OPERATION AND MAINTENANCE OF GRID AND DISTRIBUTION SUBSTATION AND SYSTEM OPERATION OF DESCO

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

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Certification

This is to certify that this project and thesis entitled "**OPERATION AND MAINTENANCE OF GRID AND DISTRIBUTION SUBSTATION AND SYSTEM OPERATION OF DESCO**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 4 may2015

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Dedicated to

Our Parents

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List of Abbreviations

DESCO	Dhaka electric supply company limited .
GM	General manager .
DGM	Direct general manager.
HR	Human recourse.
MD	Managing director
PDB	Power development board.
PGCB	Power generation company of Bangladesh.
ADB	Asian development bank.
S&D	Sells and distribution.
IT	Information technology.
ICT	Information and communication technology.
KPI	Key Performance Indicator.
MOD	Modifiers of development.
BERC	Berkeley Energy & Resources Collaborative.
SMPS	Switched-mode power supply.

RTC	Real-time clock .
LCD	Liquid-crystal display.
EMM	Enterprise mobility management.
BPDB	Bangladesh Power Development Board
DPDC	Dhaka power distribution company
SSL	Secure Sockets Layer.
SS	Sub-station.
LT	Low tension.
HT	High tension.
CT	Current transformer.
PT	Potential transformer.
AC	Alternating current.
DC	Direct current .
PF	Power factor.
KVAR	Kilovolt-amperes reactive.
KV	Kilo voltage .
MV	Mega voltage.
MW	Mega Worde.
CB	Circuit barker.
SF6	Sulfur Hexafluoride.
MVA	Mega volt ampere.

List of Symbols

.	Period
′	Prime
″	Double prime
=	Equals sign
≈	Approximately equal
( )	Parentheses
+	Plus sign
-	Minus sign
[ ]	Brackets
/	Division slash
$\sqrt{a}$	Square root
%	Percent
∠	Angle
∡	Measured angle
°	Degree
Δ	Triangle
Φ	Golden ratio
μ	Population mean
&	Ampersand

DECLARATION

We here by declare that this report on **"Operation and Maintenance of Grid and Distribution Substation and System operation of DESCO"** in Bangladesh is submitted to Daffodil International University for partial fulfillment of the requirement of the degree of Bachelor of Science in Electrical & Electronic Engineering. It has not been submitted to any other University or institution for the award of any degree previously.

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Authors

ABSTRACT

The power sector of Bangladesh haves faced numerous problems characterized by lack of supply capacity, frequent power cuts, Among the three main components of the power system, recent reform activities were centered on generation and transmission. This report is based on my internship activities which I have done at DESCO (Dhaka Electric Supply Company Limited). This report focuses on the operation of DESCO, their vision, supply capacity, financial condition, distribution of electricity and future planning. Internship is such an opportunity to learn those activities that are related to our real engineering world. During my internship period, I have been able to gather some knowledge on grid-substation, transformer and their maintenance and the power factor improvement which are closely related to my study materials. I have also observed their administrative activities of control room; complain room operation, IT (Information & Technology) and one point operation which will surely help me to visualize the effectiveness in my practical life.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Dhaka Electric Supply Company Limited, commonly known as DESCO, is a Public Limited Company which distributes electricity at the Northern parts of Dhaka City and Tongi Town of Gazipur District. The company was created on November 1996 under the Companies Act 1994 as a Public Limited Company. The company is now under the Power Division of the Bangladesh Ministry of Power, Energy and Mineral Resources and serving a total number of 604,304 consumers as of 31 December 2013.

1.2 Problems statement

We have already gathered some knowledge about DESCO‟s practical operations. But within the limited time it was really difficult task to gather the whole knowledge about everything. Due to some privacy problem we could not get enough pictures and enough accesses to every place. Due to some mechanical fault, it was really a difficult task to visit and gather some knowledge about Badda substation. At that time due to the frequent maintenance at Rampura grid; it was not possible for us to know about the coolers of the grid. Due to some technical problems we could not observe the single bus bar of Gulshan substation.

1.3 Objective of the study

1.3.1 Main Objective

- To make a thorough analysis on how Power Distribution System works and Advance Technologies can help us to meet our electricity demand. Specific Objectives

1.3.2 Specific Objectives

- To find out the Current and Potential market position of Dhaka Electric Supply Company Limited (DESCO).
- To find out distinctive supply and services provided by Dhaka Electric Supply Company Limited (DESCO).
- To study the opportunities and impediments of power distribution systems.
- To find out favorable solutions for the problems.

1.4 Methodology

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

1.4.1 Primary Source

Primary data has been collected through face to face conversation with the employees and the documents provided by them.

1.4.2 Secondary Source

Secondary data has been gathered from different Divisions of DESCO annual reports and the website of DESCO. Books of different Authors and also the internet sources are helpful for writing the study topic.

CHAPTER 2

About DESCO

2.1 Background of DESCO

DESCO was not built in one day. It was built through a long process and it took a lot of time to achieve the present condition of DESCO. Dhaka Electric Supply Company Ltd (DESCO) was created as a distribution company on November, 1996, under the company act 1994 as a Public Limited Company with an authorized capital of Tk. 5.00 billion, due to improve power sector, to provide better service and to improve revenue collection specially in Dhaka city. However, the operational activities are at DESCO field level commenced on September 24, 1998.

2.2 Organization and Service area of DESCO

The company's core operation contains an area of about 250 square kilometers covering Mirpur Road, Agargaon Road, Rokeya Sarani, Progati Sarani, New Airport Road, Mymenshing Road, Mohakhali Jhee, Rampura Jheel connected with Balu River in the south, Balu River in the east and Turag River in the west and areas under Tongi Pourashava in the north. It may be mentioned that "Purbachal Model Town" a Rajuk project, situated on the east side of Balu River, adjacent to Dakkhinkhan area, has been decided to be included under DESCO.

2.3 Company Structure

DESCO incorporated under the Companies Act 1994 with its own Memorandum and Articles of Association. The company as a whole owned by Government of Bangladesh and DESA representing government by acquiring 100% shares. DESCO managed by a part time Board of Directors appointed by its shareholders, they are responsible for policy decisions. The Board of Directors appointed managing Director and two full time Directors and they were also members of the Board Directors after appointment.

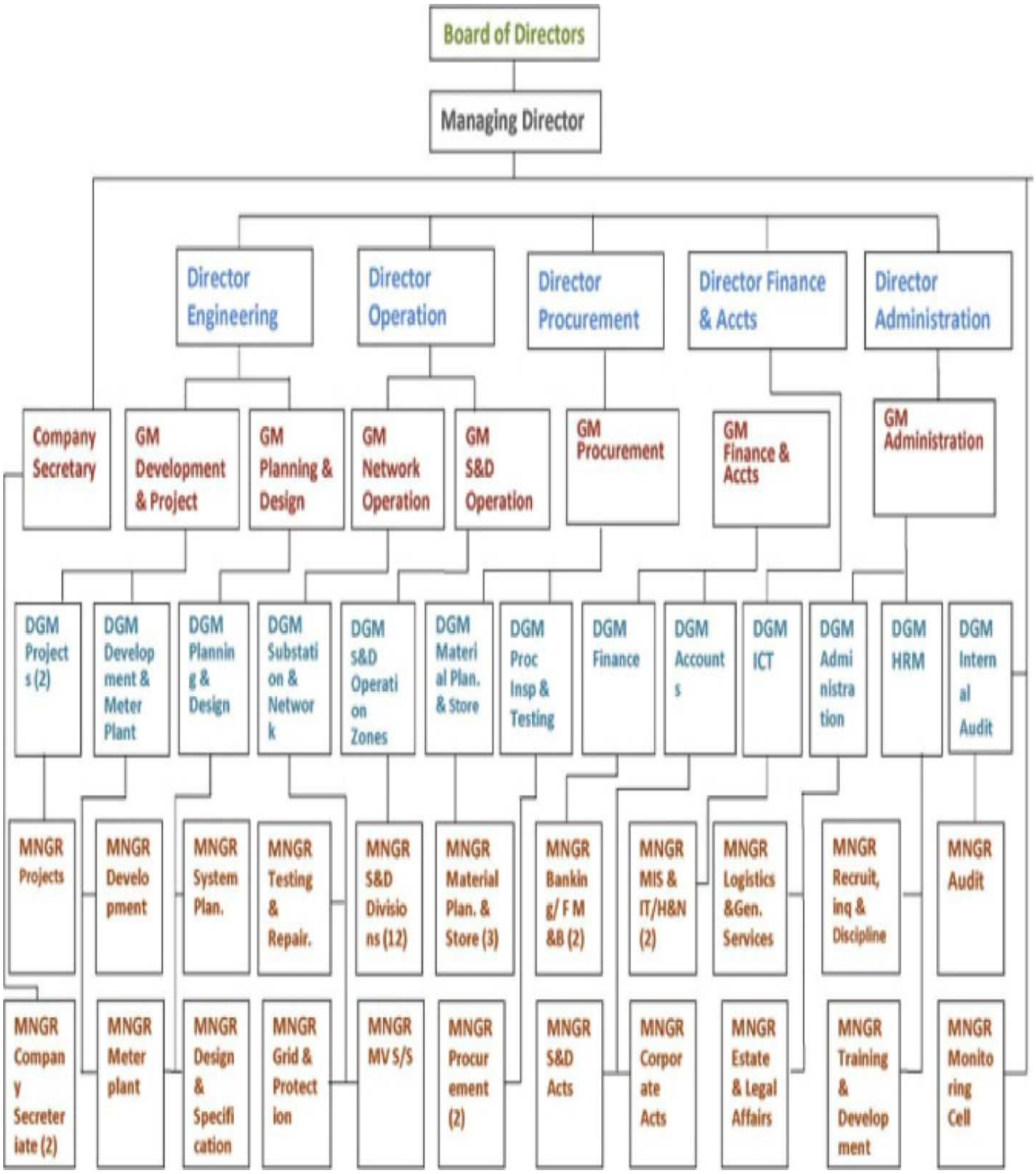


Figure 2.1: Organogram of board directors

2.6 Mission and Vision

2.6.1 Vision To be an enabler of economic development and social progress by providing safe, reliable and sustainable electricity.

