OPERATION & MAINTENANCE OF 33/11 KV SUBSTATION
OF
DHAKA PALLI BIDYUT SAMITY-1

A thesis submitted in partial fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering

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DECLARATION

We hereby declare that, this thesis**Operation& Maintenance**titled**of 33/11**" **KV Substation of Dhaka Palli Bidyut Samity-1**"has been done by us under the supervision of **Dr. M. Samsul Alam, Professor & Dean, Department of Electronics and Electronic Engineering**, Daffodil International University. We also declare that neither this thesis nor any part of this thesis has been submitted elsewhere for award of any degree or diploma.

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We would like to express our boundless honor and respect to our thesis Supervisor Professor **Dr. M. Samsul Alam,** Professor & Dean, Department of Electronics and Electronic Engineering, Daffodil International University for his encouragement and for giving our permission to involve with electronics related thesis. We have done my thesis according to his direction.

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I thank all staffs of my departments for their help during working period.

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Finally, we beg pardon for our unintentional errors and omission if any.

ABSTRACT

As technology is advancing the consumptions of power is steadily rising. There are three steps for proper electrification these are:-

1.1 Electric Power generation.

1.2 Electric Power Transmission. iii) Electric Power Distribution.

This three are equally important for proper electrification, without any one of this three the electricity system will be incomplete. Power Grid Company ltd is the BPDB (Bangladesh Power Development Board) wound company which is the only authorized company for the Electric Power Transmission sector in Bangladesh. Rural Electrification Board (REB) has many sub- stations all over the country which are connected through the distribution line, these stations are called sub-station. This project paper provides the synopsis assessment of all the systems existing 33/11KV Dhaka Palli Bidyut Samity-1,Savar.

Rural Electrification Board (REB) has the vast electricity distribution network all over the country & the electric power plants are connected with the transmission line to assure the continuity of electric power. The electric power plants produce power & feed in to the transmission line. All power plants are connected parallel with the transmission and distribution line. Dhaka Palli Bidyut Samity-1,Savar. has AIS (Air Insulated Switchgear) switchyard.

Every sub-station is controlled by some experienced manpower, including one in charge,2/3 engineers, 4/5 technical staffs. All kinds of maintenance work of the sub-station done by them in addition, sub-station operation work done by the engineers. Every year annual maintenance work is done in every sub-station in according to the official schedule. This thesis report is prepared in according to the operation and maintenance procedure of 33/11KV Sub-Station, including emergency maintenance work.

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1.1 Introduction

Electricity is the power that driving the whole world. Now a day we cannot think even a moment without electricity. Without electricity the civilization will go back to the thousands of epoch. In every step of our modern life we are totally dependable on electricity. This electric power comes to us by overcoming three steps, these are –

- Generation.
- Transmission.
- Distribution.

In our country Bangladesh Power Development Board (BPDB) is the mother organization in electric power sector. BPDB regulate all company in electric power sector. There are some companies in electric power generation and distribution sector but in transmission sector Power Grid Company of Bangladesh Ltd (PGCB) is the only company in Bangladesh and Rural Electrification Board (REB) including Palli Bedyut Samity (PBSs) is one of the largest distributer around this country.

1.2 Concerning Organization

Bangladesh Power Development Board (BPDB) was assigned to manage power transmission system, power generation and power distribution throughout Bangladesh before formation of Power Grid Company of Bangladesh Ltd.(PGCB) but Rural Electrification Board (REB) is the most larger power distributor throughout the countryside.

The Rural Electrification Board of Bangladesh has been providing service to rural member consumers for over 36 years. Continued support from the Government of Bangladesh, the donor community, consulting partners, and member consumers will help this program continue to expand, providing the gift of electricity to millions more Bangladeshi households, businesses, and industries.

The Bangladesh Rural Electrification (RE) Program was founded with a Presidential Ordinance in October 1977 that established the Rural Electrification Board (REB) as the semi-autonomous government agency reporting to the Ministry of Power Energy and Minerals Resources. Which was responsible for electrifying rural Bangladesh? Since its inception, the purpose of the program has been to use electricity as a means of creating opportunities for improving agricultural production and enhancing socio-economic development in rural areas, whereby there would be improvements in the standard of living and quality of life for the rural people.

Today there are 70 operating rural electric cooperatives called Palli Bidyuit Samity (PBS), which bring service to approximately 93,99,134 new connection being made and more than 2,42,116 kms of line has been constructed.

This eight-month Study involved more than 100 male and female qualified enumerators, as well as a number of data quality controllers working to collect quantitative and qualitative data through the completion of questionnaires during the interview of 378 cases in more than 70 villages/thanas in both electrified and non electrified areas of 23 different PBSs dispersed across the country. in addition, the fieldwork also included 27 "focus group discussion" and nine "group discussion with the PBS Board and Members". The four major categories of consumers namely domestic, commercial irrigation and industry were included when preparing the sampling sizes for both experimental and control groups. Fourteen different instruments are designed, field tested, and used for the information collection phases of the Study.

