, bus structures and steel superstructures in substations.[10]

2.8 Auxiliary Transformer:

In a 132/33kv substation one auxiliary transformer is also required to provide electricity to the grid substation. The grid and substation itself has a control room beside it and the power supply of this control room is provided through this auxiliary transformer which transforms the voltage from 33 KV to 0.4KV.

2.9 DC distribution panel:

Control room always maintains a backup battery system as DC distribution panel so that it can ensure the electricity in control room if the grid fails.

Figure 2.12: Backup battery section of Kafrul 33/11KV substation.

2.2 Protection Relays:

The protection relays are equipped for fault protection of system operation. Protection relays are designed and applied to provide maximum discrimination between faulty and healthy circuits. The system equipment will remain inoperative during transient phenomena which may arise during switching or other disturbance to the system.

Types of protection relays which are normally used for system protection includes over current and earth fault protection, differential protection, REF protection, standby unrestricted earth fault, tripping relay, pilot wire protection and trip circuit supervision.

2.3.1 Grid substation:

An electrical grid station is an interconnection point between two transmission ring circuits, often between two geographic regions. They might have a transformer, depending on the possible different voltages, so that the voltage levels can be adjusted where required. The interconnected network of grid stations is called the grid, and may ultimately represent an entire multi-state region. Grid substation is the place where 132KV line enters and stepped down to 33KV for supplying the 33/11KV substations. The operation mechanism starts with 132KV line entering through a breaker into a 132/33 KV grid substation which then goes to bus via isolators. From the isolators a line enters to current transformer (CT). CT transfers it to another breaker and then to underground lines, leading to a control. When the breaker is on the power goes to the transformers high tension (HT) line. From the HT side, seven lines goes to control panel. After stepping down to 33KV it goes to another breaker via isolator. When the breaker is ON at the control panel the power goes to other 33/11kv substations via over head or underground lines. At Digun Grid substation we saw eight 132/33kv transformers where five were in working state at that time. In a 132kv substations transformer the main equipments are bus, isolators, CT, PT and breaker.

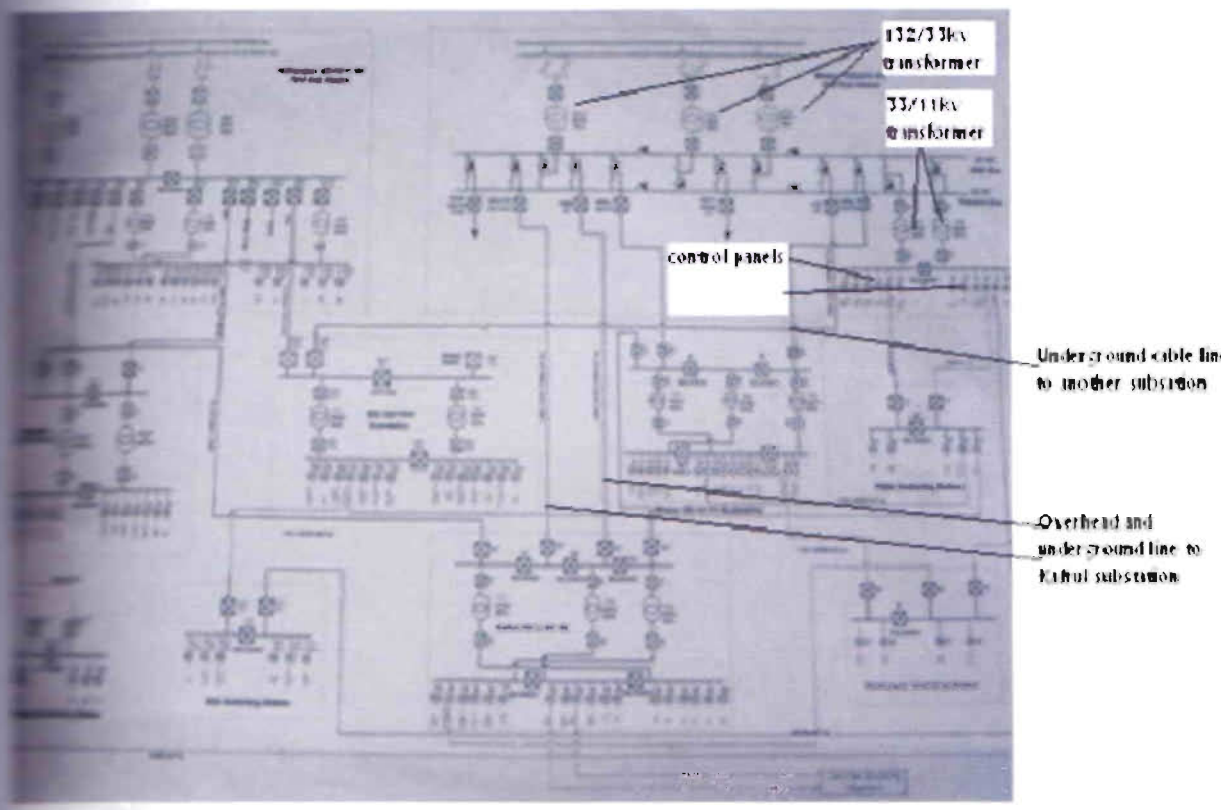


Figure 2.13: Outlet of Kallyanpur grid substations under DESCO.

2.3.2 Kallyanpur Grid Substation:

Digun grid is controlled by PGCB and DESCO together. PGCB controls the grid section and DESCO controls the substation section.

In Digun 132/33 grid substation there are,

i. Three main transformers,
ii. Double bus and
iii. Two 33/11KV transformers.

These two 33/11KV transformers are directly connected to the control panel . If any malfunction happens to one transformer another one can perform the job but in that case it will be overloaded. From the figure we can see that the control panels connected with those two transformers. There are 12 control panels in Digun substation. Digun grid substation also providing power to another two substations, where one is Kafrul substation and another is Mirpur 14 substation. In case any 132/33KV transformer goes down then they will cut out the isolator which is connected to that transformer and they will inspect whether the other two transformers are overloaded or not. If the other two transformers are overloaded then they will increase the load shading by ordering the respected substation.

2.3.3 Substation Operation:

Substations particularly consist of functions involving generation, transmission and distribution of electrical energy. There are the some stages between the grid and the users. In a typical substation, the voltage is stepped down from high to low or vice versa by using transformers. A grid can be connected to a sequence of substations each responsible for stepping down the voltage from the value transmitted by the grid to the value required by the consumer, be it industrial or domestic.

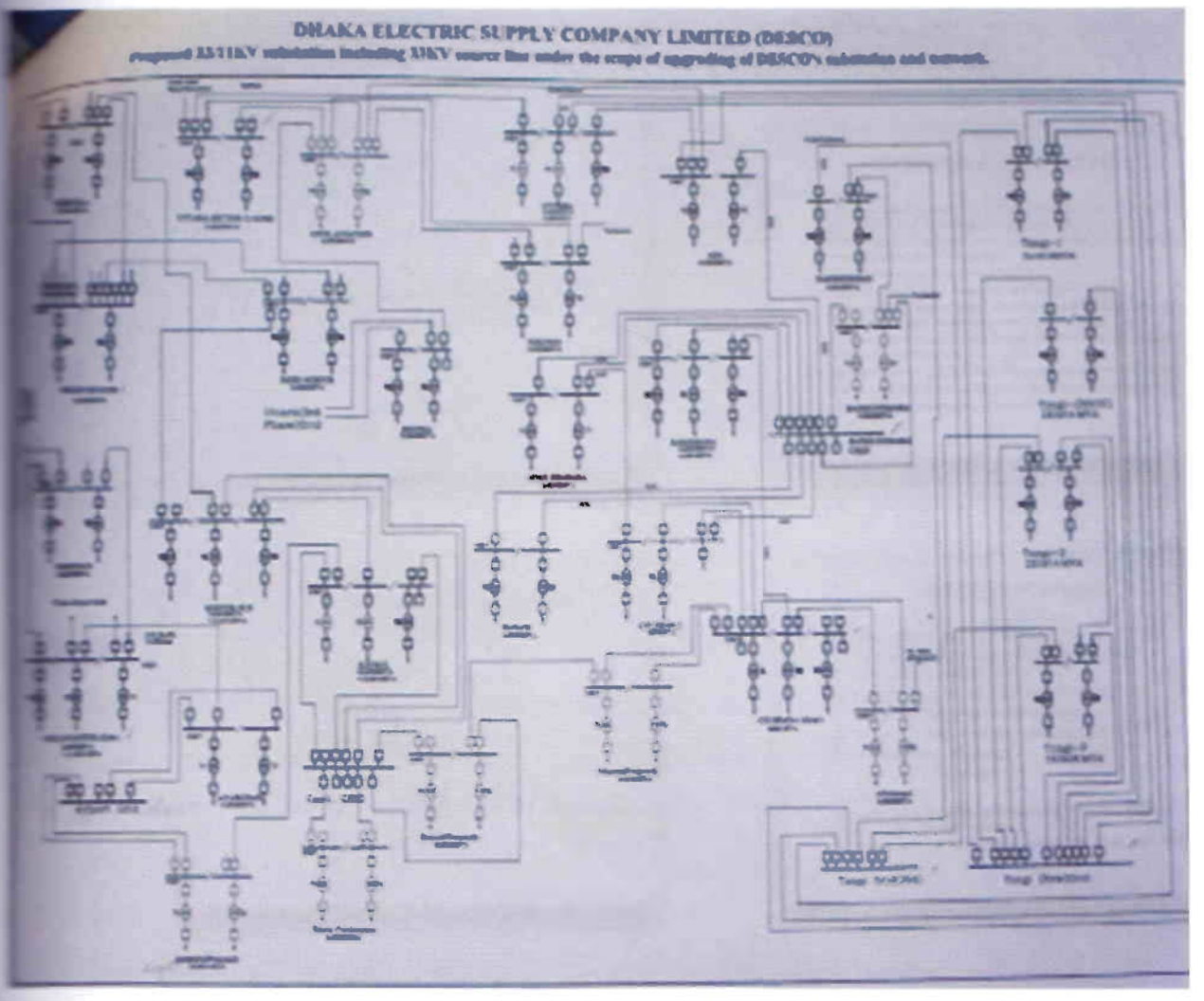


Figure 2.14: Layout of substations under DESCO

Typical substation transformer includes step down power transformers where transformations take place in the order of 33 KV transmitted voltage to 11KV. After this transformation the 11 KV is transmitted to the distribution part where in the transmission lines the distribution transformers take place to lower down the voltage (11 KV to 230 V).