2.6.2 Mission Bringing comfort to customers, supporting business and commerce and building strong communities. Achieving and maintaining the highest degree of efficiency, reliability and responsiveness for variety of customers.

2.6.3 Corporate philosophy We will achieve our vision through our core corporate principle. Safety: Placing the safety of our communities, customers and employee first.

2.6.3 Customer Focus Providing superior service to help customers more effectively manage their use of electricity; Operational Excellence: Incorporating continuous improvement to deliver safe & dependable electricity at affordable prices; Performance Driven Culture: Fostering a strong values and performance based culture designed to attract, develop and retain best talents.

CHAPTER 3

BADDA S&D DIVISION

3.1 Badda S & D Division visit

Data taken up to December 2017 suggests that DESCO has 7, 60,844 consumers. where 50% are residential, 37% industrial, 10% commercial, 3% others. To handle such huge consumers DESCO has 42 Cost Centers and 16 Sales and Distribution (S & D) divisions. Through this internship I got a chance to do a thirteen day tour at Badda S & D.

3.2 Badda S&D Operation

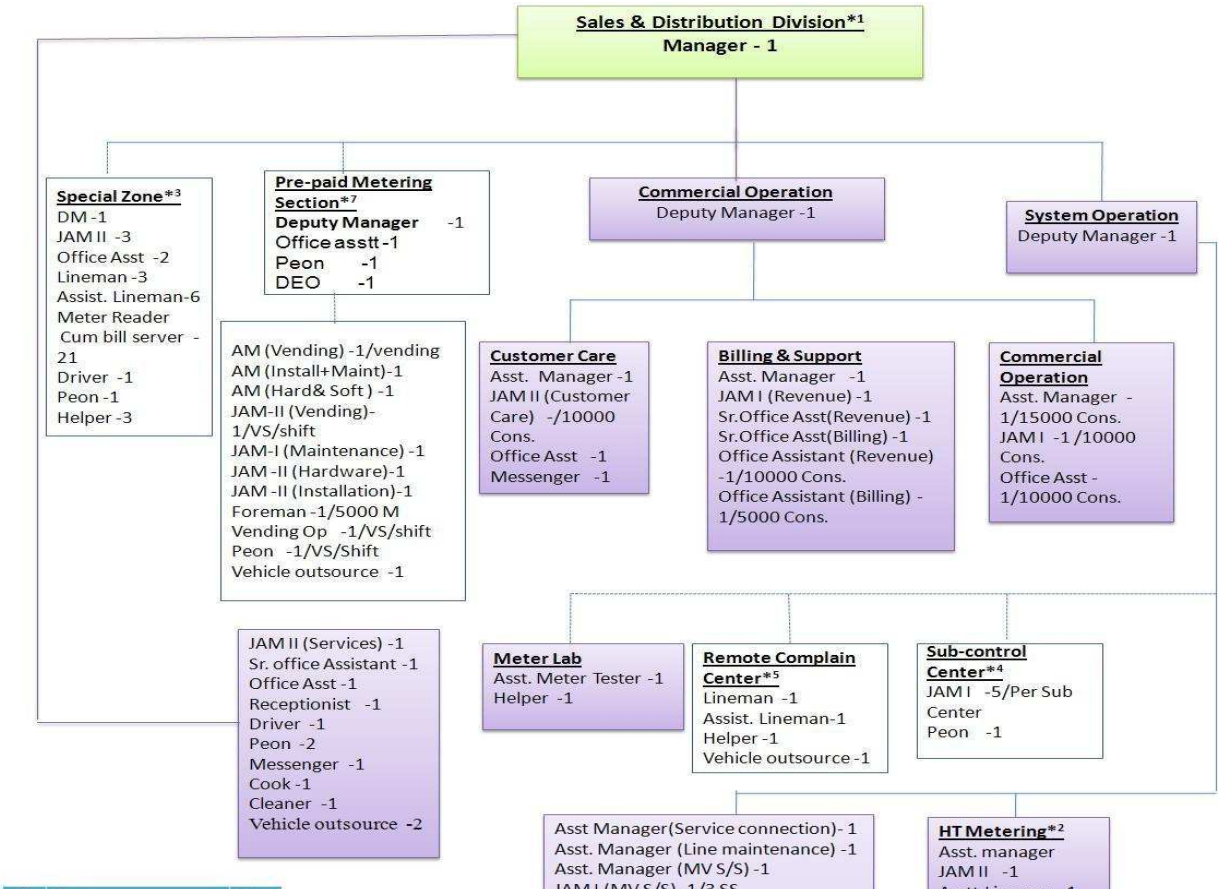
The operation of any S & D can be divided into two parts:

- Commercial Operation
- System Operation

3.2.1 Commercial Operation

Commercial operation is the main function of DESCO. The Principal activities in commercial operation are-

- Disconnection/Reconnection
- Metering
- One point service center
- Billing/ Collection
- Outsourcing activities
- Regularization of illegal connection



Sl	Post	No
1	Manager	12
2	DM	26
3	AM	100
4	JAM-1	66
5	JAM-2	103
6	Foreman	02
7	Sr. O.A	36
8	Assistant (All)	207
9	Receptionist	12
10	Vending Oper	04
11	SSA-II	156
12	C.A	48
13	A.meter tester	12
14	Lineman	16
15	Astt lineman	31
16	Driver (Heavy)	12
17	Meter Reader	21
18	Driver	12
19	Messenger	24
20	Cook	12
22	Helper	16
23	Peon	28
24	Cleaner	12
25	Vehicle*6 outsource-26	-
	Total	**968**

Notes:

1. Number of consumers will generally be limited upto 30,000 for each S&D Division. However, depending on location of the service area and/or growth in number of consumers in that particular area, new S & D division(s) may be created with approval of the Board;
2. S &D Division with more than 1500 HT connections will have additional one (1) no. of Assistant Manager and one (1) no. of Electrician for HT Metering Section;
3. One special zone shall be considered in DESCO. This zone shall be put under control of each of the S & D Division on rotational basis usually for a two-year period;.
4. Sub-control center shall be responsible for load/feeder control activities for a no. of S & D Division as determined by the management from time to time and placed under the system operation wing of one of the respective S & D Divisions;
5. In consideration of distance and inconvenience in communication from S & D offices, Remote Complaint Center may be established in a particular geographical location with approval of DESCO management;
6. Management may increase/decrease the no. of outsourced vehicles in order to meet unforeseen requirement;
7. Prepaid metering section will be opened upon commencement of prepaid metering in S & D Division.
8. Manpower is calculated considering 12 (Twelve) S & D Division.

Figure 3.1: Badda S & D Division.

Disconnection/Reconnection The prime tool to recover dues is disconnection. Disconnection Occurs under the following causes:

- Meter tempering
- Meter By-pass
- Non-payment/Bill due (More than one month)
- Over load use (More than sanction load)
- Illegal connection etc.

Metering

As meter is considered „cash box‟ of the company, DESCO has left no stone unturned to check meters regularly. The regular activities of metering section are-

- Meter renovation
- Removal of circuit breaker before installed the meter
- Checking and sealing of meter

Meter Reading

Meter Readings are collected through Meter Readers as per Schedule. They go from door to door of Consumers once in a month according to Schedule Date. They write Meter Reading in a Meter Card that is preserved in Consumer end. They also write Meter Reading in a Meter Book that is preserved in DESCO Office. Electricity Bill is prepared as per this Meter Reading.

Meter Reading Schedules are as follows:

- L T (Low Tension) Consumer: Normally from 05th to 25th of each month.
- LTI (Low Tension Industry) Consumer: Normally from 26th (current month) to 05th (next month).
- HT (High Tension) Consumer: Normally from 28th (current month) to 03th (next month).