Since its inception in 1980, Dhaka Palli Bidyut Samity-1 is playing a vital role in Agricultural, Industrial and Socio-Economic Development of Dhaka District. The Rural Electrification Program conducted by Dhaka Palli Bidyut Samity-1 has acted a leap-forward in the development of socio-economic structure of rural areas in Dhaka District as well as entire Bangladesh. If has significant and sustained impact on agricultural growth, industrialization and business & commercial activities in the rural areas. It is a consumer owned entity organized on the basic principles of Co-operative for distribution of electric power to its members and operates on No Loss - No Profit basis for the mutual benefits of all its Members.

1.3 Vision

Electricity for all by 2020

1.4 Mission

Quality and uninterruptable power supply

1.5 REB Profile

Rural electrification Board a public service company. Its Head Office is **Rural electrification Board** ,Nikunja-2, Khilkhet, Dhaka-1229 .

1.6 Objective

The Rural Electrification Association - at the programs agricultural, industrial and economic - social development of the role of the state of being. To achieve food self-sufficiency through the modern irrigation systems, and other large and small cottage industries and a wide education, health and information technology development as well as the leading role in the all Districts of Bangladesh Rural Electrification Program of the leading role in the development of quality of life. In order to obtain the broad objectives I have to find out of the following objectives. They are follows

- Study on Substation.
- Test and check the equipments of Substation.
- Identifying different types of problem which arise for operating this Substation.
- Suggest probable solution of the identified problem.

1.7 Methodology

Both primary and secondary data are being collected for the purpose of this report. The report is concentrated of 33/11 KV Substation of Dhaka Polli Bidyut Somity-1.

- Primary Data: Primary Data are collected from the books about power plants, the Engineers through a face-to-face interview with a formal questionnaire, the User Manual to the Engineers, official documents of the company and Plant Operation Manuals

- Secondary data: Secondary data has been collected from the online resources, Journals and Brochures.

