Analysis of Distribution System of Dhaka Power Distribution Company Ltd. (DPDC)

An internship report submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

Submitted By
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DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
FACULTY OF ENGINEERING
DAFFODIL INTERNATIONAL UNIVERSITY
January 2020

LETTER OF TRANSMITTAL

20 November, 2019
A.H.M Mohiuddin
Superintending Engineer
NOCS Circle, Motijheel
DPDC Ltd

Sub: Submission of the Internship Report.

Dear Sir,

It is a great pleasure to submit our report prepared by us during our internship with Dhaka Power Distribution Company Limited.
The internship has provided us with a great opportunity to experience the real environment of life development, modern technology and technology. We hope it will play a positive role in the development of our future career. In this report, we tried to summarize what we had done and experienced during our internship with DPDC Limited.
We're really lucky to have a chance to participate in this internship program. We express our sincere gratitude and gratitude to our supervisor, Professor Dr. M. Shamsul Alam, Dean of the Faculty of Engineering at the EEE Department, for guiding us continuously towards the successful completion of the internship report. We would also like to convey our gratitude to Nazmus Saqib, Lecturer (Department of EEE), for his help, support and constant encouragement.

Thank You.
Yours sincerely,

Md. Rasel Rana
ID: 161-33-3107
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ID: 161-33-3150
Department of Electrical and Electronic Engineering,
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APPROVAL LETTER

Daffodil International University
A Concern of LANDMARK Higher Education

Faculty of Engineering
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7th July 2019

Managing Director
Dhaka Power Distribution Company Ltd.
Bidyut Bhaban,
1 Abdul Gani Road,
Dhaka-1000

Subject: Regarding field study for thesis purpose.

Dear Sir,
Please note that the following twelve (12) students of Electrical & Electronic Engineering department of Daffodil International University are willing to do a field study for their thesis purpose at your organization. The duration of the field study will be at least two months being effective from 1st September 2019.

Therefore, you are requested to permit them to avail the opportunity on several convenient dates.

Details of the students are as follows:

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Sincerely,

8/7/19

Md. Dara Abdus Satter
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Electrical and Electronic Engineering Department
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7-7-19

DECLARATION

The internship "Study of the distribution system of Dhaka Power Distribution Company Ltd. (DPDC)" was submitted by the following Name: Md. Rasel Rana, ID: 161-33-3107, Name: Md. Rashed Khan, ID: 161-33-3150, Session: Fall-2019 was approved as satisfactory for the partial fulfillment of the requirements of the Bachelor of Science degree in Electrical and Electronic Engineering on 2019.

BOARD OF EXAMINERS

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Department of EEE, DIU

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Professor

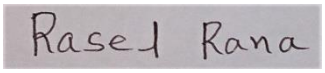
Department of EEE, DIU

Certification

I hereby declare that this report on "Analysis of Distribution System of Dhaka Power Distribution Company Ltd. (DPDC)" 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. This report does not breach any provision of copy right act.

I flintier undertake to indemnify the university against any loss or damage arising from breach of the forgoing obligation.

Signature of the candidates



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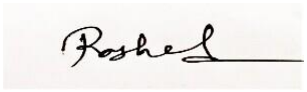
Md. Rasel Rana
ID: 161-33-3107



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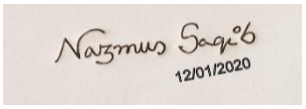
Md. Rashed Khan
ID: 161-33-3150

Countersigned



Nazmus Saqib
Lecturer
Department of Electrical and Electronic Engineering
Faculty of Engineering
Daffodil International University

Dedicated to

Our Parents

INTERNSHIP PROGRAM SCHEDULE

Date	Sub-Station	Address
08.09.2019 10.09.2019 12.09.2019	Bangovaban 132/11 KV Substation	148, Motijheel C/A, Dhaka-1000.
16.09.2019 19.09.2019 22.09.2019	Motijheel 33/11 KV Substation	148, Motijheel C/A, Dhaka-1000.
25.09.2019 29.09.2019 02.10.2019	Madertake 132/33/11 KV Substation	Mugdapara, Dhaka
06.10.2019 10.10.2019 13.10.2019 17.10.2019	Shyampur 132/33 KV Grid-Substation	Jurain,Shyampur, Dhaka
22.10.2019 29.10.2019 02.11.2019 06.11.2019	Moghbazar 132/33/11 KV Grid-Substation	Hatirjheel,Moghbazar, Dhaka

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LIST OF ABBREVIATIONS

DPDC	Dhaka Power Distribution Company Ltd.
GOB	Government of Bangladesh
PDB	Power Development Board
AIS	Air insulated Switchgear
GIS	Gas insulated Switchgear
SCADA	Supervisory control and data acquisition
BC	Bus Coupler
LA	Lightening Arresters
WT	Wave Trap
CT	Current Transformer
PT	Potential Transformer/Voltage Transformer
AT	Auxiliary Transformer
CB	Circuit Breaker
VCB	Vacuum Circuit Breaker
SF6	Sulphur Hexafluoride Gas
OLTC	On Load Tap Changer
MVA	Mega Volt Amper
KVA	Kilo Volt Amper
CSM	Customer Service management
OPSC	One Point Service Center

ACKNOWLEDGEMENT

First of all, we give thanks to Allah. It is a great intention for authors to express their unfettered gratification, sincere appreciation and a great honor to our respective Co-supervisor Nazmus Saqib, Lecturer, Department of Electrical & Electronic Engineering, Daffodil International University, for his constructive suggestion, scholastic guidance, constant inspiration, valuable advices and kind cooperation for the successful completion of work on **"Analysis of Distribution System of Dhaka Power Distribution Company Ltd. (DPDC)".** This could not be possible without his help.

Space does not allow us to mention each person by name, but we are deeply grateful to everyone associated with this field study, project and thesis. We also wish to complement all our respective concern teachers & staffs of our department of their direct and indirect assistance at different times.

Thanks to all

EXECUTIVE SUMMARY

The study summaries the work performed in the study "**Analysis of Distribution System of Dhaka Power Distribution Company Ltd. (DPDC)".** Dhaka Power Distribution Company Ltd. (DPDC) is responsible for distribution. Thus, are using equipment Transformer, circuit breaker, Lightening arrestor, current transformer, potential transformer, Auxiliary transformer, relay, isolator, fuse etc.

We also acquired a clear understanding of the different distribution system equipment. The study work assigned to us was to design a 132/33kv substation and a 33/11kv substation. We considered the incoming power at 132kv and the power transferred to the main bus through the isolator-circuit breaker-isolator combination. Power from the main bus was fed into a 20/28MVA transformer, which lowered the voltage to 33kv. The power is then fed to two busses of 33kv, from which different loads have been tapped.

We have learned a great deal in our internship at DPDC and have acquired practical knowledge to help us in future.

The study will then be submitted to our mentor for verification.

CHAPTER 1

INTRODUCTION

1.1 Internship Program

The word "internship" means the position of a student or trainee working in an organization in order to gain work experience or to satisfy the requirements of a qualification. The internship gives us the opportunity to apply the theoretical skills that we have learned at the university and to test their applications. The main task is to understand the working environment and to prepare an internship report that enables graduates to demonstrate their skills in the field of engineering efficiently. For an engineer, internship is just as important as his theoretical studies. We were doing our internship at DPDC Ltd.

In this internship, we were able to get a complete picture of the company and how it works according to different demands by going to different substations at DPDC Ltd.