One Point Service Center

Customer satisfaction is the key to success of any company. Customers are prime focus of DESCO. To ensure satisfactory customer service DESCO has established “One Point Service Center” in each S & D division. It’s activities are-

- Customer service at one place.
- Accepting new connection applications.
- Listening to customer complain.

Billing / Collection

The primary objective of maintaining the financial potency of the company is achieved by constant efforts to uphold a vigorous billing/collection ratio.

- Bill issue and decentralized collection.
- Bill preparation staggered over month.
- Bill correction.
- Identification and deletion of duplicate accounts

3.2.2 System Operation

Critical issues are handled by system operation. All O/H & U/G lines under DESCO are constructed and maintained by this section. It’s duties are-

- New connection approval & setup.
- Load sanction & load retention.
- Load management.
- Control room activity.
- Power factor monitoring & upgrading.
- Substation operation & maintenance.
- Wireless & Telecommunication.
- Line maintenance & handling etc.

3.3 New Services

DESCO introduced decentralized divisional customer service center with each sales and distribution division. From this center any customer can get the following services:

- New connection.
- Load extension or revision.
- Service or site relocation.
- Consumer name change or tariff change.
- Meter test, Change etc.
- Bill correction.
- Disconnected consumers service reconnection.
- Any other commercial related service.
- Customer information, awareness activity etc.
- Pre-paid meter service.

DESCO's has introduced pre-paid meter in one part of the capital Dhaka city. The pre-paid metered consumer expresses their satisfaction with this service for many reasons.

- E-Governance.

DESCO has implemented e-governance in their office management activity which promotes prompt customer service. Customer can enjoy dynamic web based billing and collection (link page) related information through internet.

CHAPTER 4

SS-2 33/11 KV SUBSTATION

4.1 Maintenance and Inspection of Substation

This was the most interesting part of the S & D visit. DESCO has 33/11 KV substations in which 3 substations are controlled by Badda S & D. I visit only one. The substation is powered by two source lines. Two distribution transformers draw 33 KV from bus and convert it into 11 KV for overhead distribution. The capacity of each transformer is 20/28 MVA. The single Line Diagram of SS-2 33/11 KV substation is given below.

During my internship period at DESCO, I have got some ideas about substation's equipment maintenance and practically observed maintenance period of SS-2 33/11 KV Substation. Basically there are many inspections of substations, but DESCO implements inspection of substation's equipment on monthly and half-yearly basis. At SS-2 33/11 KV Substation, there are two (2) 33 KV incoming sources and five (05) 11KV outgoing feeders. In figure (3.1), transformers transform voltages from 33KV to 11KV. At Badda 33/11 KV Substation only eight numbers of 11KV outgoing feeders are active, seven numbers of 11KV outgoing feeders are spare or in off position and three numbers of 11KV outgoing feeders are for switching.

Figure 4.1: Single line diagram of SS-2 33/11 KV substation.

4.2 Power Factor Monitoring & Upgrading

Power factor monitoring is one of the most important factors in power system. Because poor power factor impose low effects on power generation. At Badda 33/11 KV Substation I have seen the power factor was about 0.97≈0.98, but usually the average is about 0.95. Inductive load is responsible to degrade the power factor. We know that power factor is defined as the ratio of KW to KVA. But we can see that the cause of low power factor is large KVAR. And we know that the magnitude of KVAR is proportional to inductive load. All big factories, industries and workshops are main sources of inductive loads. Inductive load includes: Transformer, Induction motor and Energy saving light. Reactive power increases the amount of apparent power. This increases the reactive power and as a result apparent power creates large angle (θ) between KW and KVA and larger angle produces poor power factor (pf=cosθ).

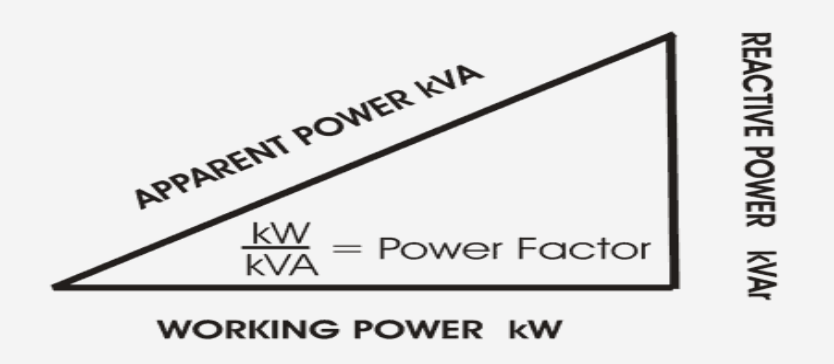


Figure 4.2: PF dependence on the amplitude of KVA.

4.2.1 Effect of Low Power Factor

Poor power factor affects the power distribution system, loss in distribution network and voltage drop in feeder line. Excessive voltage drop may cause over heating in distribution network. Poor power factor also affects the generation plant. The power generators act as an induction machine. The reactive power comes from these power generators. Poor power factor means more reactive power. More reactive power overloads the generators.

4.2.2 Capacitor Bank

A Capacitor Bank is a group of several capacitors of the same rating that are connected in series or parallel with each other to store electrical energy. The resulting bank is then used to counteract or correct a power factor lag or phase shift in an alternating current (AC) power supply. In DESCO they are use in feeders when power factor fall down.

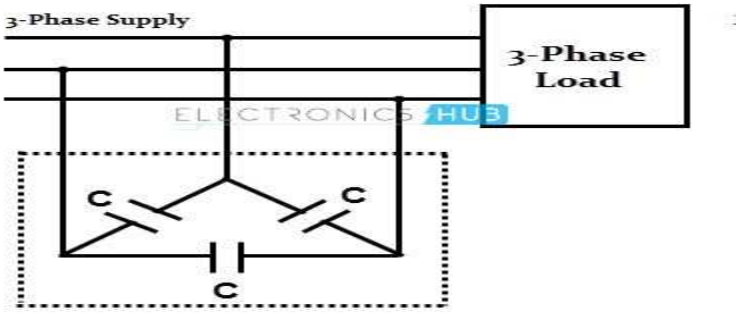


Figure 4.3: Connection of capacitor bank in feeder.

4.3 Control Room Activity

On 9-July-2018, I have spent one hour at SS-2 substations control room. Actually control room is very important in power system. This control room is open for 7 days and 24 hours. The basic operations of a control room are as follows:

- Communicates with other control rooms or grids.
- Communicates with line maintenance teams.
- Manage load shedding.
- Record data (Supply load, demand load, load shedding time).

Figure 4.4: The image of control room at SS-2 substation.

Control 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 and rearrangement 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 center

4.4 Incoming Panels or Lines

At SS-2 substation there are two incoming lines. These are as follows:

- 33KV incoming panel-1 (Kallyanpur Grid).
- 33KV incoming panel-2 (Mirpur Grid).

The equipment of 33KV incoming panels are trip circuit supervision relay-1, trip circuit Supervision relay-2, trip relay, bus isolator, ac alarm, dc alarm, on lamp, off lamp, line Isolator, earth isolator, dir. O/C and E/F relay, multifunction meter, KWH meter and also Indicator signal.

Figure 4.5: 33KV incoming panel-1 (Rampura Grid).

4.5 Relay Protection

At SS-2 substation's control room inside the 33KV incoming panel there are two trip circuit supervision relays, one trip relay, one bus isolator, one line isolator and one earth isolator which I have observed and acquired knowledge during my internship period. Trip circuit supervision relay-1 is the relay which supervises the trip circuit of the circuit breaker. It tests whether dc supply is under proper condition or not. It also provides alarm for loss of dc supply, faults in trip coil or cables, faults on the breaker auxiliary contacts and faults in the relay itself. Trip circuit supervision relay-2 is also used for same objective. Bus isolator is used to isolate the bus from incoming line due to the maintenance or service purposes of bus. Line isolator is used to isolate the Incoming line due to the maintenance or service purpose of substation.