The substation transformer has the rating of 20 to 28 MVA or 10 to 14 MVA. But the distribution transformers are usually of 200 KVA.

Table 2.2 Comparison of requirements of Grid and Substation

General equipments of Kallyanpur Grid	General equipments of Kallyanpur Substation
Power Transformer(132/33 KV, 50/75 MVA)	Power Transformer (33/11 KV, 20/28 MVA or 10/14 MVA)
Circuit Breaker(SF6)	Circuit breaker (VCB- 2000A)
Current transformer (CT) (88:1)	Current transformer (CT) (600:1)
Potential transformer (PT) (134/37.5 KVA)	Potential transformer (PT) (33/11 KVs)
Lighting Arrestor (LA)	Lighting Arrestor (LA)
Isolator/ Disconnector	Isolator/ Disconnector
Main Bus bar and Reverse bus bar	Bus bar
Auxiliary transformer(33/0.4 KV, 500 KVA)	N/A
Control relay panel	Control relay panel
AC and DC distribution panel	AC and DC distribution panel

2.4.1 Control panel:

The control panel is a place where all the controls of a substation is regularly monitored. Control panel consist of power factor indicator, additional C.T, P.T, circuit breakers. In the control room there are breakers for three phase connection. Each breaker for a particular area. Three set wires of three phases are connected to the lower part of the breaker. The upper part of the breaker is the control part. Breaker works as a switch, when it is on the power goes to control part. In the control part there is copper bus and this bus is connected to each and every control panel. When the breaker is on the power goes to each and every control panel. If this switch is on the area under this switch get the power and if this switch is off the load shading occurs at that area. In a control panel red light indicates that breaker is on and green light indicates that breaker is off.

A typical control panel of a substation component is shown in the next figure.

Figure 2.15: Control panel (Kafrul Control Panel)

2.4.2 Control Relay Panel:

Control and Relay Panels facilitate centralized control of the related controlled equipment in power stations, switching stations and industrial plant. The panels are bolted together to form a board. This approach permits replacements, extensions, rearrangement and addition when necessary.

The panel incorporates control switches and indicator lamps for remote control of controlled equipment. A "remote/ supervisory" selector switch is also provided for selection of supervisory control from remote control centre.

2.4.3 Substation Control Room Operations:

During our internship we got the opportunity to visit Kafrul 33/11KV substation and its control room. Control room activities and duties are the most important job for a substation. Control room operators are authorized to decide whether or not load shading will take place in a particular area. They also take care of the security system and maintenance of the substation.

Fig 2.16: A substation control room switching unit

Figure 2.17: Control room of Kafrul 33/11KV substation.

They also need to be alerted when any line under that substation is being repaired. When a fault occurs operators take necessary actions to coordinate the line maintenance team. During this time if they make any kinds of mistakes like tripping on the switch of faulty line when it is on the process of maintenance the repair man will be badly injured. Incorrect power calculation may lead to disastrous situation for the entire grid of the respected substation. In case of overloading the system may trip the grid off. On an average six persons are recruited to monitor the control room on 24 hours. The total day time is divided into equal segments. Persons are schedule to perform control room duties sequentially.

Figure 2.18: Danger sign to remind operator that breaker is on or load shading going on.

Other important control room activities are,

i. Responding to client calls and queries.
ii. Load shading management.
iii. Routine check all the equipments of substation and control room.
iv. Giving priorities the VVIP feeder.
v. Priorities the feeder according to their importance like exam halls, mosque at the prayer time.
vi. Shut down the feeder of commercial area after 8pm if needed.
vii. Control and observation of the 33KV feeder panels.

Power factor:

Monitoring power factor is another important job for the operators of a substation. It means the cosine of angle between voltage and current in an alternating current circuit. It can be expressed as,

Power Factor = Real Power (in KW)/ Apparent power (in KVA)

DESCO is bound to maintain the power factor of greater than or equal to 0.95. If the power factor goes down below of 0.95 then National Load Distribution Centre (NLDC) penalizes DESCO. In 2010 DESCO has been fined 2 cores taka for the lower power factor. DESCO also fines its clients for the lower power factor. To improve power factor DESCO uses power factor improvement capacitor bank.

Figure 2.19: Power factor monitor display in control panel.

VVIP feeder:

One of the major responsibilities for control room operators is to take care of VVIP feeder. We got the opportunity to visit Mohammadpur 33/11KV substation. This substation contains countries most VVIP feeder which is GONO BHABAN (prime minister's home). Load shedding of this feeder is strictly prohibited. This feeder also has a parallel back up connection with Digun grid substation to prevent any accidental load shading.

Figure2.20: VVIP feeder's control panel of Prime Minister's home

Some other feeder also gets VVIP status on particular occasions. One of them is Mirpur National Cricket Stadium. During the world cup cricket tournament'2011 it was a highly important feeder and was under observation by an assistant engineer of DESCO all the time.

Figure 2.21: Control panel of Mirpur National Cricket Stadium.

CHAPTER 03

SYSTEM PROTECTION

3.1 Protection of Power System

Power system protection is necessary for continuous operation, prevention of electrical failure and mitigation of all the adverse effects. Protection scheme in substation and grid can be divided into three parts:

1. Transformer Protection
2. Feeders Protection
3. Bus bar Protection

This excerpt is basically focused on transformer protection schemes because majority of time was passed on the days of training at Mirpur-14, transformer workshop. We also got some brief ideas about the protection of feeders and bas bars

3.2 Transformer Protection Scheme

For grid and substation transformer protection: (20/28 MVA or 10/14 MVA), the techniques used are:

1. Differential protection :

This involves the use of a differential rely. It is a relay that checks for current balance between the primary and the secondary side of a transformer. Here, the currents on each side of the protected apparatus for phase are compared in a differential circuit. Any differential current will operate a relay.

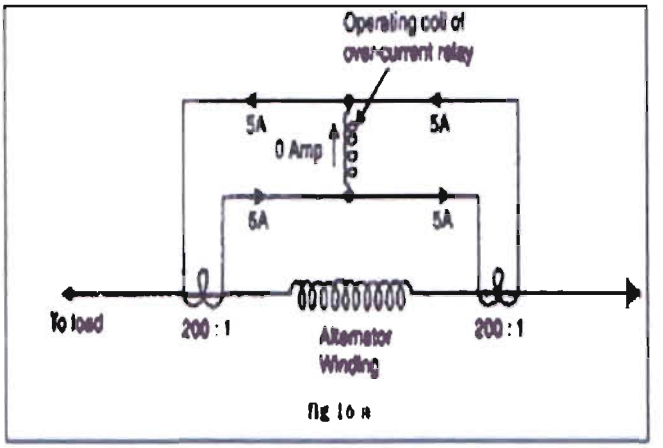


Figure 3.1 : Circuit Diagram of a Differential Relay

The functions of Differential Relay-

a. The secondary current that circulates in the coil of the relay for primary and secondary of the transformer cancels each other when the system is healthy.

b. When the fault occurs in a system the balance is disturbed and the resultant current activate the relay and cause trip.

c. This is due to the fact that with no faults within the protected apparatus, the currents entering and leaving are equal to the total current I.

d . If a fault occurs between the two sets of current transformers, one or more of the currents (in a three phase system) will suddenly increase, while that the total fault current will flow through the relay, causing it to operate.

2. Over current and earth fault protection:

Over current protection includes the protection from overloads. This is most widely used protection. Overloading of a machine or equipment generally means the machine is taking more current than its rated current. Hence with overloading, there is an associated temperature rise. Over current protection of overloads is generally provided by thermal relays.

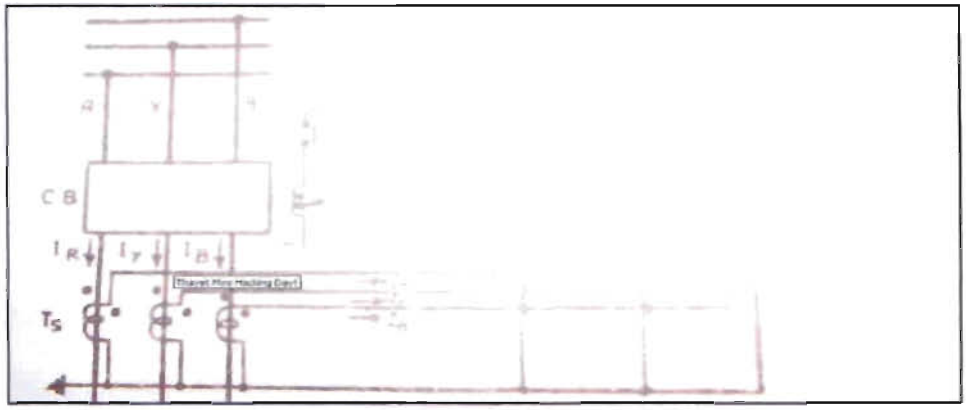


Figure 3.3 : Over current protection with three over current relays

Source: Book of Switchgear Protection and Power Systems, Sunil S. Rao

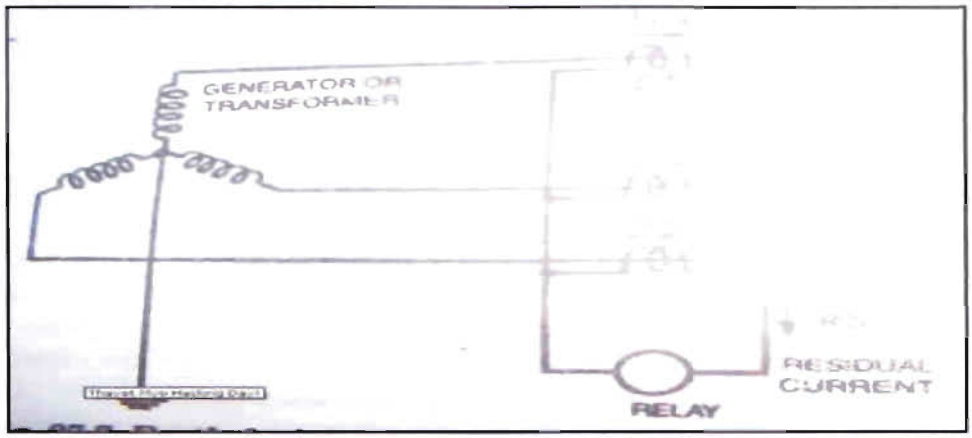


Figure 3.4 : Earth fault protection

Source: Book of Switchgear Protection and Power Systems, Sunil S. Rao

The functions are-

1. Over current protection includes short-circuit protection. Short circuits are phase faults, earth faults or winding faults.