1.2 Rationale of the Study

- To gain simple job-oriented expertise.
- To learn to take responsibilities on the ground in the work areas of DPDC Ltd.
- To become part of successful projects that will continue to have an impact later in life in the fields of ELECTRICAL & ELECTRONIC ENGINEERING.
- Comparing classroom concepts to real-life situations in order to apply the theoretical lessons learned at Daffodil International University to realistic fields.

1.3 Objective of the Study

To make a thorough analysis of how the Power Distribution System works and Advance Technologies can help us meet our demand for electricity. These are as follows:

- Substation Study.

- Identify various types of substation working apparatus.
- Learning the possible solution to the different problems.

1.4 Methodology

The study was compiled from both primary and secondary data sources.

- Primary Source: Primary data was collected through face-to-face conversations with employees and the documents provided by them.
- Secondary Source: Secondary data was collected from the different Divisions of DPDC Annual Reports and the DPDC website. Books of different authors and online sources are useful for writing the subject of the study.

1.5 Structure of Power Sector

Bangladesh with its 160 million people in a land mass of 1,47,570 sq.km. has shown unprecedented growth in recent years. Booming economic growth, rapid urbanization and increased industrialization and production have raised demand for electricity in the region. Currently, 62% of the total population (including renewable energy) has access to electricity and 321 kWh per capital generation, which is very low compared to other developing countries

Power Division is responsible for formulating power policy and for overseeing, controlling and monitoring development activities in the power sector of the country. To order to fulfill its role, the Power Division is assisted by a number of organizations linked to generation, transmission and distribution. [1, 2] The organization linkage is as follows:

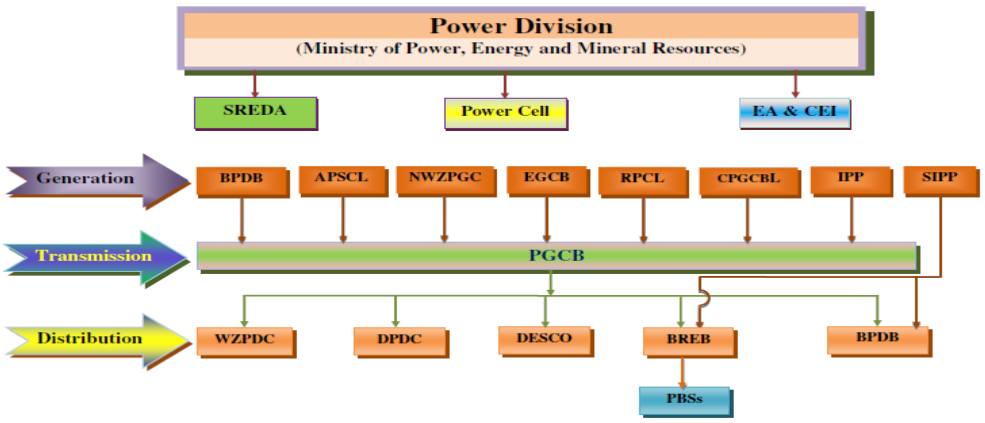

Figure 1.1: Power Sector Structure

1.6 Dhaka Power Distribution Company Limited (DPDC)

Electricity plays a vital role in a country's developing economy in many respects. Dhaka Power Distribution Company Limited (DPDC) is Bangladesh's largest power distribution company. Dhaka Power Distribution Company Limited (DPDC) was incorporated into the Power Sector Development and Reform Program of the Government of Bangladesh (GOB) on 25th October 2005 under the Company Act 1994 with an authorized share capital of Tk. 10,000 (ten thousand) crore divided into 100 (one hundred) crore ordinary shares of Tk One hundred each.

The corporation was given leave to start business from 25th October 2005 with a certification of commencement of operation.

DPDC started operating from 14th May 2007 and later 1st July 2008 took over the supply management system from then DESA along with all the assets and liabilities of DESA.

A management team is responsible for the product. The Chief Executive Officer of the company is the Managing Director. [3,5]

1.7 Corporate Motto of DPDC

The corporate motto is the "**Dependable Power — Delighted customer**".

1.8 Vision of DPDC

Provide the Dhaka City and Narayangonj area with high quality, reliable electricity for the country's desired economic, social and human development.

1.9 Mission of DPDC

- To deliver high-quality electricity with excellence in service.
- To make electricity available on request within the geographical area of the DPDC.
- To ensure the customer's satisfaction.
- Develop a new way of thinking for all employees, consistent with corporate culture.
- To achieve self-sufficiency and profitability by increasing revenue and cutting expenditure.

1.10 Commitment of DPDC

- The quickest response needs to be given to consumers.
- Our initiatives are designed to meet the changing needs of consumers.
- Distribution and Customer Support System Digitization.
- Quality power supply for all consumers.

1.11 Core Objectives

- For customers: to make the power supply for customers reliable and uninterrupted.
- The company's financial sustainability applies to owner and shareholders.
- For society: promotion of social values and social responsibility of businesses.
- For the country: make every effort to achieve domestic growth and economic prosperity.

1.12 Profile of DPDC

Table 1.1: Administrative [3,5]

SL.NO.	Particular	Description
01	Name of the Company	Dhaka Power Distribution Company Limited
02	Registered Office	Bidyut Bhaban, 1 Abdul Ghani Road, Dhaka-1000
03	Head Office	Bidyut Bhaban, 1 Abdul Ghani Road, Dhaka-1000
04	Incorporation	25 October, 2005
05	Commercial Operation	1 July, 2008
06	Authorized Capital	Tk. 10,000 crore.
07	Human Resources (as per setup)	5734
08	Human Resources (existing)	5361 (on November 28, 2019)

09	Employees (Own)	3615 (on November 28, 2019)
10	Employees (Outsourced)	1746 (on November 28, 2019)
11	Administrative Ministry	Power Division, Ministry of Power, Energy & Mineral Resources.
12	Managing Director	Engineer Bikash Dewan

Table 1.2: Operational Commercial (FY 2017-2018) [3,5]

SL.NO.	Description	Quantity
01	Number of customers	12,98,125 (on August, 2019)
02	Payment to National exchequer	7670.92 MTk.
03	Total area covered	350 sq. km.
04	Total transmission and distribution line	5,371 km.
05	132 KV Transmission Line	228 km.
06	33 KV Transmission Line	390 km.
07	0.4 KV 11 KV 11/0.4 KV Line	4753 km.
08	Total number of substations	58 Nos.
09	Total 11/0.4 KV Distribution Transformer	18986
10	Capacity at 33/11 KV Level	2644 MVA
11	Max. Demand (07-06-2018)	1479.40 MW
12	Import of Energy (FY 2017-2018)	8819 Million Kw/h
13	Sales of Energy (FY 2017-2018)	8165 Million Kw/h
14	Sales Revenue (FY 2017-2018)	62023 MTk
15	Distribution System Loss (Import Level)	7.41%
16	Annual Load growth	8.8%
17	Annual customer growth	6%
18	Load Factor	82.8%
19	System Loss (2015-2016)	8.67%
20	Install Capacity	1456 MW/1820 MWA