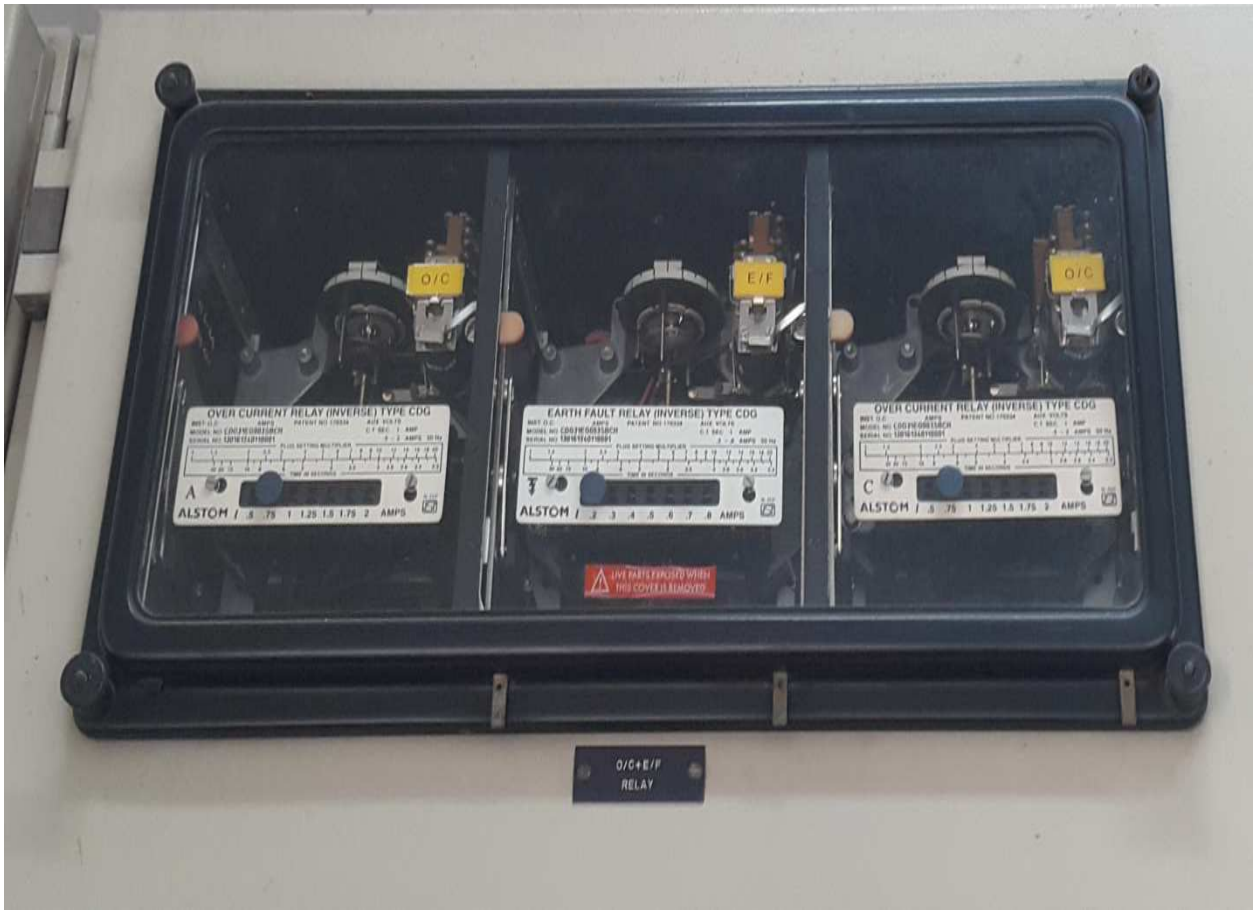


Figure 4.6: The image of relay circuit.

Figure 3.7: The image of trip circuit.

4.5 Circuit Breaker

A circuit breaker is a switching device which can open and close a circuit in a small fraction of second under normal as well as during fault condition. Basically, it is automatically operated by electrical switch which is designed to protect an electrical circuit form damage caused by overload or short circuit and its basic function is to detect a fault condition.

Types of Circuit Breaker:

- SF6 Gas circuit breaker.
- Vacuum circuit breaker.
- Air circuit breaker.

4.5.1 SF6 Gas Circuit Breakers

During my internship period at SS-2 substation, I have seen four sulphur hexafluoride (SF6) gas circuit breaker and acquired knowledge about these. A SF6 gas circuit breaker is a high voltage circuit breaker. Basically SF6 is an inert, heavy gas having good dielectric and arc extinguishing properties. It has high die-electric strength and outstanding arc quenching characteristics.

Figure 4.8: The image of SF6 Gas Circuit Breakers.

4.5.2 Vacuum circuit breaker

At SS-2 substation, I have observed two vacuum circuit breaker and acquired knowledge of them. Vacuum circuit breaker is a low voltage circuit breaker with rated current up to 3000A. These breakers interrupt the current by creating and extinguishing the arc in vacuum container. These are generally applied for voltages up to about 35000 V, which corresponds roughly to the medium-voltage range of power systems.

Figure 4.9: The image of vacuum Circuit Breakers.

CHAPTER 5

GRID-SUBSTATION & PROTECTION

5.1 Grid Substation Tour

For this part of internship, I went to two grid-substations and one distribution substation. The DESCO has no power plant. Therefore, they purchase power and transmitted from Power Development Board (PDB) via Power Grid Company of Bangladesh (PGCB) at different places of Dhaka city. Grid-substation is an interrelated network for delivering electricity from suppliers to consumers. A grid substation connects with the national grid. It takes 230 or 132 KV from the national grid and sends 33 KV to distribution substations. A distribution substation makes it 11KV and sends it to overhead and underground lines for domestic & commercial uses of electricity.

In this part of my internship I visited:

- Mirpur grid-substation (132KV/33KV/11KV).
- Rampura grid-substation (132KV/33KV)

5.1.1 Mirpur Grid Substation

On December 15, 2016 I went to the grid-substation where Assistant Engineer, Md. Abdus Salim, explained me about the basic definition and the working principal of grid-substation, single line diagram, general equipment and their operation. Actually super grid-substation voltage level is about 230/132/33KV, grid-substation voltage level is about 132/33/11KV, and substation voltage level is about 33/11KV.

At Mirpur grid-substation, there are two incoming sources from Uttra and Tongi grid. Actually single line diagram is the basic configuration to understand the basic operation of a grid substation. The Single Line Diagram (SLD) of Mirpur grid substation is given here

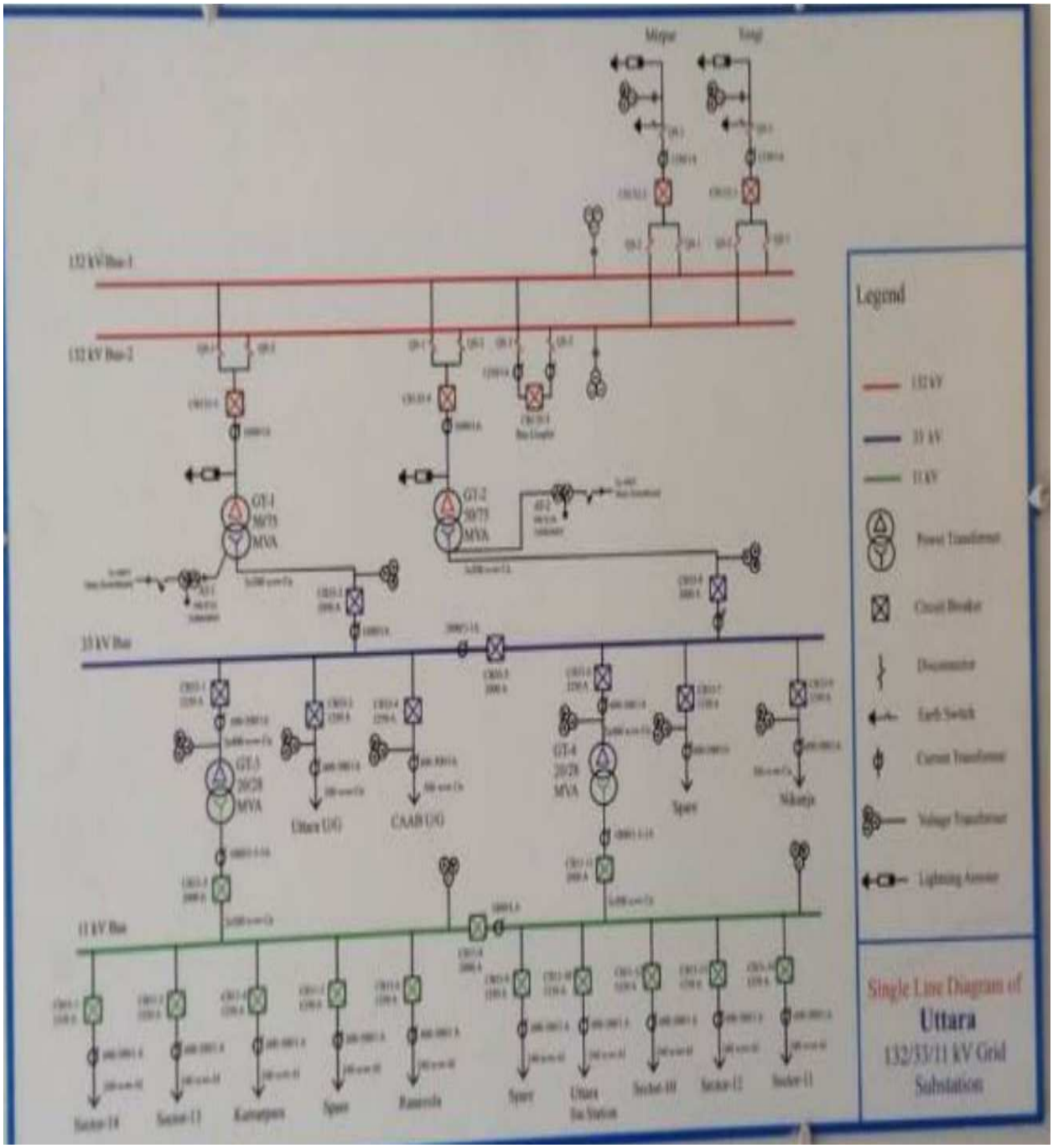


Figure 5.1: Single Line Diagram of Mirpur 132/33/11KV Grid-Substation.