2. The basic element in over current protection is an over current relay which picks up when the magnitude of current exceeds the pickup level.

3. The over current relays are connected to the system, normally by means of CT's.

4. The over current protection is needed to protect the transformer from sustained overloads and short circuits.

5. Induction type over current relays are used which in addition to provide overload protection acts as back up relays for protection of transformer winding fault.

6. The earth fault protection is used to provide protection against any earth fault in the windings of the transformer. It works on the principle that when the transformer winding is sound, the current in all the three phases will balance and no current will spill into the earth fault relay.

3. **Buchhloz trip :**

This technique utilized the use of Buchholz relays. A Buchholz relay is a gas and oil operated device installed in the pipe work between the top of the transformer main tank and the conservator. The functions of the relay-

1. Detect an abnormal condition within the tank and send an alarm or trip signal. Under normal conditions the relay is completely full of oil.
2. Operation occurs when floats are displaced by an accumulation of gas, or a flap is moved by a surge of oil. Almost all large oil-filled transformers are equipped with a Buchholz relay.

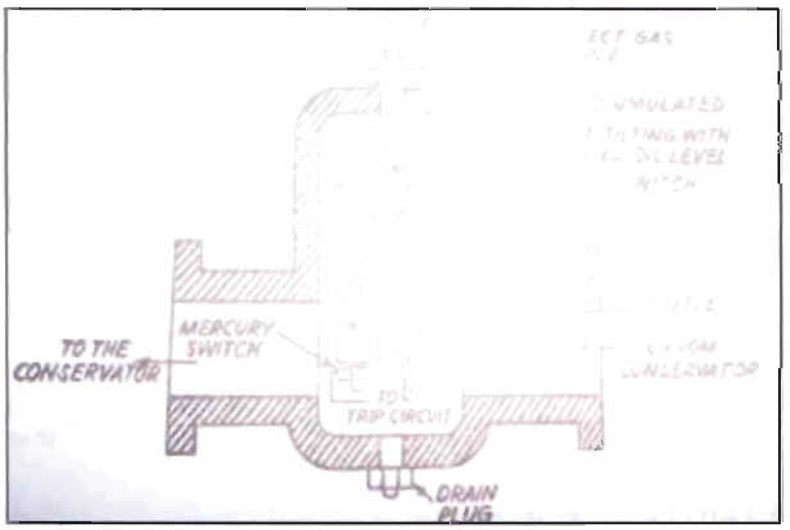


Figure 3.2 : Buchholz Relay

Source: Book of Switchgear Protection and Power Systems, Sunil S. Rao

3. Whenever a fault in transformer develops slowly, heat is produced locally which begins to decompose solid of liquid insulated materials and thus to

produce inflammable gas and oil flow. Gas gets accumulated in the Buchholz relay and replaces the oil in the relay.

4. For minor fault, upper float operates the alarm.
5. When a more serious fault occurs within the transformer during which intense heating takes place, an intense liberation of gases results. The gases rush toward the conservator and create a rise in pressure in the transformer tank due to which the oil is forced through the connecting pipe to the conservator. The oil flow develops a force on the lower float and over trips it causing its contacts to complete the trip circuit of the transformer breaker.

4. Pressure relief device:

This is regulated by the pressure relief relays. The pressure relief relay or valve (PRV) is designed as a safety device to be used to power transformer. When pressure in tank rises beyond predetermined safe limit, the relay operates and performs following functions.

- Reduces the pressure in the tank by instantaneously opening the connecting port.
- Secondly, along with above mentioned function, it operates a switch which can be used to initiate precautionary electrical system.

5. Thermal over heating protection :

This utilizes the control of two factors both of which are measured by highly calibrated thermometers which are built within the transformer and can be read externally. The variables that are continuously checked are:

a) Winding temperature

b) Oil temperature

3.3 Transformer Fault and Protection

The types of faults that the transformers are subjected to are classified as:

1. **External Faults:**

These are due to overload conditions and external short circuits. Time graded over current & Earth Fault relays are employed for external short circuit conditions. Fuses are provided for Distribution transformers

2. **Electrical Faults:**

Electrical faults are the faults which cause immediate serious damage in the system such as phase to earth or phase to phase faults, short circuits between turns of high voltage and low voltage windings etc

3. **Incipient Faults:** Incipient faults are initially minor faults, causing slowly developing damage such as poor electrical connection of conductors or breakdown of insulation etc.

Table 3.1 : Types of fault against which gives successful protection

Visible or audible alarm (upper float actuates)	Trip circuit operates (lower float actuates)
Core bolt insulation failure	Short circuit between phases
Bad electrical contacts	Winding earn fault
Local overheating	Winding short circuits
Loss of oil due to leakage	Puncture of bushing
Ingress of air into the oil system	Intense heat taking place

3.4 Feeders Protection Schemes

There are two particular protection schemes for feeders :

1. Over current (O/C) protection
2. Pilot wire protection

3.4.1 The working principles of O/C and E/F protection in feeder

1. Main relay will be fed with data from CT.
2. Main relay will transmit signal to trip coil of the Circuit Breaker (CB).
3. Trip relay then sends pulse to trip coil of the CB.
4. After tripping of CB, main relay will be reset but indication/flag will persist (this is to be reset locally)

3.4.2 Pilot wire protection

1. The differential pilot wire protection is based on the principle that under normal conditions, the current entering one end of a line is equal to that leaving the other end.
2. When a fault occurs between the two ends this condition no longer holds and the difference of incoming and outgoing currents is arranged to flow through a relay, which operates the circuit breaker to isolate the faulty line.

3.5 Bus bar Protection

Buses are essential in both the power system and industrial switchgear. Bus bar protection needs careful attention because-

1. Fault level at bus bars is very high.
2. The stability of the system is affected by fault in bus zone.
3. The fault on bus bar causes discontinuation of power to a large power to a large portion of the system.

The causes of bus bar faults can be the following-

1. Failure of support insulator resulting an earth fault.
2. Failure of connected equipments.
3. Earthquake, mechanical damage, etc.

Faulty transformer detection:

During the whole research process the student team visited ares of Bauniya Beri Baad area in Mirpur. Only a single transmission line was provided for the entire slum area.

We found out that during the maintenance period, complaints are filed from the complain center. If on spot maintenance is not possible then the transformer is usually replaced with a new one.

This involves the sequence where at first the whole line is shut down by requesting the control room at Kafrul 33/11K substation. The transformer is then hoisted down and transformer is tested of its connections by the maintenance team, who happen to use the "Insulation Tester-1010T" (rated at 1000V and with impedance value from 0 to 1000MΩ) . Insulator tester is used to test the insulation of transformer and it can detect where the fault is.

Figure 3.5: Transformers H.T section was being inspected by the maintenance team.

The insulation tester functions in following four ways:

- The torque handle is rotated with increasing speed until the clutch slips at 120 R.P.M. This speed is needed to get a steady reading.
- Testing is conducted between conductors: connected to terminals using separate good insulated wires and with reference to the ground.

- Next the high voltage cable is test, by tightly binding wires around the inner insulation and hooking it up to the guard terminal. This prevent from inaccurate reading due to surface leakage.

Figure 3.6: H.T side testing in progress

The transformer on site was found with a fault in the high tension (H.T) side. The coil section under the H.T side had burnt and hence the occurrence of the fult. This is a common problem and it is triggered by line overload.

So we detected the faulty transformer and then changed it with a new transformer. The faulty transformer was sent back to repair section.

3.6 Transformer Repair:

Transformers are carried by trucks and a crane is used to drop it safely from the tracks and then it's carried by trolley to repair room. After that the tank cover of transformer is opened and the oil of transformer tested first.

Figure 3.7: Opened transformer tank and burnt oil.

They test the temperature, moister and the insulation power of the oil. Normally oil efficiency can be maintained up to 70 degree celcius temperature. The quantity of oil in the transformer is maintained by the indicating level glass outside the body of it. When the oil level decreases it can be clearly observed by the repairing team.

After testing the oil they decide whether it can be retained or changed. In the past they changed the burnt oil by new oil but now there are so many oil refineries company so the burnt oil is refined by them and it saves a huge amount of money for DESCO. GEMCO from Chittagong , Energy pack , Alfa from India, Batelco and around 30 companies can refine burnt oil for DESCO. In the repairing room we have seen that they were tapping the strip of LT line.

Figure 3.8: Opened Core and Coils of transformer.

Initially just after removing it from the oil section it remains so oily and their first job is to remove that oil from strip of LT line. To insulate they wrap it with paper. Then they remove the coils of transformer from the body and keep it in a dark, moisture free chamber at 70 degree Celsius for two to three days. The rejected strip from the three coils inside of transformer and the burn oil is stored to sell by tender.

Figure 3.9: Dark chamber where inside body of transformer heated up to 70 degree celcius.

Figure 3.10:1000 LPH oil filtration plant

3.7 New Transformer Installation :

During the internship period, six transformer were newly installed in various places of Mirpur area. Reason of installation of new transformer was:

- Overloaded situation at the next transformer.
- Previous transformer failure.
- Theft

As we all know Mirpur is a very crowded area and the demand of power in this area rises every moment. So after installing a new transformer it is tough to pre-estimate the growth of load accurately in the subsequent months. This causes the overload problem for an area and a new transformer has to be installed in that respected area to balance the load.

DESCO at the moment is facing another big problem which is transformer theft. Every week at least two to three transformer is being stolen. DESCO has backups of plenty of transformer in their store room, so whenever a transformer is needed DESCO sends it via track. Track has a small crane in it which lifts the transformer. At the moment there exists no proper mechanism to prevent the theft of these transformers.

Figure 3.11: New transformer is being lifted to track by crane.