1.13 Organogram

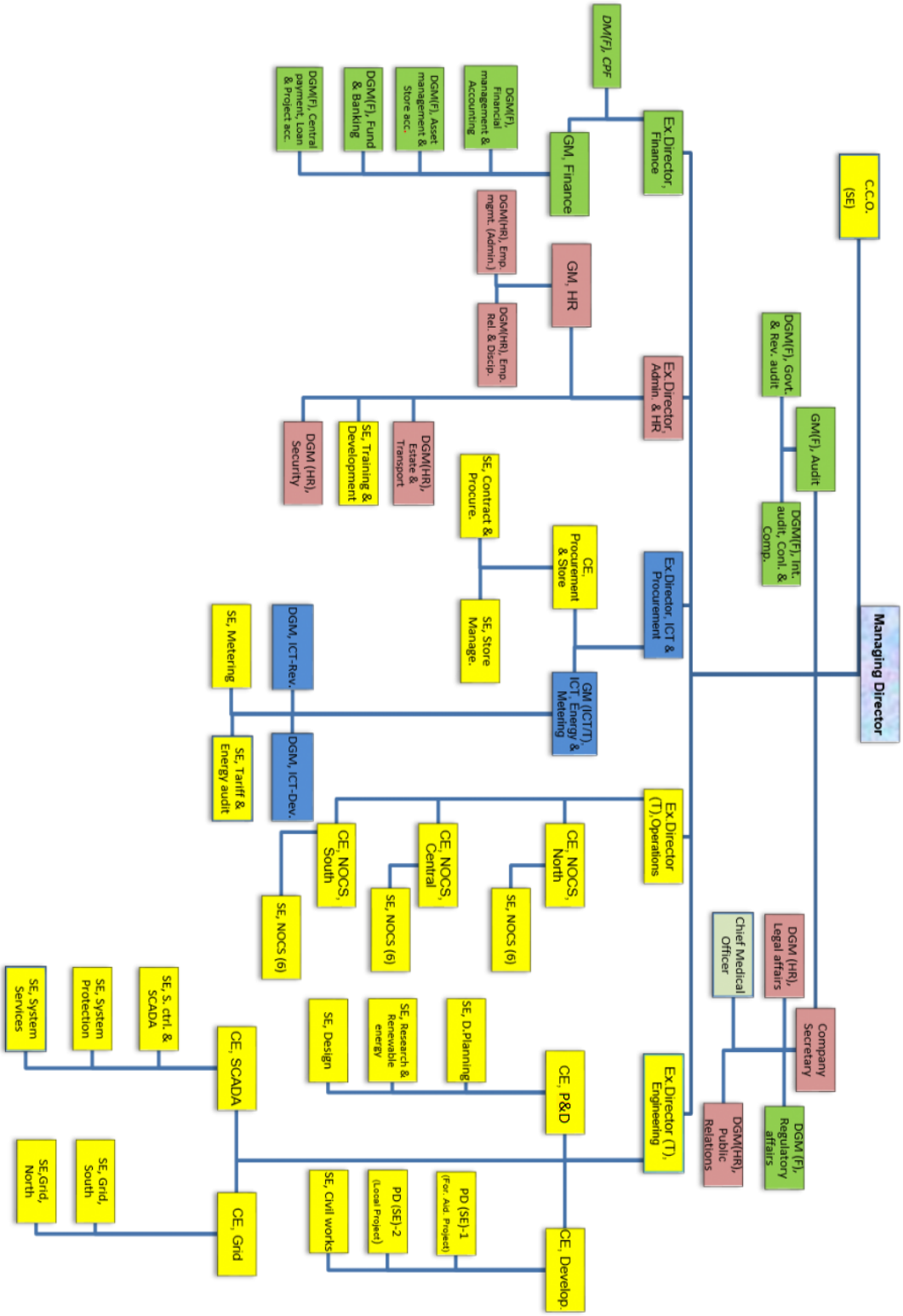

Figure 1.2: Organogram

1.14 DPDC Switchgear System

There are two types of Switchgear in DPDC. This are-

1. Air insulated Switchgear (AIS)
2. Gas insulated Switchgear (GIS)

1.14.1 Air insulated Switchgear (AIS)

AIS or air-insulated substation is ideal for substation sites where land storage is sufficient and there are no risks such as noise, human dangers.

In the case of an air insulation substation, a switching system such as circuit breaker insulation, CT, VT, a surge absorber is mounted in an air space-only at an arc quenching medium. Here are several bus configurations illustrated with a picture-single bus arrangement, double bus-double breaker arrangement, key and transfer bus arrangement, double bus-single breaker arrangement. Ring bus arrangement, breaker and a half arrangement. [14]

1.14.2 Gas insulated Switchgear (GIS)

Gas-insulated Switchgear (GIS) uses the superior dielectric gas, SF6, at moderate pressure for phase to phase and phase to ground insulation. High voltage conductors, circuit breakers, switches, current transformers and voltage transformers are constructed of SF6 gas within ground steel enclosures. Atmospheric as padding used in traditional applications. Air-insulated Switchgear needs meters of air insulation to do what SF6 can do in centimeters. Thus, Gas-insulated switchgear can be up to a factor of 10 smaller than the air insulated switchgear. Gas insulated switchgear is usually applied where space is or is not expensive. The active components are protected from deterioration by atmospheric air, moisture, in Gas insulated switchgear Pollution etc. The Gas insulated switchgear is therefore more dependable and needs less maintenance compared to the Air insulated Switchgear.

Gas insulated switchgear was first produced between 1968 and 1972 in different countries. After 5 years of experience. The utilization rate has increased to about 20% of new substations in countries where space is limited. In other countries with readily available space, the higher cost of gas-insulated switchgear compared to Air insulated switchgear has limited use of special cases. [14]

1.15 System Loss

System loss is the primary performance indicator for any power distribution company. The indicator must be at a minimum level. It is one of the key performance indicators of any electricity distribution company and is determined by the amount of energy purchased and sold. The system loss was 9.18% at 132 KV and 8.67% at 33 KV during the 2015-2016 fiscal year, compared with 9.41% at 132 KV and 8.91 per cent at 33 KV in the 2014-2015 fiscal year. [3,5]

Year wise system loss (%) trend at 33 kV Level is shown below:

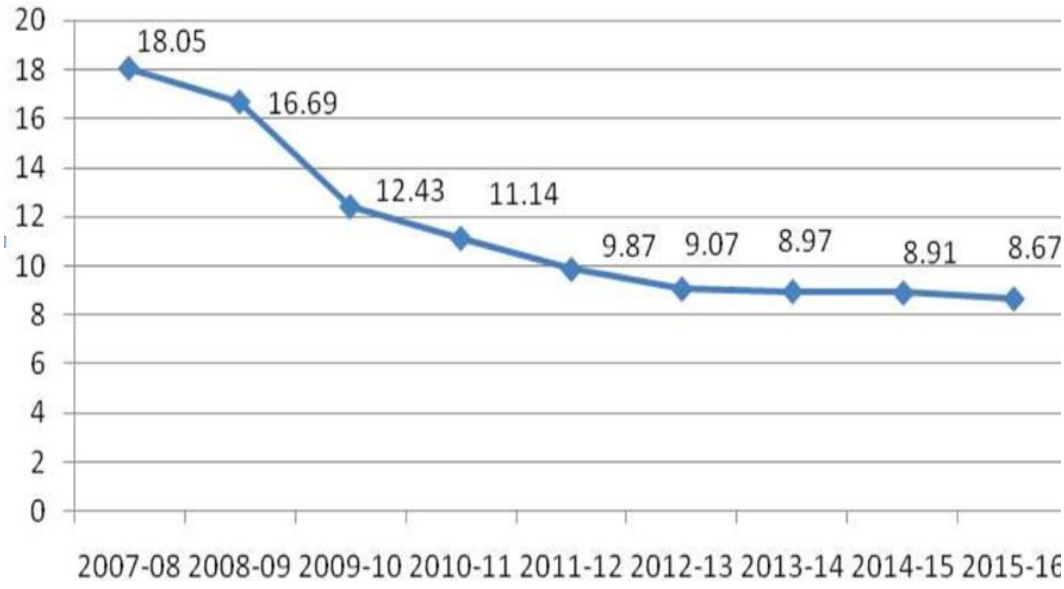

Figure 1.3: System Loss

CHAPTER 2

OVERVIEW OF POWER SYSTEM

An electric power system can be divided into three components:

- Generation System
- Transmission System
- Distribution System

2.1 Generation System

Electricity generated by electromechanical generators is created mostly by power plants, mainly driven by heat turbines and fuel through combustion or nuclear fission, but also by other methods, such as moving water and wind kinetic energy. Solar photovoltaic and geothermal resources are other sources of energy.