In fig 5.1, it is shown that how 132KV incoming sources are connected to the Uttara gridsubstation and then how it transforms from 132KV to 33KV. Also 33KV transforms to 11KV. Initially 132KV incoming sources from Tongi grid and Uttra grid are connected to Mirpur gridsubstation via U/G or O/H line, then safety equipment L.A. (Lighting Arrester), potential transformer (PT), wave trap, earth switch, isolator, current transformer (CT), SF6 gas circuit breaker are connected to 132KV bus-1. Then 132KV bus coupler is used to run or to keep active both 132KV bus-1 and 132KV bus-2. Then again isolator, CB, CT, L.A. are connected between 33KV bus and grid-transformer-1 which transforms the voltages from 132KV to 33KV. Subsequently 33KV is also connected with 33KV bus via SF6 gas circuit breaker.

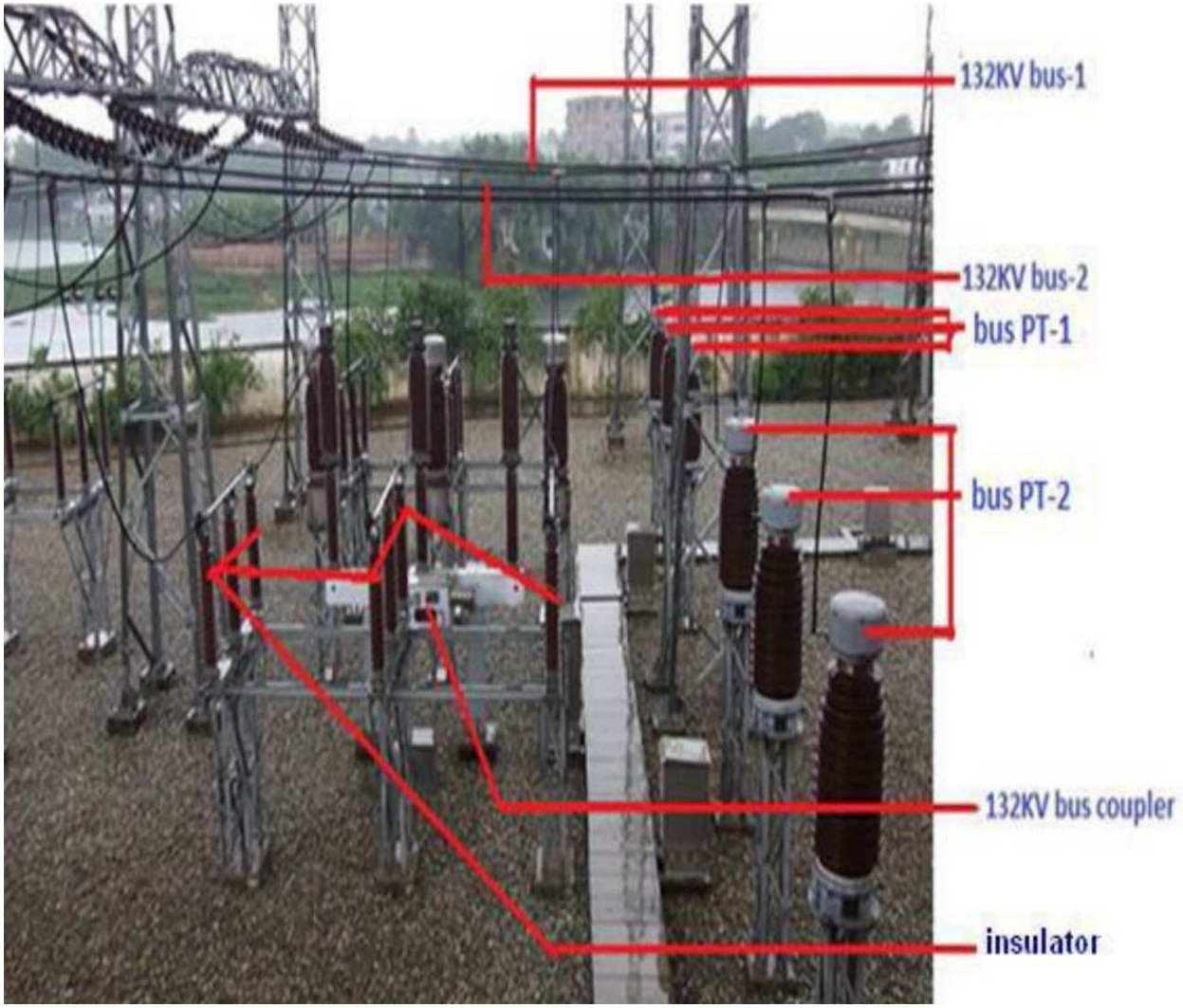


Figure 5.2: Mirpur grid-substation with bus-1, bus-2, isolator, PT and bus coupler.

Here also 33KV bus coupling is used to run both 33KV bus-1 and 33KV bus-2. Last of all VCB (Vacuum Circuit Breaker) is also connected to 33KV bus and then grid-transformer-3, which transforms the voltages from 33KV to 11 KV. Subsequently 11KV is also connected with 11KV bus via VCB and then active ten numbers of 11KV outgoing feeders are connected to different sectors of Mirpur.

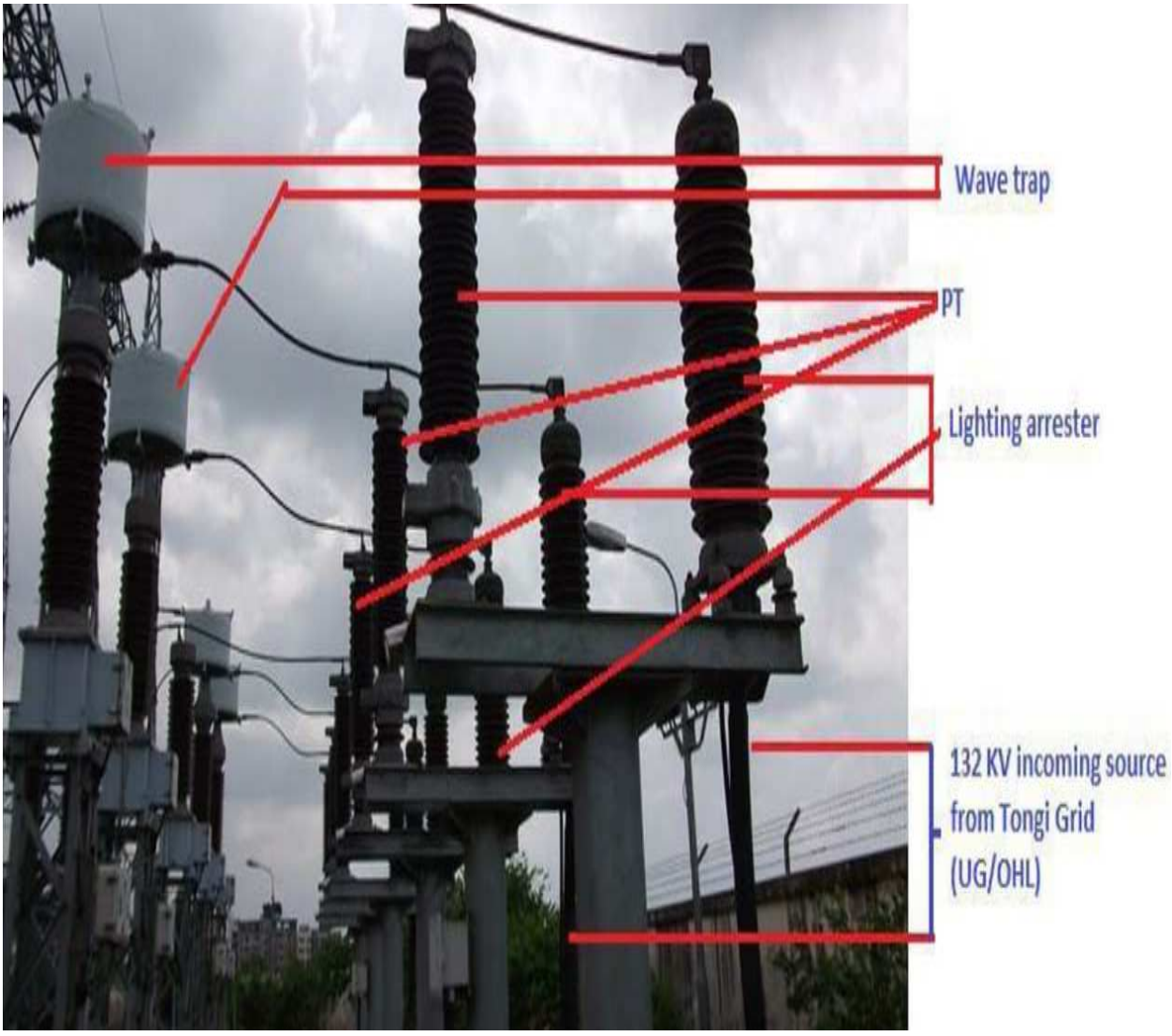


Figure 5.3: 132KV incoming source from Tongi grid, wave trap, PT and L.A.