As a simple example to illustrate this issue:

During the course of the internship, at Ibrahimpur bazaar one of the transformer was stolen and the whole area was facing load shading for 18 hours, so it was an emergency call job for DESCO to reinstall a new transformer there.

The activity starts very late in the afternoon since demand for electricity is high during the day. The process includes first shutting down the whole line by requesting to the control room via wireless radio.

Figure 3.12: A new transformer was being lifted up by crane .

The new transformer is then lifted up to the pole and the high tension (H.T) and low tension (L.T) were connected very carefully.

Figure 4.13: Connection was given to H.T line. to the H.T side of transformer.

After all necessary checking we finally gave the permission to control room to start the feeder of Ibrahimpur bazaar.

Chapter 4

Sales and Distribution (S & D)

4.1 Load Estimation and Management Plan:

When DESCO install a new transformer in an area, they follow steps to standardize parameters which include line voltage, conductor size & capacity, voltage drop etc. Those factors remain constant during the installation process. The installation are guided by the following objectives,

i. Sufficient space should be provided for line construction/pole erection.
ii. Line construction along both sides of a road should be avoided.
iii. Sufficient clearance between building/installation and electric line.
iv. Limitations of appropriate line route.
v. The numbers of transformers in electric distribution line are minimized as much as possible.

DESCO avoids the installation of transformer on each pole. DESCO also considers,

i. Load Points in the buildings or premises in estimation of maximum use of load and load sanction.

ii. Each floor Area of the building

Total area including basement, car park and other common areas in a building	12,500 sq. feet or more irrespective of number of floors in the building	Customer shall install his/her own substation (distribution transformer, PH plant, etc.) irrespective of assessed load
Load point	Assessment of total load as per calculations in load estimation	For 50 KW load or above, customer install his/her own substation (distribution transformer, PFE plant, etc.

4.2 Load Determinants and Assessment Factors:

DESCO keep records of load points and those load points can be classified as,

(i) Light load
(ii) Fan Load
(iii) Socket Load
(iv) Lift
(v) Water pump
(vi) Other Electric Machines/ Equipments/ Appliances

Descriptions of those lodes,

i. Light Load:

Light load means electric bulbs or tube lights load which are used in bed room, living room, passage, garage, open yard etc. It is not so heavy load and the range is 60 to 100W. As an example from table 1.1, living room is considered as a single point room and the required load for the point is 100 W.

Table 4.1 : Light Load for various points

Loacation	Single point room		2 points per room		More than 2 points per room		Estimated Load
	No. of points	Watt per points	No. of points	Watt per points	No. of points	Watt per points	
Bed Room/Drawing room/Living room/ Kitchen room	A	100	B	60	C	40	(A*100)+ (B*60)+ (C*40)
Corridor/Passage/ Toilet/Stair	No. of Points		Watt per points				
	X		60				X*60
Garage/Basement/Ver andah/Garden/Open yard	Y		60				Y*60

Estimated Light Load= [(A*100)+(B*60)+(C*40)+(X*60)+(Y*60) [Watt]

ii. **Fan Load:**

Fan load is required to estimate the load for various types of fan. If number of ceiling fan is A, watt per fan points is 80 then the estimated load will become A*80.

Table 4.2 : Fan Load for various types of points

Type of Fitting/Fixture	No. of Fan points	Watt per Fan points	Estimated load	Remarks
Ceiling Fan/Table Fan	X	80	(X*80)	Load shall be considered At actual if installed load exceeds standard load
Exhaust Fan/Pedestal Fan	Y	90	(Y*90)	

Estimated Fan load = [(X*80) + (Y*90)] [Watt]

iii. **Socket Load:**

Socket loads are required for various types of room, garage, open yard etc. There are different kinds of socket such as 2-pin and 3-pin sockets. Socket load are categorized on the basis of the number of sockets per room.

Table 4.3 : Load Socket points

Location	Socket type	Single Socket point Per room		2 socket points per room		More than 2 socket Points per room		Estimated Load
		No. of points	Watt per points	No. per points	Watt per points	No. of points	Watt per points	
Various types of Room	2-pin	X	200	Y	150	Z	100	(200*X)+ (150*Y)+ (100*Z)
	3-pin	A	1000	B	600	C	400	(100*A)+ (600*B)+ (400*C)
Garage/Base Ment/ Varandah/ Garden/ Open yard		No. of sockets			Watt per points			
	2-pin	D			150			(D*150)
	3-pin	E			600			(E*600)

Estimated Socket Load=

[(200*X)+(150*Y)+(100*Z)+ (100*A)+(600*B)+(400*C)+(D*150)+(E*600)] * 0.6 (Diversity factor) [Watt]

(v) Lift Load (Lift Load per unit as Kilowatt):

Total number of passenger divides the amount of load for the lift.

Table 4.4 : Lift Load

Passengers capacity	Load			Remarks:
	Lift to be installed			
	Lift at site	In case of Availability of document	In case of non-Availability of document	At the time of lift installation if the actual load is found to exceed that in Col-3 or Col-5 the same shall be communicated to DESCO by the consumer for total load reassessment and load re-sanction thereof.
1	2	3	4	

4 Person	As per nameplate Rating	As per catalogue/ Drawing	5	
6 Person			8	
Above 6 up to 10 persons			10	
Above 10 Persons			15	

Estimated lift Load= [Col-2*no. of units]+[(col-3/col-4)*no. of units [Kilowatt] [8]

iv. Electric Equipments/Appliances Load:

In our home we use many home appliances for better living, examples are refrigerator, iron, air conditioner, television or micro wave oven. All of those applications consumes different amount of powers. Table 1.5 will give a brief idea.

Table 4.5 : Various types of Equipments and their Standard Load [Ref-1]

Equipments	Standard Load (W)	Remarks
Refrigerator	100	Actual load already connected to a socket, higher than specified standard shall be considered in estimation of total load.
Television	100	
Micro-Waves Oven	1000	
Washing Machine	500	
Iron	1000	
Air Conditioner	2000	
Electric Geezer	2000	
Electric Heater	2000	
Water Pump	At actual	Based on actual motor rating
Industrial Machine	At actual	Based on actual motor rating
Any other Electric Equipment.	At actual	Based on actual motor rating

Estimated load for Equipments= Col-2*no. of units. [Watt]

4.3 Load Sanction:

We have learned about the method of load sanction from the policy guideline of DESCO and those are,[8]

i. For the purpose of load sanction for any building/premise, DESCO shall review the applicant's request and the total estimated load. The sanctioned load shall not exceed the total estimated load.

Load Sanctioning Authority will be as follows,

Table1 4.6 : Load Sanction and respective Authority

Estimated Load	Sanctioning Authority
Below 50 KW	Head of S &D Division
50-250 KW	General Manager(E&SC)
Above 250 KW	Director (Technical)

ii. Prior to sanction of load DESCO shall review various technical issues including the availability of infrastructure for load supply and capacity of the respective distribution Transformer, Feeder Line, RMU, 33/11 KV Substation, 11 KV Switching Station, Grid Substation, etc.

iii. For addition to previously sanctioned load, the conditions mentioned above shall be applicable.

iv. Load sanction will be subject to clearance of any due electricity bill or other bill issued by DESCO for the respective building/installation/premise.

v. For individual service connections through separate meters under a consumer-supplied transformer, load sanction for each service connection shall be on the basis of the respective estimated load. Load for Common Services form the same transformer will be calculated as follows:

Common Services Load= Sanctioned Load for the building/premise - $\sum$ Estimated load against individual meters.

vi. For unauthorized use of load beyond the sanctioned load, the provision of electricity tariff rule shall be applicable.

vii. In case of limitations due to technical reasons, DESCO may refuse to sanction load or make partial load sanction till such limitations are overcome.

4.4 Load Management:

DESCO manages the loads area wise and it also distribute the electricity according to demand. Load management depends on the situation.

From the policy guideline of DESCO

i. Load shedding schedule published in the web should be updated frequently.
ii. Distribution load shedding evenly throughout different segments of the day rather than continuing it at a stretch for hours.
iii. Increasing vigilances to shutting down markets, shopping malls etc.
iv. Increasing customer awareness to reduce misuse of electricity through electronic and print media.
v. Creating awareness among the people to use energy efficient electric equipment, energy efficient bulbs etc.
vi. Building its own supervisory control and Data Acquisition System (SCADA) to manage its loads a single point.

CHAPTER 05

COMMERCIAL OPERATION

The main objective of the Commercial Operation of DESCO is monitoring of all support system for effectively operating the system.

The Commercial Operation includes :

- Disconnection / Reconnection
- Outsourcing
- Tariff Setting
- One Point Service

5.1 Disconnection/ Reconnection

For the purpose of Disconnection & Reconnection, Begum Rokeya Sharani, Mirpur was monitored. Various crude methods of illegal connections were made. Some common methods included :

1. Use telephone wire to carry current from the nearest feeder
2. Usage of illegal heaters.
3. Leeching of power from nearby factories using coat hangers.

The field workers resolved to immediate steps to remove all the illegal connections. The most illegal connections were found in slums. Other areas included street hotels, cinema hall, tea stalls, etc. Such types of illegal connections create a huge system loss and hence increased load shedding at a regular rate.

This disconnection/ reconnection process is done by-

1. Engineers of DESCO with some fieldworkers
2. The investigate team maintain their works routine wise. This inspection starts approximately after 12 PM at each day, checking feeders, poles, lines

Figure 5.1 : Disconnection of illegal connection

3. Sometimes the inspection team penalizes the responsible public for illegal connections.

Reasons for disconnection of consumer lines from DESCO:

- not paying electric bills on time.
- Usage of illegal electricity.
- When consumers are electrically unsafe or insecure.
- When consumers demand- (a) Temporary D/C (b) Permanent D/C

After all dues are paid by consumer and complete all official formalities the reconnection is established.

5.2 Outsourcing

We were informed by DESCO that, previously DESCO used their staff for field work. But in that way the probability of crime, system loss, problems were increased too much as the workers of DESCO knew all the key tunnels that they had the chance to spoil the system. So to improve that situation, DESCO promotes outsourcing method and it is selected by tendering after every three months.

Outsourcing activities of commercial operation are-

1. Collect meter reading.
2. Bill distribution.
3. Disconnection and Reconnection activity.

4. New meter and service drop installation.
5. Defective/faulty meter and service drop change.
6. Notice and certificate distribution.
7. Major/Huge meter or consumer related data collect.
8. Disconnection of Illegal connection.