Power generation by gas in Bangladesh is usually produced. In Bangladesh, electricity generation usually takes place primarily by gas (88.39%) and electric power is provided by 11 kV. Natural gas is a major power source through gas turbines and steam turbines. [1]

2.2 Transmission System

Normally, the construction of electric grids and electricity transmission is mostly related to an electric transmission. Alternating current is generally favored, as the transformer may quickly raise the voltage to reduce robust loads on the conductors that transfer power over long distances.

Electric transfer typically is achieved with overhead lines, as this is the most cost-effective approach.

For crowded urban environments with high voltage direct current underground transmission submarine cables are used. [2]

2.3 Distribution System

The distribution systems provide electrical energy. The energy supply is the final step of the electricity supply, transmitting electricity from the electrical transmission system to individual consumers. Sub-stations connect to the transmission system and rising transmission voltage through medium voltage transformers. This medium-voltage control is distributed to the customer's premises through the main distribution lines. Bright, industrial machinery or home equipment may reduce the voltage of the transformer output again. In consumers with much larger power, the simple delivery level or the sub-transmission level can be directly connected. [10]

2.4 Important Terms of Power System

The power system is a network consisting of a system of generation, distribution and transmission. This takes the energy source and converts it into electrical energy. The power system comprises system-connected devices such as substations, transformer, switchgear, circuit breaker, bus-bars & bus coupler, lighting arrester, isolator, wave trap, current transformer (CT), voltage transformer (PT), auxiliary transformer, DC power supply, earth switch, control and relay panel and are the main power system components. [7,8]

2.4.1 Substation

A substation for power generation, transmission and distribution is part of the system. Substations convert high to low, or other essential features to the opposite voltage. The power stations will move between the power plant and the customer at various voltage levels. A substation may be a source of electricity, or a major industrial or commercial customer. Normally, substations are not monitored and SCADA is responsible for remote monitoring and control.

A substation may include transformers for adjusting voltage rates between high and lower voltages of transmission for connecting two separate transmission voltages. The word substation was used in the days before the distribution system was turned into a grid. As the central generating facilities grew larger, smaller generators were turned into distribution stations and generated electricity from a larger facility instead of their

own generators. The first substations were connected to only one generator station and the branches of this power plant. [9]

2.4.2 Transformer

A transformer is a system that converts electrical energy by electromagnetic induction between two or more circuits. Electromagnetic induction generates an electromotive force across a driver subjected to different magnetic fields over time. Transformers are typically used in applications with electrical power to increase or decrease the alternating current voltages. [13]

Figure 2.1: Transformer

2.4.3 Switchgear

It is a general term for a wide range of switching and protection equipment. The term switchgear applies to all devices associated with the fault clearing process. Switchgear includes switches, fuses, circuit breakers, insulators, relays, control panels, lightning arrestors, CT, PT and various related equipment. Control gear is used for switching and controlling power consuming equipment. [15]

2.4.4 Circuit Breaker

A circuit breaker is an electrical device that is automatically controlled to protect an electrical circuit from damage caused by over current / overload or short circuit. The basic function is to interrupt current flow following the detection of faults condition by Protective relays. Unlike a fuse that works once and then has to be replaced, a circuit breaker can be reset to resume normal service (either manually or automatically). Circuit breakers are manufactured in different sizes, ranging from

small devices to protect an individual household appliance to large switchgear designed to protect high voltage circuits that feed a whole community. [11,12,14]

Figure 2.2: Circuit Breaker

2.4.5 Bus-Bars & Bus Coupler

Bus-bar is a term that is used for a bar or driver that holds an electric current to which many are connected. Busses are essentially convenient ways to connect switches and other devices to different arrangements. The normal contact structure in most substations allows almost all equipment input or output feeders to be worked continuously. Busses are open to the air at the substation. The electric energy is conveyed by aluminum or copper conductors on porcelain isolators.

Bus Coupler is used to connect to the dual bus system. Bus coupler consists of a bus insulator, a circuit breaker, an earth switch. By using a bus coupler, either one or two busses can be operated at a time and each load can be shared. [14]

2.4.6 Lightening Arresters

The substation equipment is installed outside, such as conductors, transformers etc. When there are light surges, these electro-components are transmitted by a high-voltage device which causes them damage (both temporary and permanent damage due to the voltage increase). Therefore, lightening arresters are put to move the whole lightning on to earth to prevent this trouble.

Other stoppers are used to soil switching spikes called surge arresters. [14]

Figure 2.3: Lightening Arresters

2.4.7 Isolator

The insulator transfer is used to ensure that the electric connection for operation or repair is fully de-energized.

Such switches are frequently found in electrical and industrial systems, where machinery may extract the moving energy source for modification or repair. [14]

Figure 2.4: Isolator

2.4.8 Wave Trap

Wave trap is an instrument used to trip the wave. The function of this trap is to trap unwanted waves. Its function is to trap the wave. Its shape is just like a drum. It is

connected to the main incoming feeder so that it can trap waves that could be hazardous to the instruments in the substation. [14]

Figure 2.5: Wave Trap

2.4.9 Current Transformer (CT)

An instrument transformer in which the secondary current is substantially proportional to the primary current and differs in phase from that of approximately zero is referred to as a current transformer. [14]

Figure 2.6: Current Transformer

2.4.10 Voltage Transformer (PT)

Voltage transformers, also known as potential transformers, are just like normal transformers with a primary winding directly connected to a high voltage point and with one or more secondary windings rated at a standard voltage to provide a secondary voltage for protection and measurement. [13,14]

Figure 2.7: Voltage Transformer

2.4.11 Auxiliary transformer

Auxiliary transformer is used to supply low voltage in the substation for AC power system such as lighting, air conditioners and other AC supply system and DC power system such as relays, batteries and other DC supply system. Auxiliary transformer capacity 33/ 0.415kV, 500KVA. [13,14]

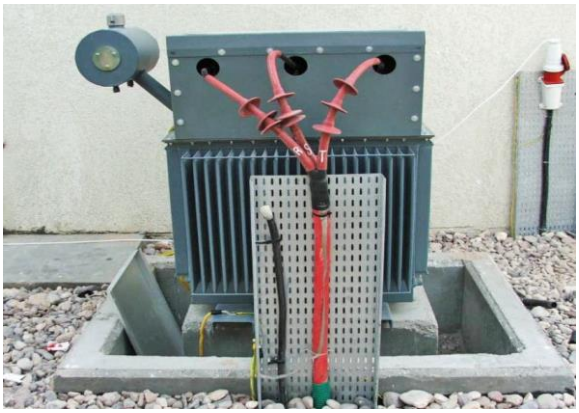

Figure 2.8: Auxiliary transformer

2.4.12 DC Power Supply

DC power supply is heart of a substation. DC power provides for the provision of essential services including breaker trip coils and relays, data acquisition and supervisory (SCADA) and communication systems. DC Power is used to provide core services. [14]

Figure 2.9: DC Power Supply

2.4.13 Earth Switch

Earth switch is also classification as a land connection system used to align the machinery with a conductor grid electrically controlled on the ground on the station's premises. It is intended to protect people employed at grounding sites. It does this by pursuing a circuit track and thus increasing the voltage difference between the system and its setting. It is important that soil disconnections and all contact are well-touched and immune for safety purposes. The protection board must not be damaged accidentally. Thus, all Planet transitions, removals and disconnections are linked and sequenced correctly. [14]

Figure 2.10: Earth Switch

2.4.14 Control and Relay Panel

The control and relay panel are cubic for the floor mounting. For easy operation and control all safe, indicating and controlling elements are mounted on the front panel. The hinged rear door will allow all internal elements to be easily inspected and maintained.