5.1.2 Rampura Grid-Substation

At Rampura grid-substation, there are four incoming sources from Mirpur and Uttra grid. Two lines are from Mirpur grid and two lines from Uttara grid.

Initially 132KV incoming sources from Mirpur & Uttra grid are connected with Rampura grid via O/H line. , it is shown that incoming lines are connected with 132KV bus bar by LA, PT, wave trap, earth switch, CT, CB, isolator. 132KV bus coupler is used for coupling 132KV bus1 & bus2. Then Grid transformers are connected with 132KV bus by isolator, CB, CT, LA and 33KV bus by CT, PT, CB, earth switch. In this substation three 132/33KV power transformers are used. The capacity of each transformer is 50/75 MVA. 33KV bus coupler is also used for coupling 33KV bus1 & bus2. At last, eleven outgoing lines are connected with 33KV bus bar by earth switch, CB, CT.

5.2 Grid Protection Scheme

5.2.1 Protection Systems for transformer

The principal relays and systems used for transformer protection at DESCO‟s grid-substation are described below:

- Buchholz devices providing protection against all kind of incipient fault i.e. slow developing faults such as insulation failure of windings, core heating, fall of oil level due to leaky joints etc.
- Earth-fault relays providing against earth-faults only.
- Over current relays providing protection mainly phase-to-phase faults and overloading.
- Differential system (or circulating current system) providing protection against both earth and phase fault.

5.2.2 Circuit Breaker

A circuit breaker is a switching device which can open and close a circuit in a small fraction of second under normal as well as during fault condition. Basically, it is automatically operated by electrical switch which is designed to protect an electrical circuit form damage caused by overload or short circuit and its basic function is to detect a fault condition.

- **SF6 Gas Circuit Breakers**

During my internship period at Mirpur grid-substation, I have seen four sulphur hexafluoride (SF6) gas circuit breaker and acquired knowledge about these. A SF6 gas circuit breaker is a high voltage circuit breaker. Basically SF6 is an inert, heavy gas having good dielectric and arc extinguishing properties. It has high die-electric strength and outstanding arc quenching characteristics.

The followings are the advantages of SF6 gas circuit breaker:

- ✓ Due to the superior arc quenching property of SF6, such breakers have very short arcing time.
- ✓ Since the dielectric strength of SF6 gas is 2 to 3 times that of air, such breakers can interrupt large currents.
- ✓ The SF6 gas circuit breaker gives noiseless operation due to its closed circuit.
- ✓ There is no risk of fire in such breakers because SF6 as is non-inflammable.
- ✓ The SF6 breakers have low maintenance cost, light foundation requirements and minimum auxiliary equipment.

Figure 5.4: SF6 gas circuit breaker at Mirpur grid-substation.

- **Vacuum Circuit Breakers**

At Mirpur grid-substation, I have observed two vacuum circuit breaker and acquired knowledge of them. Vacuum circuit breaker is a low voltage circuit breaker with rated current up to 3000A. These breakers interrupt the current by creating and extinguishing the arc in vacuum container. These are generally applied for voltages up to about 35000 V, which corresponds roughly to the medium-voltage range of power systems.

5.2.3 Isolators

At Mirpur grid-substation, I have seen different types of isolators. These are line isolator, bus isolator, earth isolator, pin isolator and post isolator. Isolators are used to break the 3 phase power circuit under no load condition. These are (mostly in substation) installed before and after

the transformer maintenance purpose. Basically it is used to disconnect a component of electrical systems from the power source. Isolator switch is used to make sure that an electrical circuit can be completely de-energized for service or maintenance. It operates only on “no load” condition since there is no ability for arc extinguishing.

Figure 5.5: Line isolator at Mirpur grid-substation.

5.2.4 Current Transformers

At Mirpur grid-substation, I have observed twelve (12) current transformers (CT). These are connected in series with the bus bar. Current transformers (CT) are also used for reducing ac current from higher value to lower value for measurement, protection and control purpose. At Mirpur grid-substation the ratio of current transformer is (1600/800/1) Ampere.

Figure 5.6: Current transformer at Mirpur grid-substation.

5.2.5 Potential Transformers

At Mirpur grid-substation, I have observed twelve (12) potential transformers (PT). These are connected in parallel with the bus bar. Potential transformer or voltage transformer is used for reducing ac voltage from higher value to lower value for measurement, protection and control purpose. At Mirpur grid-substation the ratio of potential transformer is 132KV to 110V.

Figure 5.7: Potential transformer at Mirpur grid-substation.

5.2.6 Lighting Arresters

At Mirpur grid-substation, I have seen six (6) lighting arresters. Lighting arrester is a device used in grid-substation to protect the insulation of the grid-substation from the damaging effect of lighting. 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 lighting arrester, the current from the surge is diverted around the protected insulation in most cases to earth. Lighting arrester is installed on power poles and towers, power transformers, CB and bus structures in substation.

Figure 5.8: Lighting Arrester of GT-2 at Mirpur grid-substation.

CHAPTER 6

CALCULATION

6.1 Calculate the Suitable Capacitor Size in kVAR for Power factor Improvement

Suppose, we have a 3 Phase, 20kW Inductive load with P.F (Power factor) of 0.90 (lagging). Now we find size of Capacitor in kVAR is required to improve the P.F (Power Factor) to 0.95.

Given value,

Input P = 20 kW

Original P.F $\cos\theta 1 = 0.90$

Final P.F $\cos\theta_2 = 0.95$

Now,

Angle is, $\theta_1 = \cos^{-1}(0.90) = 25°.84$

$\theta_2 = \cos^{-1}(0.95) = 18°.19$

$\tan\theta_1 = \tan(25°.84) = 0.4842$

$\tan\theta_2 = \tan(18°.19) = 0.3286$

Required Capacitor kVAR to improve P.F from 0.90 to 0.95

We know,

Required Capacitor kVAR = P (Tan θ_1 – Tan θ_2)

= 20kW (0.4842 – 0.3286)

= **3.12 kVAR**

Rating of Capacitors connected in each Phase 3.12/3 = **1.04 kVAR**

6.2 Power factor Calculation

We know,

Power factor = |cos φ| = $\frac{\text{Real power(kw)}}{\text{apparent power(kva)}}$

Now,

Reactive power = $Q_{(kVAR)} = \sqrt{(|S(kVA)|^2 - P(kW)^2)}$

⇨ $Q(kVAR)^2 = (|S(kVA)|^2 - P(kW)^2)$

⇨ $|S(kVA)|^2 = Q(kVAR)^2 + P(kW)^2$

⇨ $S(kVA) = \sqrt{(Q(kVAR)^2 + P(kW)^2)}$

⇨ So, power factor = $\frac{P(kw)}{\sqrt{(Q(kVAR)^2 + P(kW)^2)}}$

Now, we calculate power factor at T-3 feeder.

Given value,

Real Energy = 6109956 KW

Reactive Energy = 3287700 KVAR

So, power factor = $\frac{\text{P(kw)}}{\sqrt{(\text{Q(kVAR)}^2 + \text{P(kW)}^2)}}$

$= \frac{6109956}{\sqrt{((3287700)2 + (6109956)2)}}$

= 0.88

P.F = |cos φ| = 0.88

6.3 Energy import/export statement of Badda S&D division

6.3.1 Monthly import Energy Statement

SL. No	Substation	Name of the feeders	Real Energy (KWHr)	Total Reactive Energy (KVARHr)	PF	Sub Total KWHr
01	Import from Baridhara	T-3	6109956	3287700	0.88	**18331056**
02		T-4	8178480	4007160	0.90	
03		T-5	4042620	1758960	0.92	
05	Import from Aftabnogor	SS-2 UG	6763500	1877400	0.96	**15389280**
		SS-2 UG	8625780	3006320	0.94	
	Total 33 KV Import Energy		**33720336**	**13937540**		

Table 6.1: Monthly Import Energy.