5.3 Tariff

Being a commercial organization, DESCO charges for electricity it distributes on a "cost plus performance based return" principle to cover its capital costs, operation costs as well as to target a post tax return of 15 percent on its equity. It is therefore proposed that, till the recommendations of the tariff study to be conducted with World Bank financing are available, DESCO charge a "cost - plus-fixed- return" tariff from its consumers.

The various categories of Tariff is indicated in Figure 5.3

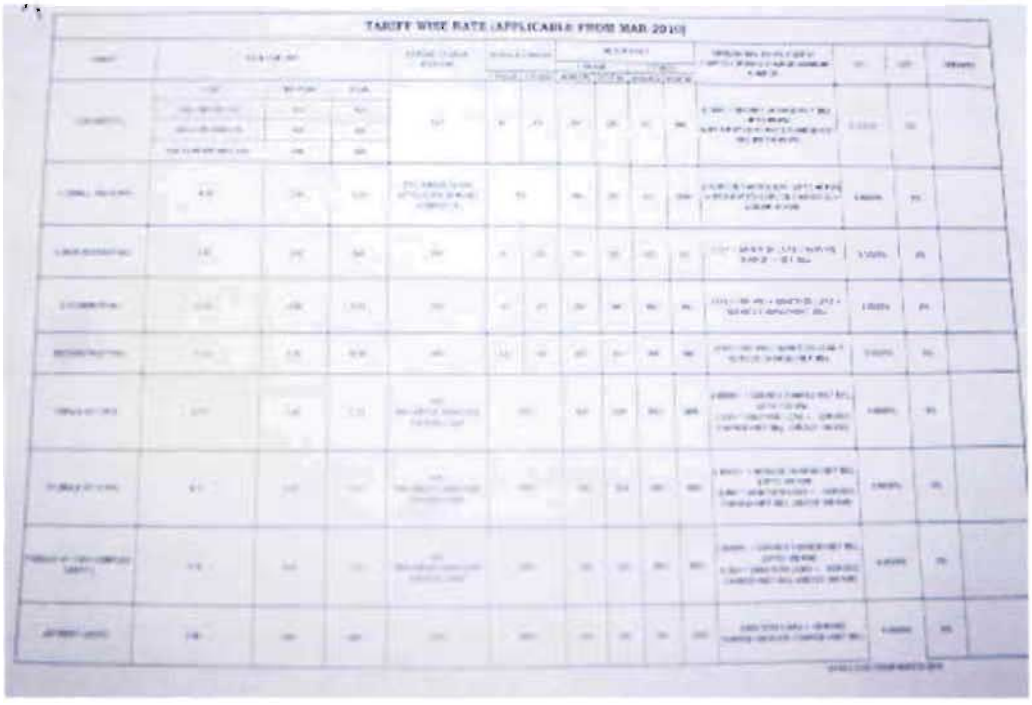


Figure 5.2 : Example of a tariff sheet

RETAIL TARIFF

Sl. No.	Tariff Category	Consumption Slab	Present Tariff (from March 01, 2008) Taka/KWH
1.	Domestic-A	i) from 00 to 100 units	2.50
		ii) from 101 to 400 units	3.15
		iii) above 400 units	5.25
2.	Agriculture-B		1.93
3.	Small Incustries C	i) Flat	4.02
		ii) Off peak hour	4.20
		iii) Peak hour	5.62
4.	Non Residential D (Charitable Industry)		3.35
5.	Commercial E	i) Flat	5.30
		ii) Off peak hour	3.80
		iii) Peak hour	5.20
6.	Medium Voltage-F (11 KV)	i) Flat	3.80
		ii) Off peak hour	3.14
		iii) Peak hour	5.73
7.	Very High Voltage-G (132 KV)	i) Time: 23.00-06.00	1.49
		ii) Time: 06.00-13.00	2.48
		iii) Time: 13.00-17.00	1.66
		iv) Time: 17.00-23.00	5.52
		v) Flat Rate	2.82
8.	High Voltage-H (33 KV)	i) Flat	3.58
		ii) Off peak hour	3.03
		iii) Peak hour	5.45
9.	Street Light and Pump-J		3.86

BULK PURCHASE TARIFF

Sl. No.	Tariff Category	Present Tariff (from October 01, 2008) Taka/KWH
1.	BPDB to DESCO (for energy)	2.4452
2.	PGCB to DESCO (for wheeling)	0.2291

Fig: 5.4 Tariff Setting

5.4 One Point Service

The One Point Service Center is the one stop solution for:

i. Bill Clearance
ii. New Connection
iii. Reconnection
iv. Complaints
v. Information
vi. Meter Complaints

vii. Special Request
viii. Load extension or revision
ix. Service relocation
x. Consumer name change or tariff change
xi. Meter test, change etc
xii. Bill correction

Fig 5.4 : Through a One Point Window

Main activities of one point service center are-

- Receive all type of consumer complaint or information with smiling face.
- Possible all service or information are provide to the consumer instantly.
- All types of consumer complaint or information are entry in register.
- Give the proper guidance to the consumers.
- Communication with the consumers for required further information.
- Consumer's needs/solution handover to the consumer.
- Maintain consumer complain /information record.

DESCO gives highest priority to their consumers. That's why they have developed their standard of commercial operations. For disconnection/ reconnection purpose engineers of DESCO with some field workers investigate the distribution lines, feeders, transformers, poles etc.

Outsourcing workers are selected by tendering after every three months to minimize the crime, system loss etc. Outsourcing workers deal with some important works such as collect meter reading, bill distribution, new meter and service drop installation etc. DESCO charges a "cost-plus-fixed-return" tariff from its consumers and designs tariff sheet which is categorized by

i. residential,
ii. irrigation,
iii. small & medium industry
iv. Large industry

CHAPTER 06

METERING AND BILLING SYSTEM

6.1 Metering

Metering is the process which usually involves meter reading. It indicates how much load is used by consumers. Energy measurements are conducted along with load measurement in a complete Metering Process. Such a task is undertaken by an Energy Meter.

Energy Meter

The energy meter is an electrical measuring device, which is used to record electrical energy consumed over a specified period of time in terms of units.

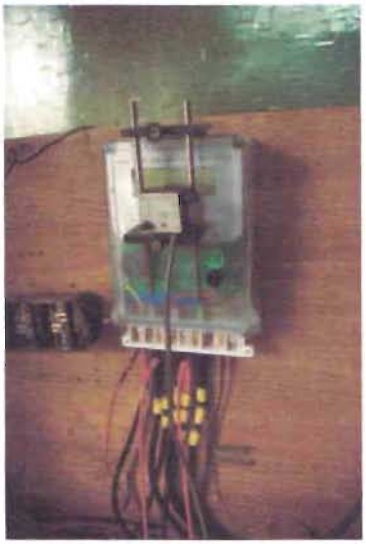


Fig 6.1 : Energy Meter calibration in progress

Through our ongoing internship process we found out that every house, small factory, business establishment, shops, offices etc. need at least one energy meter to register the net power consumption. The electricity provider regulates the bill on the basis of the meter reading. The producer of electricity sells units of electricity to the electricity board. The board in turn sell this energy to the consumer. The consumer needs to pay the amount against

the bill raised by the supplier. The data generate by the energy meter is based to raise the bill by power supplier.

6.2 Unit of Measurement

The most common unit of measurement on the electricity meter is the kilowatt hour (kWh), which is equal to the amount of energy used by a load of one kilowatt over a period of one hour, or 3,600,000 joules. Demand is normally measured in watts, but averaged over a period, most often a quarter or half hour.

Fig 6.2: Meter – testing bench to calibrate for kWh as per standard rating

6.3 Metering process

In Bangladesh usually two types of metering is used:

- Post paid metering
- Pre paid metering

6.3.1 Post paid metering

The standard business model of electricity retailing involves the electricity company billing the customer for the amount of energy used in the previous month or quarter.

Post paid metering usually refers when the consumers pay the bill after they enjoy their load connection. The meter shows the unit of used energy itself and then DESCO raises the bill on the basis reading shown by this meter. Then the consumers pay the bill according to the reading showed in the meter. Post paid meters provided in Bangladesh are usually two types:

1. Analog Meters (Electro mechanical Meters)
2. Digital Meters (Electronic Meters)

❖ Analog Metering

The most common type of electricity meter is the analog meter or electromechanical induction watt-hour meter. The electromechanical induction meter operates by counting the revolutions of an aluminum disc which is made to rotate at a speed proportional to the power. The number of revolutions is thus proportional to the energy usage. It consumes a small amount of power, typically around 2 watts.

Figure 6.3 : Analog Meters

The metallic disc is acted upon by two coils. One coil is connected in such a way that it produces a magnetic flux in proportion to the voltage and the other produces a magnetic flux in proportion to the current. The field of the voltage coil is delayed by 90 degrees using a lag coil. This produces eddy currents in the disc and the effect is such that a force is exerted on the disc in proportion to the product of the instantaneous current and voltage. A permanent magnet exerts an opposing force proportional to the speed of rotation of the disc. The equilibrium between these two

opposing forces results in the disc rotating at a speed proportional to the power being used. The disc drives a register mechanism which integrates the speed of the disc over time by counting revolutions, in order to render a measurement of the total energy used over a period of time. The type of meter described above is used on a single phase AC supply. Different phase configurations use additional voltage and current coils. In Bangladesh usually the analog meters are a range of 450 revolution/ KW} or 800 revolution/KWH

- **Digital Metering (Electronic meters)**

  Electronic meters display the energy used on an LCD or LED display, and can also transmit readings to remote places. In addition to measuring energy used, electronic meters can also record other parameters of the load and supply such as maximum demand, power factor and reactive power used etc. They can also support time-of-day billing, for example, recording the amount of energy used during on-peak and off-peak hours.

Figure 6.4 : Digital Meter

In digital meter, the solid-state type of mode is used which make use of a current transformer to measure the current produced in the current-carrying conductors. Which means that the current carrying conductors need not be connected to the actual' measuring device. The measurement is done through pulse counting over this current carrying conductor and according to this the reading is shown. Usually in Bangladesh, the digital meters are of the range in, 1600 pulse/KWH or 3200 pulse/KWH.