Connections CT, PT aux 230 AC and 110V/48V DC at specified terminal points are approved for the control and relay panel.

The 110V/48V DC supply is used in the control of all internal relays and timekeepers and also in the energizing of breaker closing and tripping spindles. [14]

CHAPTER 3

OPERATION, MAINTENANCE & PROTECTION OF GRID SUBSTATION

3.1 Grid-Substation

Grid-substation is an inter-connected network for delivering electricity from suppliers to consumers. The DPDC has no power station. Therefore, they procure power transmitted to different places in Dhaka City from the Power Development Board (PDB).

A sub-station converts the voltages by using power transformers from high to low. A substation with a step-down transformer reduces voltage while rising electricity current for domestic and industrial use. We visited Shyampur grid-substation, during our internship. [9]

Figure 3.1: Shyampur Grid-Substation

3.2 Shyampur Grid-Substation

Four incoming Haripur and Hasnabad power sources are accessible at the grid substation in Shyampur. Haripur grid consists of two lines, while Hasnabad grid consists of two lines. Shyampur grid substation's Single Line Diagram (SLD).

Shyampur was initially connected to sources of 132KV from Hasnabad and Haripur Grid by the O / H line. Input lines are also connected by the LA, PT, wave trap, Earth switch, CT, CB and isolator, using 132KV bus bars, 132KV bus coupler for 132KV bus 1 & bus 2 coupling.

Then the grid transformers are connected by CT, PT, CB, and Earth Switch to a 132KV isolator bus and 33KVbus. Three power transformers are used in this substation, 132/33KV. Each transformer's power is 50/75 MVA. In coupling 33 KV bus1 & bus2 is also used.

3.3 General Equipment

There is various equipment such as-

- Power transformer
- Switchgear
- Circuit breaker (Air blast, Vacuum CB, SF6 CB)
- Instrument transformer (CT & PT)
- Isolator
- Earth switch
- Wave trap
- Lightening arrester
- Auxiliary transformer
- Bus bar (main bus bar and reserve bus bar)
- Bus Coupler
- Battery and battery charger
- Control relay panel
- AC distribution panels
- DC distribution panels
- Voltage regulator.

3.4 Transformer at DPDC

During our internship at the Motijheel substation (33/11KV), we acquired knowledge of the transformer. In fact, a transformer is a system that converts electricity without changing frequency, from one circuit to another. Transformer electrical power is generated by electromagnetic induction between winding and circuits. According to windings scale, the voltage and current values are changed with constant frequency from primary (source) to secondary (load).

We observed a power transformer at DPDC that converts power from 132 KV to 33 KV, 132 KV to 11 KV and from 33KV to 11 kV where PGCB supplies 132 KV. Many power transformers are manufactured and operated by Energy Pack. [5,11,12]

Figure 3.2: Transformer

3.5 Transformer Specification

Different types of transformers are available. At DPDC, transformers imported from India prefer oil-based transformers. They supply transformers at a lower cost than companies in Bangladesh.

So, this sector has been completely captured by India.

The principal reason for using oil-based transformers is availability and competition with other forms of transformers with a reasonable price. [5]

3.6 Transformer Component

There are so many transformer components such as:

- Winding
- Main tank
- Conservator tank
- Breathing system
- Cooling system
- Transformer oil
- Oil level indicator meter
- On load tape changer
- Silica gel
- Insulator
- Radiator
- Oil temperature meter
- Winding temperature meter
- Buchholz relay
- Pressure relief device

3.6.1 Winding

The primary winding is 33KV and the following one is 11KV. This is because the primary winding is bound to the delta and the secondary winding is connected by y (wye). The acid source is referred to as primary recirculation. A secondary rewinding is the load from the source. The transformer is made of a strong iron core or a core of silicon steel.

Two windings, main winding and secondary winding are connected to it as well. The windings are each other isolated. Depending on the application, the material used for the, but in each case each turn must be electrically isolated to ensure that turns of the current are flowing. [13]

3.6.2 Main Tank

The primary winding and secondary winding tank are such a type of protective feature. To one side of the main tank is the end of the primary winding. And on the

other side of the main tank is the starting edge of the secondary winding associated. Full of oil is the main tank. And oil is used to protect the main tank from the waves. [13]

3.6.3 Conservator Tank

Windings (both primary and secondary) produce heat when the oil is stretched due to transformer internal loss or if load decreases. This can contribute to an increasing oil output. And oil volume can be extended via a buchholz relay from main tank to preserving tank. In reality, the tank is designed to expand as an oil expansion reservoir during service. [13]

3.6.4 Buchholz Relay

A protective feature for transformers is the Buchholz relay. In the central position are the transformer tank and the tank. Where the gas is formed by a minor failure in the main tank, the oil volume increases and the Buchholz relay in the storage tank can be reached. The signal is sent to the control room on 1st when petroleum moving is very fast 26. If the fault is serious, it will be a transformer. [13]

3.6.5 Cooling Equipment

Cooling equipment including radiator extracts the hot oil from the top of the main tank and brings cooled oil down on the main tank side. [13]

3.6.6 Winding Temperature and Oil Temperature Indicators

Temperature winding indicator (meter) shows the correct winding temperature (normal winding temperature location 75 ° C). The Oil Temperature Indicator (meter) shows the right oil temperature (the normal oil temperature location is 65 ° C). [13]

3.6.7 On Load tap Changer

Changing the load tap is a device which is typically used when the primary wind is interrupted or the main winding is not influenced by the real voltages. The main torque in is 33KV and secondary torque is 11KV. When the load tap changer reduces 33KV from 28kV to 33kV, the load tap adjustment is decreased. [13]

3.6.7 Transformer Oil

Transformer oil is used to separate the transformer tanks from the central transport mechanism and winding it to keep the transformer cold. It gives the coils a strong dielectric strength and a center immersed into them. It makes the transformer more economical. [13]

3.6.9 Breathing System

Transformer breathing system is controlled by the silica gel system. It is used for the absorption of moisture. During the injection of oil into the transformer tank, some air may enter or exit the conservator tank, depending on the expansion and extraction of the oil from the main tank and the silica gel used to absorb the moisture from that air. [13]

3.6.10 Pressure relief device

A flashover or short circuit in a liquid-filled transformer is usually accompanied by an overpressure in the tank due to gas formed by the decomposition and evaporation of the oil. The pressure relief device limits the overpressure of the tank and reduces the risk of rupture of the tank and uncontrolled oil spills, which could also cause fire. The valve disk has a low mass and the closing springs have a low spring rate to allow for a quick and wide opening. The valve closes again, once the overpressure has been released. [13]

3.6.11 Silica gel

Silica gel is used to regulate the moisture level and prevent it from reaching the equipment in breathing transformers. These are especially useful to protect the transformer oil from harmful moisture effects. [13]

3.7 Losses in Transformer

During our internship at the Shyampur grid-substation, we have acquired knowledge of the losses of the transformer. These are as follows:

Iron Losses: in actual iron cores, in the case of lamination, some heat is still produced by eddy currents.