6.3.2 Average Real Energy of Baridhara Grid Substation

Average power = $\frac{(T-3)+(T-4)+(T-5)}{3}$

$= \frac{6109956+8178480+4042620}{3}$

= **6110352 KWHr**

6.3.3 Average Real Energy of Aftabnogor Grid Substation

Average power = $\frac{(SS-2\ UG)+(SS-2\ UG)}{2}$

$= \frac{(6763500)+(8625780)}{2}$

= **7694640 KWHr**

6.3.4 Average Reactive Energy of Baridhara Grid Substation

Average power = $\frac{(T-3)+(T-4)+(T-5)}{3}$

$= \frac{3287700+4007160+1758960}{3}$

= **3017940 KVARHr**

6.3.5 Average Reactive Energy of Aftabnogor Grid Substation

Average power = $\frac{(SS-2\ UG)+(SS-2\ UG)}{2}$

= $\frac{1877400+3006320}{2}$

= **2441860 KVARHr**

6.3.6 Average Power factor of Baribhara Grid Substation

Average power factor = $\frac{(T-3)+(T-4)+(T-5)}{3}$

= $\frac{0.88+0.90+0.92}{3}$

= **0.90**

6.3.7 Average Power factor of Aftabnogor Grid Substation

Average power factor = $\frac{(SS-2\ UG)+(SS-2\ UG)}{2}$

= $\frac{0.96+0.94}{2}$

= **0.95**

6.3.8 Average import Real Energy of Badda S&D division

Average power = $\frac{\text{Baridhara}+\textbf{Afabnagor}}{2}$

= $\frac{18331056+15389280}{2}$

= **16860168 KWHr**

6.3.9 Average import Reactive Energy of Badda S&D division

Average power = $\frac{\text{Baridhara+}\mathbf{Afabnagor}}{2}$

$= \frac{9053820+4883720}{2}$

= 6968770 **KVARHr**

6.3.10 Average import power factor of Badda S&D division

Average power factor = $\frac{\text{Baridhara+}\mathbf{Afabnagor}}{2}$

$= \frac{\mathbf{0.90+0.95}}{\mathbf{2}}$

= 0.93

6.4 Monthly Export Energy Statement

SL. No	Substation	Name of the feeders	Capacity (KWHr)	Maxim lode (KWHr)	PF	Sub Total PF
01	Baridhara Substation 33/11kv	Satar kul	400	300	0.97	0.90
02		GM bari	300	362	0.94	
03		Sadhinata sareni	400	265	0.99	
04		Adarsha nagar	300	232	0.95	
05	Aftabnagor Substation 33/11kv	Alatunn nnesa	300	205	0.98	
06		DITP				
07		Merul OH		249	0.97	
08		Krishi Bank	300	236	0.96	

09	Aftabnagor Substation 33/11kv	Anandangar	300	149	0.95	0.95
10		Aftabnagor	300	73	0.91	
11		East-west RUM	300	160	0.96	
12		BTV	300	61	0.96	
13		Wasa RMU	300	113	0.98	
14		Dawkandi	300	29	0.97	
15		Bazaar road	300	227	0.83	

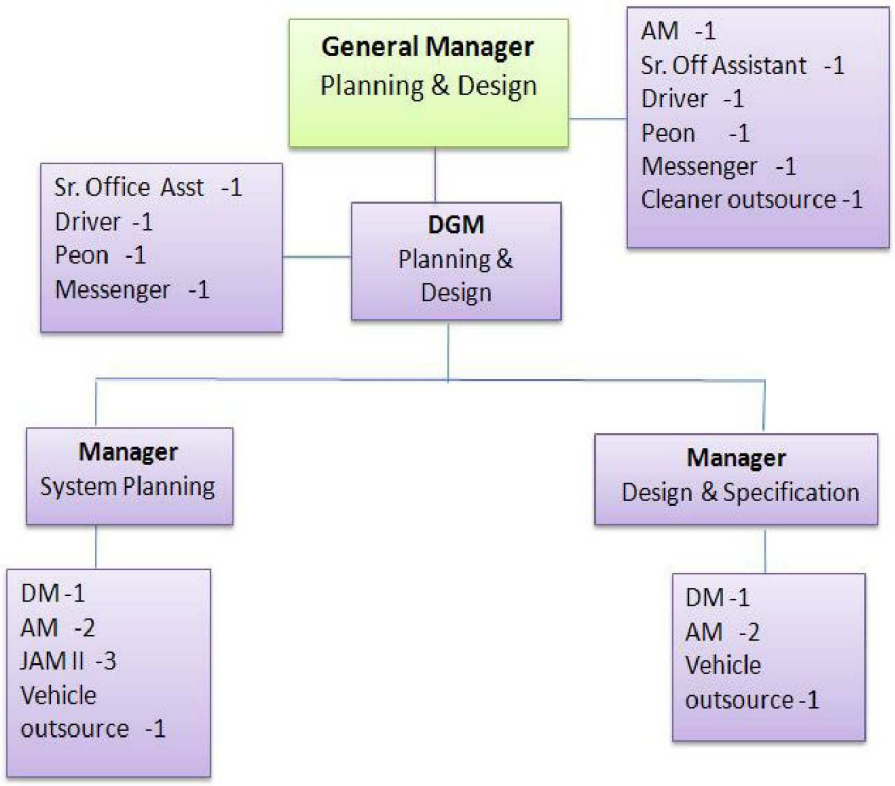
5.5 Total Calculation

Ratio Analysis	**Last month**
Import(kwh)	20743752
Sales(kwh)	18322964
System loss(%)	11.67
Billing Amount(Tk)	134849694
Collection Amount(Tk)	143913495
Bill Collection Ratio(%)	106072
CI Ratio(%)	94.27

CHAPTER 7

OTHERS OPERATION OF DESCO

7.1 Planning & Design Division



3	Post	No
1	GM	01
2	DGM	01
3	Manager	02
4	DM	02
5	AM	05
6	JAM-2	03
7	Sr. Office Asstt.	02
8	Driver	02
9	Peon	02
10	Messenger	02
11	Vehicle outsource-02	-
12	Cleaner outsource-01	-
	Total	22

Figure 7.1: Organogram of Design & Planning division (DESCO)

This division is responsible for planning new things and also for their design. We do not have any work at planning division but it is as important as other department. It includes a lot of investment as well as future electricity distribution process.

A partial organogram of planning & design division is given bellow

7.2 Testing & Repairing Division

DESCO‟s this division is located in Mirpur10. Here they check the meter and repair distribution transformer and also build new transformer.

7.2.1 Meter Testing & repairing

In this division each meter is checked for certain periods. Analog and Digital both meters are tested here. For analogue if for every hundred disc rotation if error is 2 to 3 then it may be acceptable. For digital meter this error rate may be maximum one. More the sampling fore is the accuracy. For digital meter this sampling is ranging from 2600 bit to 4000bit in every hour.

Meter was tested by pc by using definite software. As each meter record how many time it open, fault events, time date etc. If there is any fault the software diagnose it and report it. If there is any lose connection in meter then it can be manually repaired.

Figure 7.2: Prepaid Meter all parts.

Figure 7.3: Meter testing & repairing unit.

Figure 7.4: Meter testing board.

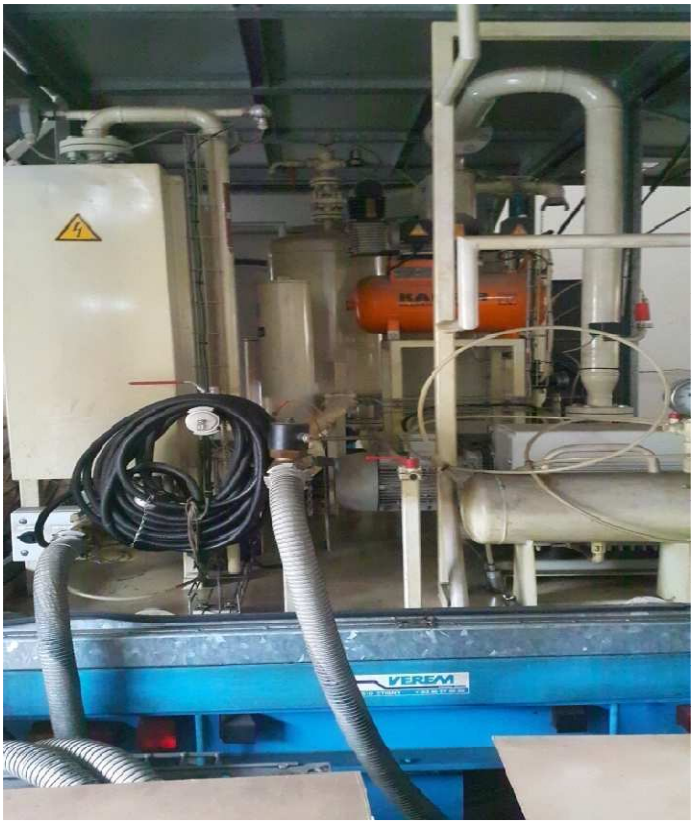
7.2.2 Transformer Testing & repairing

There is a transformer workshop of DESCO in Mirpur division. They repair distribution transformer here. They cannot repair power transformer here. They also made new transformer here. At first they make turn of primary and secondary winding. For a 200KV transformer 360 kg core is used and 280 liter oil is needed. After making the structure it was made dry by using heating process automatically or manually. Three phase and single phase, both transformers are made here.

(a) (b)

Figure 6.5: LT winding (a) and HT winding's (b) Paper coding turn is created here.

(a)



(b)

Figure 6.6: Transformer dried here (a) and then filled oil from here (transformer oil refining machine) (b).

Figure 7.7: Normal construction of a inside transformer.