The Dhaka Electric Supply Company Ltd (DESCO) has started commercial production of pre-paid electric meters to help enhance government revenue, checking electricity theft and reducing systems loss. They have started commercial production of pre-paid electric meters at the Mirpur DESCO manufacturing factory. DESCO already has installed this metering system in some sectors in Uttara and Mirpur area.

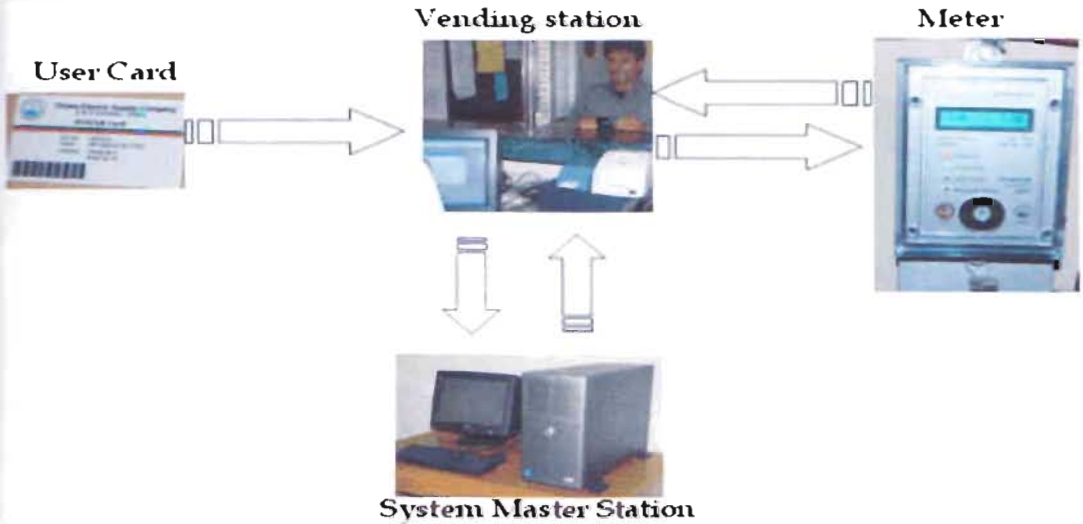


Figure 6.5 : Signal flow of Pre-paid metering

6.4.2.1 Pre-paid Metering System

1. The basic principle of payment is to buy Energy in advance and inform the meter in some ways.
2. The credit stored is deducted as per energy usages and the meter will cut the output line as the credit reaches zero.
3. If the consumers buy more credit and recharges, he can enjoy energy usages without discontinuity.
4. Vending Stations are used to sell credit to the consumers.
5. A number of vending stations are connected to a System Master Station (SMS). The SMS is used to process the data centrally.

Working Principle

This project has a digital energy meter, smart card etc. The meter is connected for the house. For electricity, the card has to be charged with credit by paying the corresponding amount at the One Point and loading the card in to the machine.

As soon as the card is inserted the microcontroller is programmed in such a way that it will detect the card and then it will read the amount in the smartcard. The communication between smart card and microcontroller is done through 12C communication. After reading it will check the total amount with the unit amount (Unit amount is nothing but amount for I unit of power), if the amount is there then the microcontroller will switch on relay which is used to connect the power to the house.

Fig 6.6: Loading a Pre-paid meter card

The power consumed will be monitored and deducted as per the consumption. If the amount starts to reduce and reaches near to zero then the microcontroller starts to give beeps indicating that the amount is low. If ignored the microcontroller switches off the power.

This device we can eliminate the energy billing system for the government. The Card is recharged from the Vending Station PC. A VB front end runs so that user can enter the amount in the PC. The PC sends the amount details into microcontroller through serial port, then the controller will write the data into smart card using i2c protocols.

6.4 Meter Reading

Most domestic electricity meters must be read manually, by a representative of the power company. The electricity company will normally require a visit by a company representative at least annually in order to verify customer-supplied readings and to make a basic safety check of the meter. The meter reading schedule is being prepared in every month following a definite time table. The chart-schedule contains information of consumer's address by dividing them into Zone, Block and Road.

Dhaka Electric Supply Company Ltd. (DESCO)

Monthly Meter Reading Schedule

ZONE-F

Month : May 2011

Name of Meter Reader

Reading Date	Block No.	Reading Q'ty	Block No.	Reading Q'ty	Block No.	Reading Q'ty	Block No.	Reading Q'ty	Submit Date
07.05.11	FB 120	50	FE 150	110	FB 280	86	FE 180	80	07.05.11
07.05.11	FB 280	110	FB 070, 100	50, 162	FE 290	62	FE 135	115	10.05.11
08.05.11	FE 060	114	FE 145	118	FE 210	132	FB 090	96	09.05.11
09.05.11	FE 250	83	FE 240	159	FE 300	52	FE 220, FX 180	57, 85	11.05.11
10.05.11	FE 170	79	FX 140	140	FB 060	112	FX 460	113	12.05.11
11.05.11	FD 190	111	FE 250	140	FE 310	107	FE 200	197	13.05.11
12.05.11	FE 777	252	FE 350	100	FB 330	255	FX 480	136	17.05.11
14.05.11	FE 360	122	FX 160, 190	96, 94	FE 727	243	FX 200	109	17.05.11
15.05.11	FD 280	73	FE 778	219	FD 550	122	FE 310	106	18.05.11
16.05.11	FD 778	211	FD 210	52	FX 410	102	FE 777	171	19.05.11
18.05.11	FE 200	178	FC 070	107	FX 320, 11 170	56, 96	FD 270	94	20.05.11
19.05.11	FD 210	63	FE 140	97	FC 440	100	FE 744	182	21.05.11
21.05.11	FD 240	99	FD 070	100	FE 781	126	FC 080	136	24.05.11
22.05.11	FD 250, 010	90, 119	FE 260	84	FC 010	119	FD 030	121	24.05.11
23.05.11	FC 090	70	FE 300	76	FC 060	112	FE 080	123	25.05.11
24.05.11	FD 030	160	FD 100	147	FD 040	75	FB 110	69	26.05.11
25.05.11	FE 040	130	FD 140	98	FG 010	117	FD 130	113	27.05.11
26.05.11	FF 305	188	FB 331	153	FE 175	98	FE 050	239	01.06.11
	19	2253	20	2328	19	2228	19	2362	

Coordinator
Zone-F

Asstt. Manager
S & D Division, Pallabi, DESCO

Figure 6.7 : Example of a monthly meter reading schedule

6.5 Meter Tempering by Consumers

Some consumers temper meter very wisely to avoid actual payment of bill. Actual payment of bill is based on accurate meter reading. In this case, meter readers come to check the meter and take the fault reading. If readers can catch the particular consumers with tempered meter then they penalty them calculated that how many days, consumers used these faulty meters.

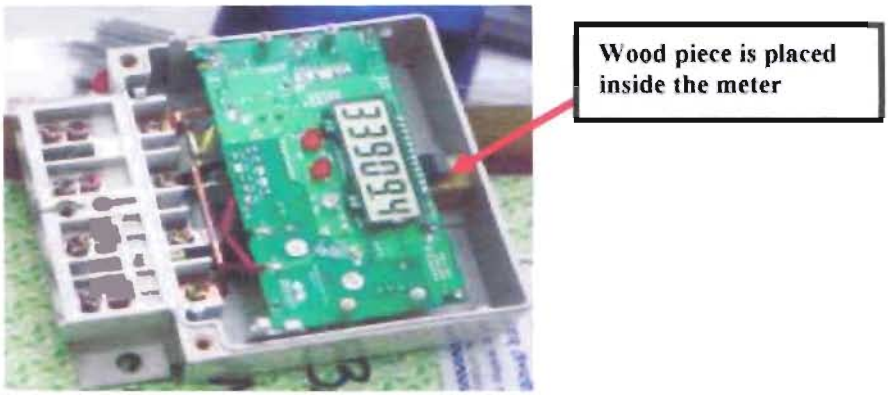


Figure 6.8 : Example of a faulty meter

In DESCO's meter checking room, we noticed the above meter with a little tempering which is identified as a faulty meter. In this meter a wood piece is placed inside the meter case and a small switch is placed on it. When the meter reader comes to take the reading then the meter holder pauses it by using a pin from the outside, so that the meter reader cannot get his actual meter reading.

6.6 Billing

The primary objective of maintaining the financial strength of the Company is achieved by continuous efforts to maintain a healthy billing/ collection ratio.

After meter reading has been taken the meter reading book is being 'submitted to the IT section for preparing the bill. In IT section by two ways, the meter reading is collected. In entry book, by zonal division, according to the consumer number and meter number the rated bill is done. After that, again the- billing entry is done in the PC for more accuracy and calculation easiness.

For meter reading purposes the company is committed with some outsourcing constructor. Moreover, to make this work more efficient, every effort has been made to change defective meters, sealing of meters and inspection of meters on a regular basis and a meter report is being generated in this basis.

One of the major objectives of establishing DESCO was to improve the revenue/bill collection. Within seven (07) years from its inception. DESCO improved its collection/bill (%) from 59.25 to near hundred. DESCO achieved this performance by notifying the

consumers regularly regarding their dues and disconnecting the service connections for not paying the bills after receiving the notices.

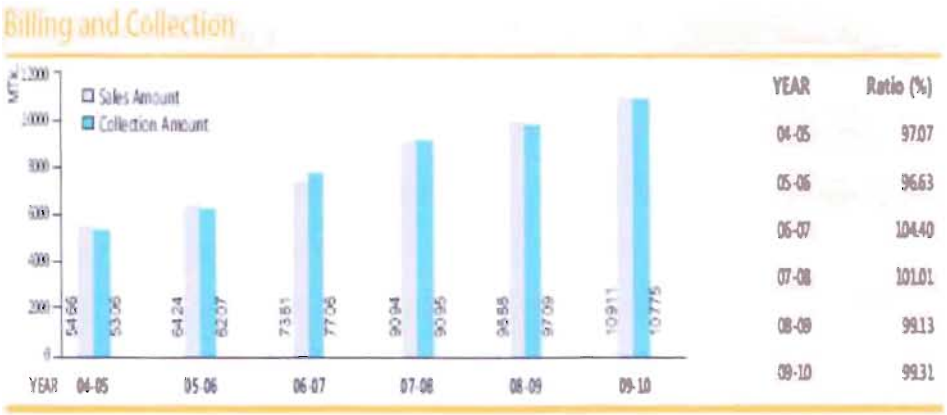


Figure 6.9 : Billing and collection based on annual report 2010 of DESCO

Source: Yearly Financial Progress report of Dhaka Electric Supply Company Limited to ADB.