Copper Losses: In actual practice, the transformer coils have some resistance. So, part of the energy is lost because of the heat produced by the resistance of the coils.

Hysteresis Losses: The alternating current in the coils repeatedly absorbs the iron core through the complete magnetization cycle. So, the energy is lost because of hysteresis.

3.8 Protection Systems for transformer

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

- Buchholz devices that protect against any initial defects i.e. slow development of defects such as insulating windings, core heating, oil rates decreasing due to leaky joints etc.
- Earth-fault relays toward earth-faults only.
- Current relays providing protection, primarily phase-to-phase faults and overloading.
- Differential system (or current circulating system) for earth and phase fault safety. [13]

3.9 Circuit Breaker

A circuit breaker is a switching device that can open and close the circuit in a small fraction of a second under normal and fault conditions. Essentially, it is automatically operated by an electrical switch designed to protect the electrical circuit from overload or short circuit damage and its basic function is to detect a fault condition. [9]

3.9.1 SF6 Gas Circuit Breakers

Throughout our internship at the Madertake grid-substation, We saw four Sulphur hexafluoride (SF6) gas circuit breakers and acquired knowledge of them. A gas circuit breaker of SF6 is a high voltage circuit breaker. SF6 is basically an inert, hard gas that has strong dielectric and arc-extinguishing properties. It has high die-electric power and excellent arc-quenching characteristics. The following are the benefits of SF6 gas circuit breaker:

- Due to SF6's superior arc-quenching abilities, these breakers have a very limited arcing duration.
- Since the dielectric strength of the SF6 gas is 2 to 3 times that of the surface, large currents can be disrupted by such breakers.
- The SF6 gas circuit breaker has a noiseless function owing to its closed circuit.
- SF6 breakers have low maintenance rates, strong base specifications and limited auxiliary facilities.

3.9.2 Vacuum Circuit Breakers

We observed two vacuum circuit breakers at Madertake grid substation and acquired knowledge of them. Vacuum circuit breaker is a low-voltage circuit breaker with up to 3000A level current. Such breakers disrupt the current in the vacuum container by generating and extinguishing the arc. These are commonly used for voltages up to 35000 V, which roughly refers to the medium-voltage spectrum of power systems.

3.10 Isolators

We have seen different types of isolators at Shyampur grid substation. These are line isolator, bus isolator, terrestrial isolator, pin isolator and post isolator. Under no load condition, isolators are used to split the 3-phase power circuit. These are installed (mostly in substation) before and after the intention of maintenance of the transformer. In essence, it is used to isolate an electrical system component from the power source. The isolator switch is used to ensure that an electrical circuit for operation or repair can be fully de-energized. It works only on the basis of "no load," as there is no arc extinguishing capability. [14]

3.11 Current Transformers

Current transformers were observed at Shyampur grid substation (CT). These are connected to the bus bar in order. In order to reduce ac current for calculation, safety and control purposes, current transformers (CT) are used as well from higher value to lower value. The ratio of the new transformer is (1600/800/1) ampere at Shyampur substation. [13,14]

3.12 Potential Transformers

Potential transformers (PT) were found at Shyampur substation. They are linked to the bus bar in parallel. For calculation, safety, and control purposes, the possible transformer or voltage transformer is utilized to decrease the ac voltage from higher to below value. The transformer ratio is 132KV to 110V at the Shyampur grid substation. The Lighting Arrester is a grid substation system used to secure the separation from the damaging effect of lighting from the grid substation. A high voltage terminal and a land terminal are also used to be a common lightning arrester classified as a spike arrester. When the torch or the moving pulse travels through the power system into the light arrester, the current from the surge is in the majority of cases redirected to earth around the covered isolation.

3.13 Battery and Battery Charger

Battery is at the heart of the Substation. Battery is a storage facility. In order to ensure protection, it is necessary to back up the supply of DC. Battery supplies 110V DC voltage to the control and protection circuit if the ac fails or the charger fails. For protection, control and signaling, dc voltage is required in a substation. The battery charger adjusts the 400V ac to 110V dc and supplies the dc voltage to the control panels for this purpose as well as to charge the batteries. [14]

3.14 Transformer Maintenances:

Transformer maintenances at Shyampur grid-substation are given below:

- General cleaning or washing of the transformers.
- Check the insulation resistance between the winding and the ground.
- Check the OLTC control system and driving mechanism.
- Change OLTC oil (OLTC means On Load Tap Changer).
- Check the strength of the low terminal and high terminal.
- Check oil temperature and winding temperature meter performance.

CHAPTER 4

SUBSTATION VISITED

4.1 Moghbazar 132/33/11 KV Grid Substation

The substation of Moghbazar is a 132/33/11 KV substation. The substation has a two-stage transformation system, converting the 132 KV voltages obtained to 33 KV and supplying it to some customers. It also converts the 33 KV to 11 KV for its users with lower voltage. This is the whole method of the open yard. The station receives electricity from Rampura on two circuits. The power is fed to two parallel buses, a main bus and a backup bus that stays energized but does not take power from it. It is used during repairs on the main bus or when the fault occurs.

The bus has a capacity of 1250 A. The bus power is supplied to three 50/75 MVA transformers with 132/33 KV voltage ratio and 12.5 % impedance. The power from the transformers is fed to three 33 KV feeders, which have a total of 16 feeders. Tejgaon-1,2,3, Lalmatia-1,2, Green road-1,2, Moghbazar T&T-1,2, Kawran bazar and Local transformer TR-1,2,3,4, Bus PT-1,2 as known as 33Kv feeder

Four of which are for the 33/11 KV transformers, an extra one for the prospect of an extra transformer, and the rest for the consumer. The 33/11 KV transformers are rated as 20/28 MVA. The power of these transformers is fed to three busses which are interconnected for power distribution.

The combined bus has a total of 28 feeders. Doctor goli, T&T, Achor Ice, Aambagan, Tejgaon S/S 1&2, Modhubag, Banglamotor, Mogbazar nearest, MP suit, Konipara, Iskaton, Garden, Ispahani, BGMEA, Noyatola, BSRS, OLD building, TCB, Pollibhaban 1 &2, Sangsad, Holiday Inn, Spare, Sonargaon, Tejturi bazar, New building, Channel 24 as known as 11Kv feeder.

4.2 Motijheel Substation

Motijheel's substation is a substation of 33/11 KV. There are two outlets at the Motijheel substation. The substation in Motijheel provides access to two incoming

Maniknagar circuit-1(GT-1) and Maniknagar circuit-2 (GT-2) power sources. The transformers of 33/11 KV are rated as 20/28 MVA.