7.3 Meter Plant Division

Although its name is meter plant division, it deals only with prepaid meter. New single phase & three phase prepaid meters are built and defective prepaid meters are tested & repaired here. DESCO inaugurated this prepaid metering system in September 7, 2005. At now 23,516 consumers use prepaid meter which is 3.25% of total consumer. The main components of a prepaid meter are-

- SMPS Circuit
- Main Circuit (RTC, Microcontroller, Buzzer, LCD monitor, Smart Card Reader)
- Energy Measurement Module (EMM)
- Current Transformer (CT)
- Latching Relay
- Backlight

All this components are jointed and then calibrated. After calibration meters are kept for load testing. Load test are done for 72 hours so that meter can operate at actual huge load.

7.3.1 Prepaid Meter

This division of DESCO located in Mirpur 1. Here prepaid meter is made and tested. Normally they taste 72 hour each meter so that when they go to field the wont get damaged. Different IC; s are used here. ATMALE microprocessor based software and PLC are also used here. Prepaid meter is latest meter in our country. Bill collection will be lot more easier for this technology. Tempering this meter is difficult because if anyone tries to open the meter it will raise alarm and will be off. So security is high here and it has all the basic function of previous meter. There are friendly hour opportunities in this meter so that if its credit got nil after 10pm then it won't shut down till next 10am, so user can refill their card easily. There is a calendar inside it so people can get holiday facilities also.

Figure 7.8: Prepaid Meter (a) outside view, (b) inside view.

Number of Prepaid Meter

year	phase	jan	feb	Mar	apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2009	1	179	269	488	175	140	50	11	37	33	29	23	53	1487
2009	3	137	58	15	9	15	9	2	8	16	27	13	19	328
2009	**TOTAL**	**316**	**327**	**503**	**184**	**155**	**59**	**13**	**45**	**49**	**56**	**36**	**72**	**1815**
2010	1	48	39	0	0	0	0	0	1	0	0	0	0	88
2010	3	17	16	2	0	0	0	0	1	0	0	0	0	36
2010	**TOTAL**	**65**	**55**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**124**
2011	1	0	9	4	0	0	2	9	83	45	165	40	75	432
2011	3	0	1	0	1	1	1	0	0	4	5	2	6	21
2011	**TOTAL**	**0**	**10**	**4**	**1**	**1**	**3**	**9**	**83**	**49**	**170**	**42**	**81**	**453**
2012	1	79	112	99	312	36	3	4	9	23	34	7	43	761
2012	3	2	4	4	67	3	0	2	3	6	5	1	5	102
2012	**TOTAL**	**81**	**116**	**103**	**379**	**39**	**3**	**6**	**12**	**29**	**39**	**8**	**48**	**863**
2013	1	251	209	160	457	409	379	366	176	135	24	84	51	2701
2013	3	19	13	12	81	40	51	40	6	4	3	4	18	291
2013	**TOTAL**	**270**	**222**	**172**	**538**	**449**	**430**	**406**	**182**	**139**	**27**	**88**	**69**	**2992**
2014	1	194	862	741	336	418	332	203	39	93	11	43	17	3289
2014	3	11	12	70	150	55	48	5	0	0	0	0	0	351
2014	**TOTAL**	**205**	**874**	**811**	**486**	**473**	**380**	**208**	**39**	**93**	**11**	**43**	**17**	**3640**
2015	1	17	43	17	140	841	3558	0	0	0	0	0	0	4616
2015	3	0	1	5	2	4	606	0	0	0	0	0	0	618
2015	**TOTAL**	**17**	**44**	**22**	**142**	**845**	**4164**	**0**	**0**	**0**	**0**	**0**	**0**	**5234**

No of Total 1 Phase Prepaid Meter from the year 2009 TO 2015=13374

No of Total 3 Phase Prepaid Meter from the year 2009 TO 2015=1747

No of Total Prepaid Meter from the year 2009 TO 2015=15121

Table 6.1: Prepaid meter list.

7.4 IT Division

Main responsibilities of IT division are,

1. Researching, consulting, analyzing, evaluating system program needs.
2. Database design, management, administration, performance tuning and backup.
3. Software design, development, testing & implementation and upgrading of existing software interface and platform to respond to the changing needs for all offices.
4. Development and maintenance of applications to integrate DESCO system with Mobile operators and Banks for the purpose of bill collection automation. Provide supports to these collection hubs.
5. Identifying technology limitations and deficiencies in existing systems and associated process, procedures and methods. Proceed to resolve these limitations.
6. Provide Database & Software related all support to all S&D and other offices.
7. Create, develop and manage content for DESCO‟s website & perform routine site maintenance as needed.
8. Routine audits of existing software.
9. Ensuring database security by implementing modern techniques.
10. Website secured by SSL to ensure debit/credit card transaction.
11. User Manual Development, Training & Deployment.
12. Yearly bill payment clearance certificate issue to consumers.

Another responsibility is,

1. Preparation and dispatch of reports on Monthly Operation Data (MOD) to the concerned authorities (DESCO, BERC, Ministry, Power cell, ADB) in prescribed formats.
2. Preparation and dispatch of reports on outstanding of Government, Semi Government/ Autonomous bodies and Private to the Power Cell and Ministry.
3. Preparation of effective and achievable Key Performance Indicators (KPI) based on historical and future planning data for the organization by taking detail review from management that will meet up with the target planning of Power Cell and continuous monitoring of S&D wise progress and feeding back the achievement report to the management.

4. To present analytical trends of tariff wise revenue earnings and rate of return during preparation of tariff increase proposal to BERC.
5. To answer and satisfy those queries of external auditors with explanation and analysis of reports and data those were prepared and presented by ICT.
6. Maintenance & reconciliation of online bill payment & online collection system through internet, mobile operator & various banks.
7. Database Audit of S&D's.

7.5 Summary

There is a transformer workshop of DESCO in Mirpur division. They repair distribution transformer here. They cannot repair power transformer here. They also made new transformer here. At first they make turn of primary and secondary winding. For a 200KV transformer 360 kg core is used and 280 liter oil is needed. After making the structure it was made dry by using heating process automatically or manually. Three phase and single phase, both transformers are made here. There are friendly hour opportunities in this meter so that if its credit got nil after 10pm then it won't shut down till next 10am, so user can refill their card easily.

CHAPTER 8

CONCLUAION

8.1 Discussion

We have spent some remarkable days at DESCO during our internship program. DESCO is one of the best practical grounds for the Electrical and Electronic Engineers in our country. We must say the theories that we have learned at our University was practically observed by us at DESCO. We consider ourselves very much lucky to have our internship program with a reputed electricity distribution company like DESCO. It gave us an opportunity to implement our theoretical knowledge in practically. Our achievements from DESCO are as follows:

- Industrial training provided by DESCO has enriched our practical knowledge.
- It has enlarged our thinking capacity about practical operations of the different equipment.
- It has increased our confidence level for facing job interview in future.
- DESCO gave us a unique experience of observing the equipment of substation

8.2 Conclusion

We are really grateful to DESCO because it gave us a great opportunity and privilege to complete our internship training appropriately. The all employee tries heart and soul to train us properly. They are friendly and have seen the every equipment to us very quietly. I have learned a lot and obtained practical knowledge during my internship at DESCO which will help me in future life.

REFERENCES

For Journal papers:

[1] R. E. Brown and S. Gupta and R.D. Christie and S.S. Venkata and R. Fletcher "Distribution System Reliability Assessment Using Hierachical Markow Modeling" IEE Transactions on Power Delivery, Vol.11,NO,4,October 1996.

[2] Pedram Jahangiri and Mahmud Fotuhi-Firuzabad "Reliability Assessment of Distribution System with Distributed Generation" IEEE PEC-08 December 1-3, 2008.

For proceedings papers:

[3] Photo taken by personal communication at DESCO.

[4] History and Divisional Data of Dhaka Electric Supply Company limited . "Goal of DESCO" Tutorial. Producing by Mr. Mamunor Rashid . Deputy General Manager(CC).HRM Divison.

For Books:

[5] A Text Book of "Electrical Technology" IN S.I.Units .Volume 2. AC&DC Machines. B.L.THEAJA ,A.K. THEAJA

[6] A Text Book of "Principles of Power System" V.K. MEHTA. ROHIT MEHTA.

For Web page:

[7] https://www.wikipedia.org

[8] http://www.desco.org.bd/

[9] Differential protection of transformer (differential relays), [Online].Available: http://www.electrical4u.com/differential-protection-of-transformer-differential-relays/.

[10] Directional sensitive earth fault, the electrical engineering section, [Online]. Available: http://www.cr4.globalspec.com/thread/77378/Directional-sensitive-Earth-Fault.

[11] Wise geek clear answer, Function of an over current relay, [Online]. Available: http://www.wisegeek.com/what-is-an-overcurrent-relay.htm.

[12] Function of a trip circuit supervision relay and its working principal, [Online]. Available: http://www.allinterview.com/showanswers/132221.html.

[13] Buchholz Relay Operation, [Online]. Available: http://electrical4u.com/buchholz-relay-in-transformer-buchholz-relay-operation/