6.7 Important terms related with Billing and collection

6.7.1 Collection Import Ratio

For a specific period of time-

Collection Import (CI) Ratio =100 - ((System loss % /100) X Collection %)

6.7.2 Account Receivable Equivalent Month

At an instant of time –

Account receivable equivalent month = (Total account receivable / Average monthly bill)

Chapter 07

Technical Activities, Major Projects and Future Plans.

7.1 Data Acquisition System (DAS):

DESCO has implemented a data acquisition system. Data acquisition system is an integrated remote terminal unit for data gathering and computer –server network.

i. Monitor the real time load status of the network.

ii. Implemented rational load shading

Data Acquisition System (DAS) software has been developed by Bangladesh University of Engineering and Technology (BUET).

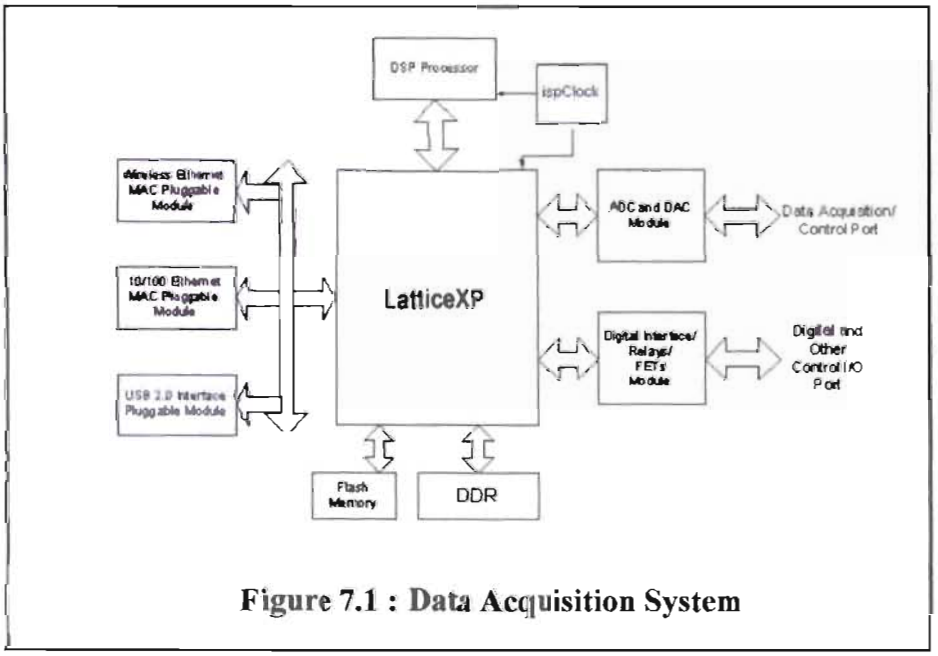


Figure 7.1 : Data Acquisition System

7.1.1 E-Governance System:

An e-Governance project has been undertaken by DESCO as technical activity. The objective is to create a paper-less office for quick and better management.

Figure 7.2: E-Governance In Action

i. All of the nine S&D and all other units of DESCO will be interconnected under single network.
ii. Data to and from each administrative unit will be transmitted to HQ using the network.
iii. All decision on a file will be made electronically.
iv. Institute of Information and Communication Technology (IICT) of BUET is developing the system.

7.1.2 Electronic Bill Payment:

To start viewing or paying bills online, consumers first need to login, using their bill account number to view their bill, internet payment and other services. Once successful login, simply click on view bill/view outstanding bill to access their **DESCO** bills.

Pay eBill

i. **Through mobile phone**
   a. **Grameen Phone (In process)**
   b. **Banglalink (In process)**
   c. **City cell (In process)**
ii. **Through Internet**
   a. **NEXUS Gateway of Dutch-Bangla Bank**
iii. **View bill**
   a. 12-month history of consumers paid bills.
   b. To take print of consumers bills.
   c. 12-month history of consumers outstanding bills.

7.2 Major Projects

Planning of Underground 33KV line:

Near Mirpur sector 14, there is a vast free land. Initially it was empty so DESCO just established the 33KV over head poles through that free land, but recently nearby a plot was approved for residential housing. To build house near 33KV line is hazardous that is why DESCO has sent a designated group to plan for underground line in that area. They took us with them and we inspected the whole area then made a plan where to establish an underground line.

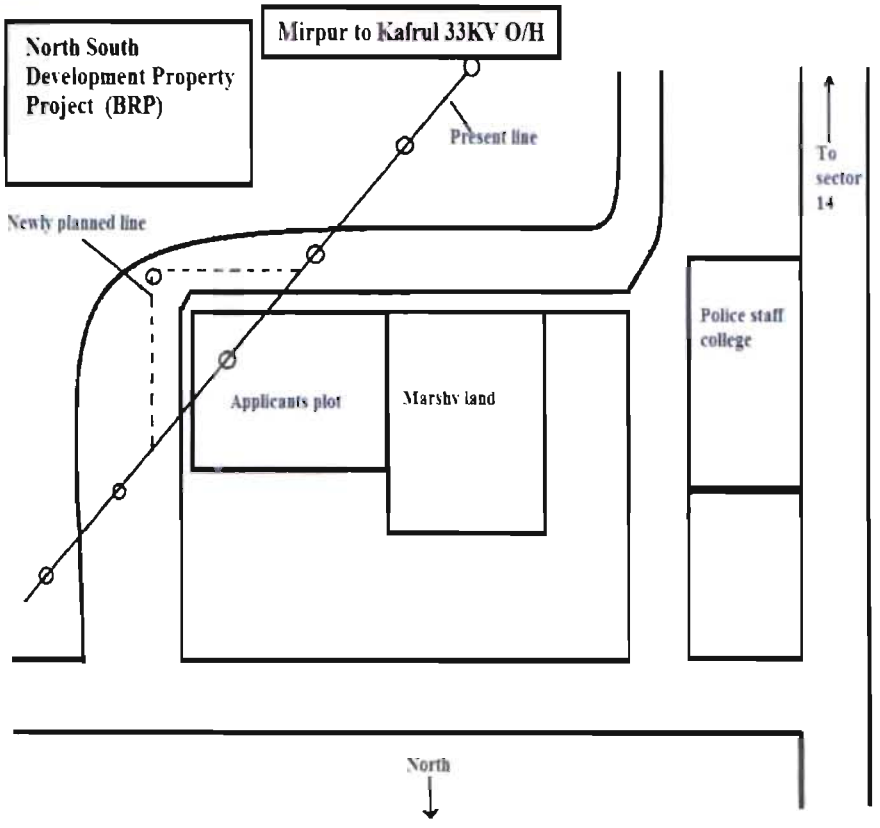


Figure 7.3: Planning for underground 33KV line in sector 14, Mirpur.

In the figure we can see the existing line and the proposed modified line. The designated group designed the line which will be located 10 meters away and 1 meter beneath the ground from this residential plot which will be perfectly safe.

Other projects include:

i. Use of Solar Power in all installation of DESCO

ii. DESCO's own security arrangement for KPI installation

iii. Installation/ rehabilitation of 33/11 KV substations

iv. 33 KV network planning for 33/11 KV substations

v. 11 KV underground line planning for feeders and switching stations.

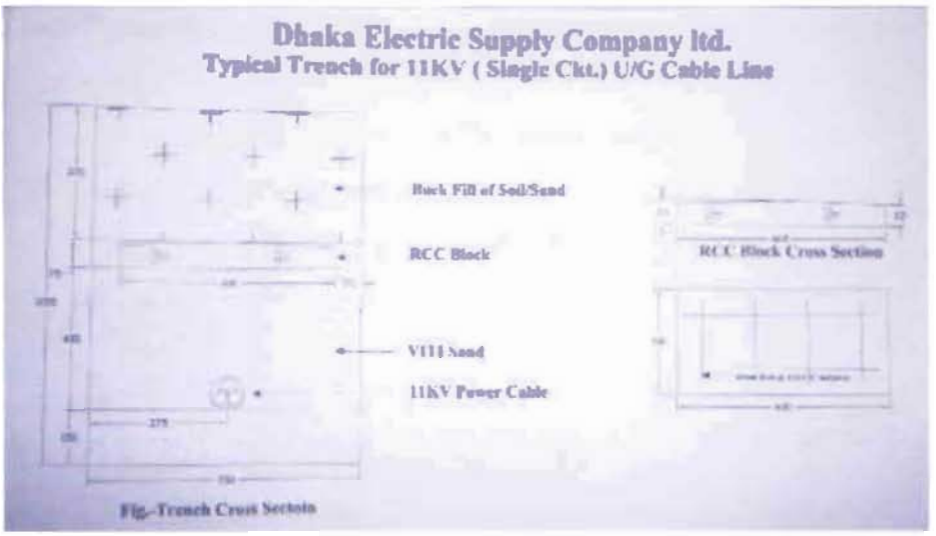


Figure 7.4 : Underground construction for 11 KV line

vi. Purbachal new town project.

vii. Uttara 3rd phase project.

viii. Strengthening DESCO's electric distribution network.

ix. Upgrading and expanding distribution system in Gulshan circle.

7.3 Future Plans:

DESCO has some future plans on the basis of load management, load forecast, planning of new 33/11 KV substation or maximizing the current capacity of substations.