There are a total of 15 feeders in the combined bus. Spare-5, PDB Design (Spare), Spare-4, Agrani Bank, Nikotborti, Arambagan, IFIC bank, NCC Bank, Spare-3, Spare-2, Spare-1, Mohamedan Club, Box Culvert, Station Road. Fakirapul Water Tank as known as 11KV feeder

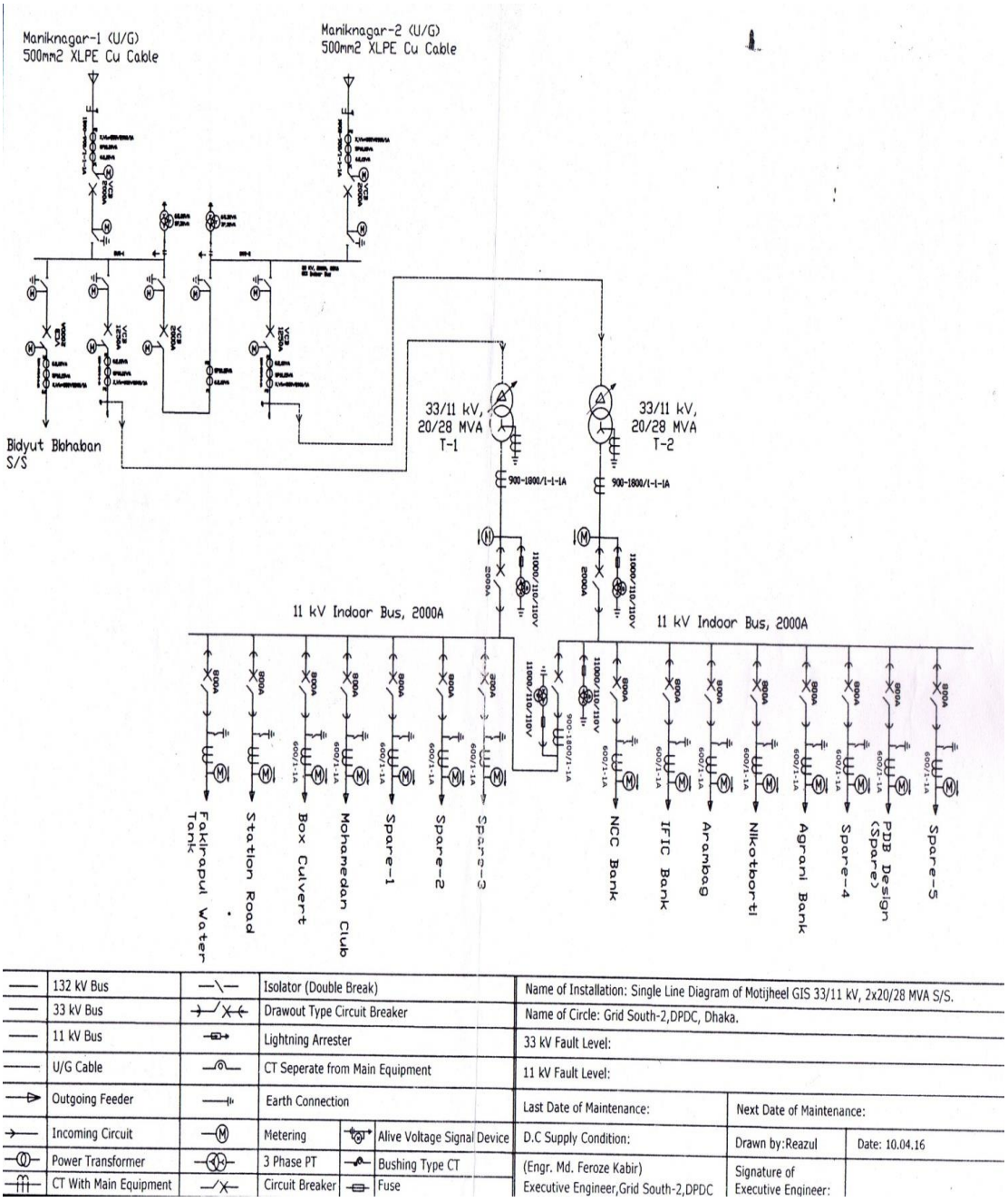

Figure 4.1: Motijheel 33/11 KV Substation

4.3 Madertake is a 132/33/11 KV Substation

The substation of Madertake is a 132/33/11 KV substation. Madertake is a step-down 132/33/11KV Substation. It has two incoming sources from Maniknagar circuit-1(GT-1) and Maniknagar circuit-2(GT-2) at 33kv and delivers transformed power by 15 feeders at 11kv range. Sobujbag, Madartek, Rajarbag, Goran, DokkhinKhilgaon, Manda, Town, Bisshoroad, Mugdapara, Singapore road, Mayakanon, Ahmedbag, WASA road, Nandipara, Thihomony as known as 11kv feeder.

It is equipped with two 20/28MVA transformers and has two buses that are coupled by a bus coupler.

Figure 4.2: Madertake is a 132/33/11 KV substation

4.4 Bangovaban Substation

At DPDC, we observed a power transformer converting power from 132 KV to 33 KV, 132 KV to 11 KV and 33KV to 11 kV. Bangovaban's substation is a substation of 132/11 KV. There are two outlets at the Bangovaban substation. The substation in Bangovaban provides access to two incoming Maniknagar circuit-1(GT-1) and Maniknagar circuit-2 (GT-2) power sources. The transformers of 132/11 KV are rated as 28/35 MVA. There are a total of 20 feeders in the combined bus. BCIC,

Senakaylan, DIT S/S RMU, Janata Bank, Sonali Bank, Bangabhanban Hospital zone RMU, PDB Design, Wapda Building RMU, Station Road, Bangabhaban staff Quarter, Navana, Arambagan, Food & Sugar, Madhumita via Avisar, Bangabandhu Avenue SS, P&T S/S, Bangladesh Bank, Saidabad Water Treatment Plant, BB DIT Gate RMU, DIT S/S -1 as known as 11kv feeder.

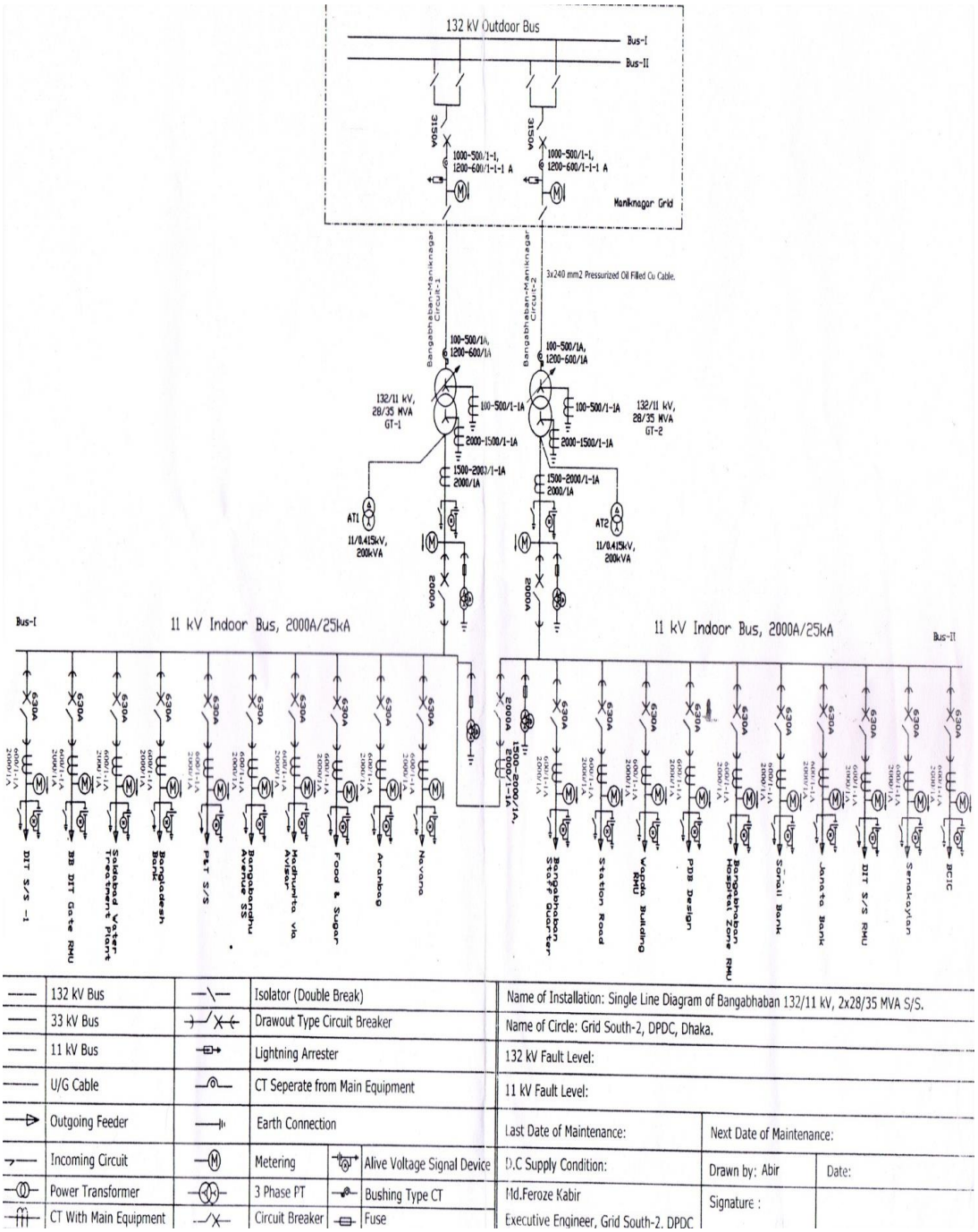

Figure 4.3: Bangovaban 132/11 KV Substation

CHAPTER 5

OPERATION & MANAGEMENT

5.1. Commercial Operation

Commercial operation is the main function of DPDC. The major commercial operations are-

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

5.2 System Operation

Important issues are solved by operating the system. This section builds and manages all O / H & U / G lines under DPDC. It's the tasks-

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

5.3 Revenue Management:

- Centralized billing system
- Online application for new connection
- Payment automation
- Meter reading collection through mobile
- Prepaid Metering System

5.4 Customer Service Management:

- Contact Centre/Complaint Management System
- Interactive website
- Customer Service Application
- SMS and E-mail Management System

5.5 Disconnection/Reconnection

Disconnection is the primary restore tool. Disconnection takes place as follows:

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

5.6 Metering

The meter is considered the company's cash box, and DPDC has left no stone unturned to regularly check meters. Optional metering practices are –

- Meters repair
- The removal of the circuit breaker before the meter is set up
- Meter check and meter monitoring

5.7 One Point Service Center

Customer satisfaction is the key to the success of any company. Customers are the primary focus of DPDC. "One Point Service Center" has been set up to ensure satisfactory customer service. Its activities are -

- Customer service in one place
- Accepting new applications for connections
- Listening to the customer's complaint

5.8 Billing/ Collection

The primary objective of maintaining the financial power of the company is achieved through constant efforts to maintain a strong billing / collection ratio.

- Bill's issue and the decentralized collection.
- Bill's preparation has staggered over a month.
- Bill's correction. [3,5]

5.9 Control Room Activity

Basically, in the power system, control room is very important A control room's main function is as follows:

- Communicates with other control rooms or grids
- Communicates with line management teams
- Manage load shedding
- Record data (load, load demand, shedding time) [3,5]

5.10 ICT Division

- Research, consulting, analyzing, evaluating the needs of the system program.
- Design, development, testing & execution and updating of the existing software interface and platform to meet changing office requirements
- Developing and maintaining software for DPDC system integration with mobile operators and banks in the automation of bill collection.
- Consumers are given regular bill payment approval certificates.
- User Manual Development, Training & Deployment.
- Creating, developing and managing DPDC website content and performing routine site maintenance as required.
- Provide Database & Software related all support services to other offices. [3,5]

5.11 New Services

DPDC has established a decentralized Customer Service Center with each sales and distribution division.

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

5.12 Commercial/Operational Performance

The following are the main commercial operations worked out by the DPDC during the FY 2014-2015: [3]

Description of Items	Financial Year		Increase %	Decrease %	Remarks
	2013-2014	2014-2015			
New Connections	62,253	71,848	15.41%		Nos
Disconnections	48,061	46,861		-2.50%	Nos
Reconnections	24,875	21,820		-12.28%	Nos
Mother Meter Installed	9,206	9,508	3.28%		Nos
Child Meter Installed	63,941	60,041		-6.10%	Nos
Customer Complain Attended	54,512	44,101		-19.10%	Nos
Service provided through One Stop Service Center	43,398	43,244		-0.29%	Nos

Table 5.1: Commercial/Operational Performance

CHAPTER 6
CONCLUSIONS & DISCUSSION

6.1 Conclusion

Distribution stations operate throughout a power system at different scales. These generally represent an interface between different levels or power system parts with the ability to switch or reconfigure the connections between different transmission and distribution lines. The major stations include a control room from which to manage operations.

Smaller substations follow the same concept of receiving higher voltage power on one site and sending out a number of lower voltage distribution feeders on the other, but they serve a more limited local area and are usually unstaffed.

The central component of the substation is the transformer, which provides an effective interface between the high-and low-voltage parts of the system. Other key components are circuit breakers and switches. Breakers act as protective devices that automatically open when a fault occurs, that is, when a protective relay displays excessive current due to some irregular condition. Switches are control devices that can be intentionally opened or closed to establish or break a connection. An important difference between circuit breakers and switches is that the breakers are designed to interrupt abnormally high currents (as they occur only in situations where circuit protection is required), while the regular arc switches are designed to operate under normal currents. Breakers are placed on both the high-and low-voltage sides of the transformers.

Finally, substations may also include condenser banks to provide voltage support.

6.2 Limitations of the Work

We have already gathered information on the operational activities of the DPDC. But it was really hard to gather the entire knowledge about everything within the short period of time. We could not get enough images and sufficient access to every place

because of some privacy problem. It was a difficult task to review and gather information about three of our preferred substations due to mechanical failure. At that time it was not possible for me to know about the grid coolers because of the frequently maintained Mogbazar 33/11KV sub-stations. I couldn't observe the Madartake (local) 33/11KV Sub-station single bus bar due to some technical problem.

6.3 Recommendation

Our internship is small, but the proper use of the qualified and educated human resources will help to maximize its use. Therefore DPDC must make machine losses more careful so that they can reach acceptable levels of loss

6.4 Discussion

Dhaka Power Distribution Company Ltd. (DPDC) is responsible for the distribution. The Transformer, Circuit Breaker, Lightening Stopper, Current Transformer, Potential Transformer, Auxiliary Transformer, Relay, Isolator, Fuse etc. are thus used. We also acquired a clear understanding of the different distribution system equipment.

Throughout our internship program we spent several amazing days at DPDC. DPDC is one of the best practical reasons for electrical and electronic engineers in our region. We have to assume that the ideas that we studied at our university were basically tested by us at DPDC.

We are very fortunate to have our internship program with a well-known electricity distribution company like DPDC. It has provided us an opportunity to put our theoretical knowledge into action.

6.5 Our achievements from DPDC

Our achievements from DPDC are as follows:

- The Industrial Training provided by DPDC has enhanced our practical knowledge.
- Our achievements by the DPDC are as follows.
- To expand our ability of reflection on the practical activities of the various equipment.
- It has increased our confidence in future work interview.

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