7.3.1 Future Plan for Topographical Survey:

i. Collection of geographic map of concerned area.

ii. Topographic survey using standard method

iii. Production of maps in digitized form using latest version of AutoCAD. [11]

7.3.2 Future plan for Topographical Maps:

DESCO has future plans for establishing new electricity lines adjacent to roads, highways, railway tracks inside Dhaka city.

i. Proposed locations are Ashulia Beri Badh area, Purbachal Recidential City etc for implementing electricity lines by roads and lanes.
ii. Highways, railway tracks near at air port and Uttara to Tongi area.
iii. Proposed locations for residential and commercial areas are Kuril slum and Uttar Badda.
iv. Overhead power line poles and towers for Uttara sector 14.
v. Identity number of overhead power lines poles and towers 132/33 KV, 33/11 KV substations and 11/ 0.4 KV distribution substations. [11]

7.3.3 Future plan for survey of Loads and Load Forecast:

DESCO has a future plan on the basis of determination of increasing loads. They survey the loads and make forecast about it,

i. Determination of the present load of 33/11 KV substations and maximum demands for the last 10 years from the substations log book.
ii. Load of all 11 KV feeders.
iii. Future demand of bulk loads/ establishments.
iv. Historical (Previous 10 years) and present load of 33/11 KV substations and 11 KV feeders.
v. Expected feeder wise load growth rates suggested by DESCO.
vi. Demand forecast for the project area.
    a. For 5 years for distribution planning
    b. For 10 years 33/11 KV sub-stations and substation lines.

7.3.4 Planning of 33/11 KV Substations:

DESCO also has the plan for maximizing the present load and shifting load from the overloaded substation.

i. Shifting of load from over loaded existing substation on adjacent existing/ proposed substratum.

ii. Modification or extension of control room building, equipment foundation, and cable trenches, etc.

7.3.5 Detailed Planning of Distribution network:

Every day new consumers are being added and DESCO has plans to maximize its distribution network to minimize interruption of power supply, to create facilities for new consumers, to limit voltage drop to the following maximum figures at points farthest from the supply point.

i.	33 KV system	:	1%
ii.	11KV system	:	3%
iii.	400/230 Volt system	:	4%
iv.	Service drop	:	1%

7.3.6 Planning of staking sheets:

DESCO has stacking sheets (record book) and they keep every record of pole numbers and locations, substation name, transformers with KVA rating, feeder name, assembly, type and numbers in staking sheets.

7.3.7 Re-arrangement Network:

Two separate grids are separate to supply every substation parallely. The second one is for standby operation. In case of the failure of major grid the standby grid will be connected to the substation. Overhead sources lines will be replaced by underground line. For future substations some existing cables will be rerouted. DESCO will make ring between substations and will search alternative source for substations.

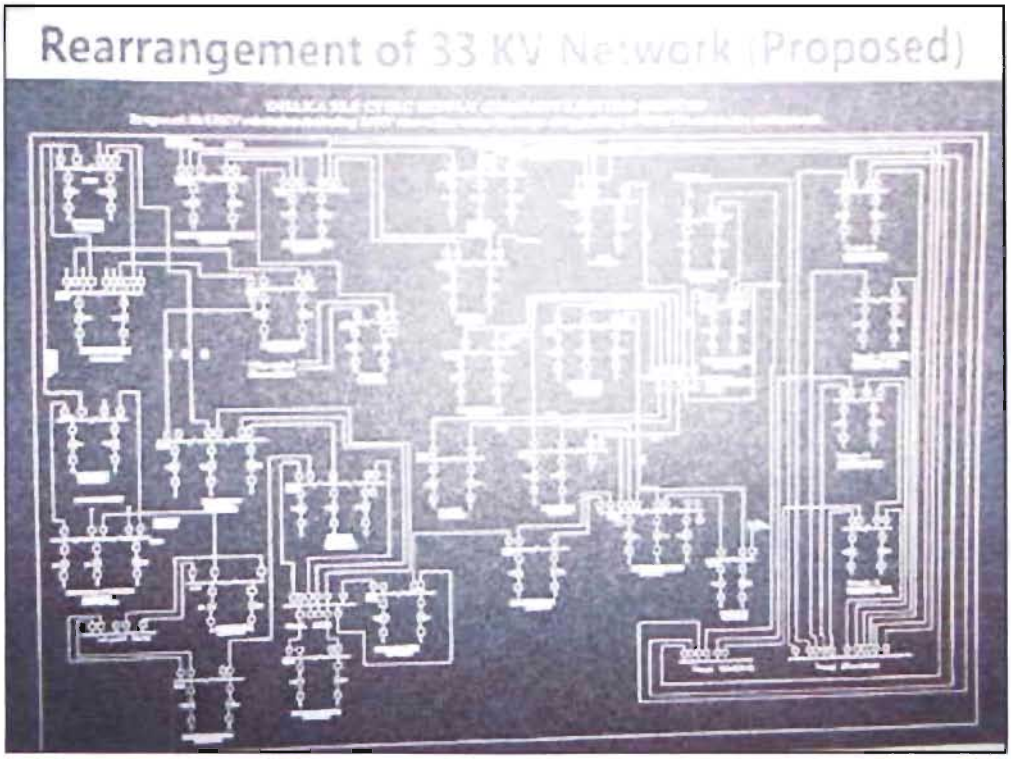


Figure 7.5 : Rearrangement of 33 KV Network (Proposed)

DESCO always aims to provide better services. To achieve the goal they have a planning department. To update their consumers they have a dynamic web portal from which a subscriber can easily view his/her monthly electric bills. To make electric bill payment easy DESCO have introduced CARD PAYMENT System and they are trying to introduce mobile payment method also. As a distribution company they always give highest priority to the consumer, which is very important in power distribution business.

7.3.8 Building New Power Plant of 200MW:

DESCO already planned to build a new power plant of 200MW near at Ashulia Beri Badh, Dhaka city. It will be completed at the end of 2016. 200 hector areas are acquired to build this power plant. Raw material will be heavy fuel oil (heavy fuel oil means blended oil based on the residues from various refinery distillation and cracking processes). This viscous liquid with a characteristic odor require heating for storage and combustion. Heavy fuel oils are used in medium to large industrial plants, marine applications and power stations in combustion equipment such as boilers, furnaces and diesel engines.[9] This 200MW power will cover 15% load of Dhaka city.

CHAPTER - 08

LIMITATIONS AND RECOMMENDATIONS

8.1 Limitations

1. Though there are five distribution companies in the power distribution industry and the industry structure for competition is monopoly, therefore consumers in the distribution area are bound to use power from that responsible company distributing power in that territory.
2. Collection of sufficient data was a great problem during report preparation. When DESA handed over the assets and liabilities to DESCO, all of the data, information, papers, design and drawings were not collected accurately and stored properly. As a result shortage of data about any subject becomes a problem.
3. Many data and information have to be collected from different department of the organization. Some of the information were very confidential to the respective department and thus were difficult to collect.

8.2 Recommendations

1. Ensured effective Load management.
2. Direct connectivity with the bank.
3. Implementing E- Governance broadly.
4. Enhancing Prepaid Metering System to reduce system loss and wastage of electricity.
5. Expanding mobile court activities.
6. Improvement of One Point Service and introducing Call Center.
7. Conducting Regular Consumer Satisfaction Survey.

CHAPTER 09

CONCLUSION

Through the bureaucratic ideology in the power sector, DESCO has been able to emerge as force to be reckoned with. The need of electricity in Bangladesh is such that the demand will always surpass the supply. The economic goals of the country cannot be achieved without flourishing the power sector of Bangladesh. Relying on decade old plants with faulty units or unfair power sharing schemes from nearby countries will not suffice the need of electricity for the daily consumption of this country.

As power sector is a capital-intensive industry, huge investment will be required for additional generation capacity. DESCO is a role model in this stature based on the context that its operation under a Public-Private Partnership (PPP) has helped improves the disastrous power sector of this country. Recognizing these trends, GOB amended its industrial policy to enable private investment in the power sector and Private Sector Power Generation Policy was framed in 1996 for promoting private sector participation in the generation of electricity.

Today DESCO is most profitable organization in Bangladesh in the field of power sector.
The most important problem of power sector was shortage of fund, lack of long term plan and regulatory or monitory commission. But after creation of DESCO, system loss had been downgraded to a value that fell from 52% to only 9%. This has been achieve through persistence addition of technology, digitizing the mechanism of bill collection, payment and load retentions. DESCO is only a distributing company. When generating companies add more electricity to the existing grid infrastructure, greater MW usage of electricity will be available for the people of the country.

Throughout this internship we have learned that DESCO is one of the main electricity distribution company and the fastest growing. We have sequentially learned that after receiving large quantities of electricity from main generation units outside Dhaka, DESCO is responsible for distribution throughout the zones that has been allocated for them in the city.

The electricity from the generation units are sent via transmission lines to the substations, where stepping down and switching of the electrical power takes places by the means of transformers. We then found out that the substations send the electricity to smaller units. All of these are regulated by engineers and monitored by a computerized system called the Data Acquisition System (DAS). The DAS enables the system operators to find out the amount of electricity available, being distributed and also the power factor of the whole operation.

Aside from the distribution and monitoring, we have learned that DESCO is also responsible for the maintenance of their equipments such as transformers and the switching stations. Though most of the work is under outsourcing at the moment, the technical teams of DESCO keep a close liaison with the outsourcing team to ensure efficient management of the repair and maintenance operations.

In addition, we have learned that DESCO maintains a close-knit relationship with it customers through its One Point Service Centers, which are distributed strategically throughout their allocated zones. Through the means of the One Point Service Centers, DESCO is able to cater to the needs of its clients, which include bill payment, load extension, meter testing, repairing and new connection.

Thus we can say that DESCO has created and is maintaining a very systematic system of electrical power distribution, maintenance and customer relations, which is in lieu with their mission statement. As the generating capabilities of Bangladesh will rise, so will the overall system efficiency of DESCO. Eventually, people will be able to live their lives load-shedding free.

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18. Policy Guideline on Load Estimation and Load Sanction of DESCO

Appendix

[illegible] Development Bank

[illegible] Bangladesh Power Development Board

[illegible] Collection-Import

[illegible] Dhaka Electric Supply Authority

[illegible] Dhaka Power Distribution Company

[illegible] Dhaka Electric Supply Company Ltd.

[illegible] Fiscal Year

[illegible] Gross Domestic Product

[illegible] Government of Bangladesh

[illegible] Giga Watt hour

[illegible] Independent Power Producer

[illegible] Kilo-Watt-Hour

[illegible] Kilo-Volt

[illegible] Kilo-Watt

[illegible] Million Kilo-Watt-Hours

[illegible] Million Taka

[illegible] Mega Watt

[illegible] Power Grid Company of Bangladesh Limited

[illegible] Palli Biddut Samity

[illegible] Rural Electrification Board