1.8 Organogram

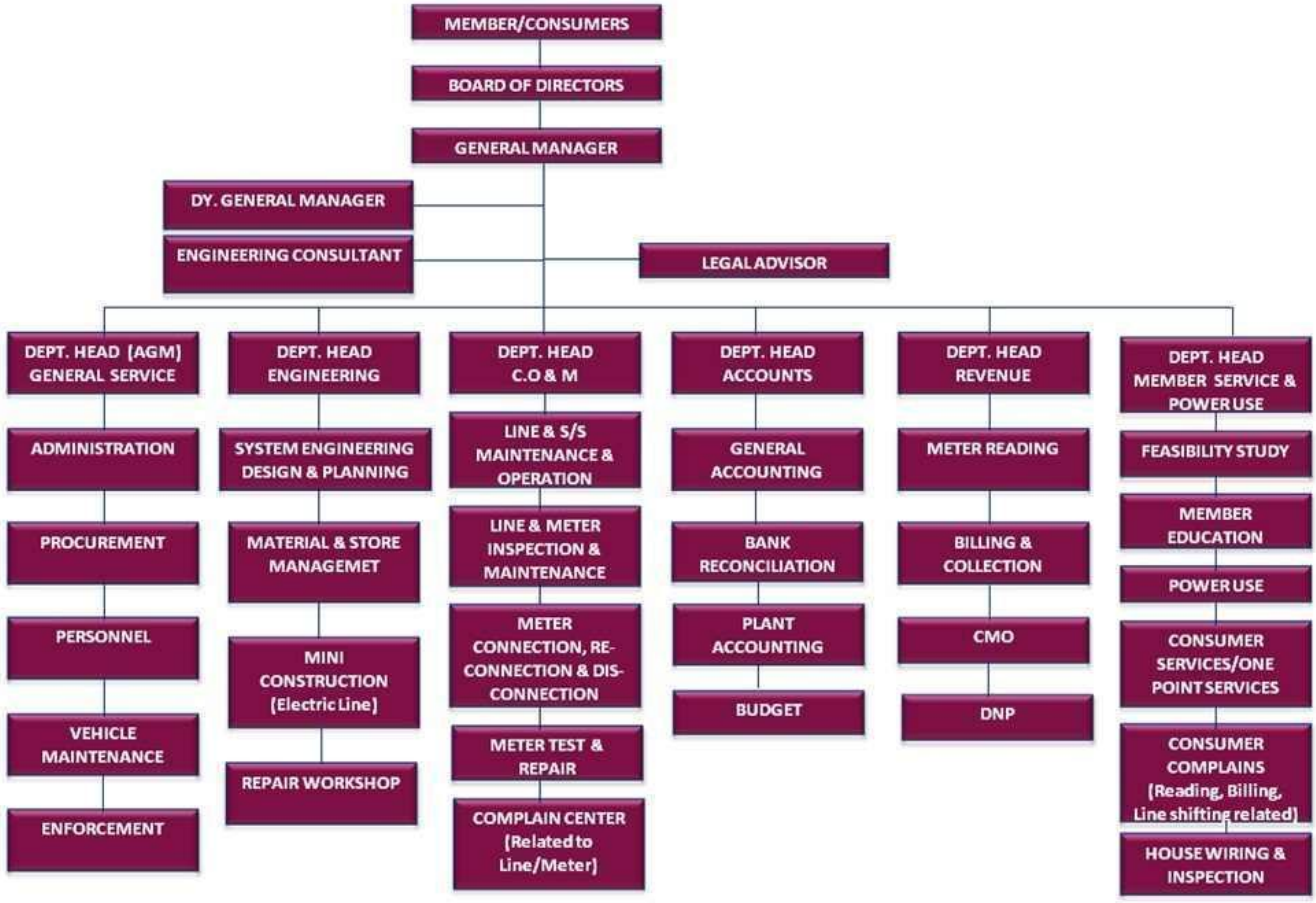


Fig 1.01: Organogram

1.9 Execuitve Members of Dhaka Palli Bidyut Samity-1

SL	Name	Designation
01.	MR. GOLAM MORTUJA	General Manager
02.	MD. MAMUN MOLLA	AGM (CONSTRUCTION AND MAINTANANCE)
03.	SANJIDA AKTAR	AGM (TECHNICAL)
04.	SHAJAHAN FAKIR	AGM (Finance)
05.	PROSANTO KUMAR	AGM (Engineering)
06.	MD. MAMUN MOLLA	AGM (Grid)

1.10 General Managers

The Board of Directors mainly makes policy decisions to manages business of the company. The Board has delegated a few authority to the Managing Director and other Executive Directors to operate the day to day business of the company. Each PBS has a General Manager. The General Manager are as mentioned below:

- Brigadier General Moin Uddin Chairman, REB
- MR. GOLAM MORTUJA (General Manager , Dhaka Palli Bidyut Samity-1).
- Ismail Hossain (Chittagong Palli Bidyut Samity) etc.

1.11. Electricity Bill

1-75 unit……3.36 taka

75-200 unit..4……05taka

201-300 unit……..8taka4.1

301-400 unit……..6.88 taka

401-600 unit……..7.18 taka

600+ unit……9.38 taka

1.12 Activities of Dhaka Palli Bidyut Samity-1

Every Forth month later in different area they arrange a meeting for awareness of use of electricity. How they save the electricity. How reduce the load shedding. They not only arrange the meeting for electricity but also they call the meeting in different social work.

1.13 Associations

RURAL ELECTRIFICATION BOARD

Website : http://www.reb.gov.bd/

DHAKA PALLI BIDYUT SAMITY-1

Website : http://www.dhakapbs1.org.bd

MINISTRY OF POWER, ENERGY RESOURCES

Website : http://www.powerdivision.gov.bd/

DHAKA ELECTRICITY SUPPLY COMPANY LIMITED

BANGLADESH POWER DEVELOPMENT BORD

http://www.bpdb.gov.bd/

Chapter-02

Fundamental Information about Electrical System

2.1 Electric Power

2.2 Electricity

2.3 How Electricity Produces

2.4 Types of Electric current

2.5 How AC & DC Generate?

2.6 Some important terms

2.7 Basic Principle of AC generator

2.8 Basic Principle of DC generator

2.9 How are they used?

2.10 Why use AC?

2.11 Electrical circuits

2.1 Electric Power

The amount of electrical energy developed in one second is called electric Power. The electric power in a circuit is calculated using the equation $P = VI\cos\varphi$.

Electric power where electric current is used to energized equipments. In modern life we cannot think even a single moment without this electric power. In our daily life we need electricity. We need electricity in every work what we do in our daily life. Now the question is why this electric power is must for modern life? The best answer is electric power is the convenient power which can be converted in to any power as our requirements such as:-

2.2 Electricity

Electricity is the set of physical phenomena associated with the presence and flow of electric charge. Electricity gives a wide variety of well-known effects, such as lightning, static electricity, electromagnetic induction and the flow of electrical current.

In electricity, charges produced, electromagnetic fields which act on other charges. Electricity occurs due to several types of physics:

- **Electric charge**: A property of some subatomic particles, which determines their electromagnetic interactions. Electrically charged matter is influenced by, and produces, electromagnetic fields.
- **Electric current** : **A** movement or flow of electrically charged particles, typically measured in amperes. In other word we can say that the flow of electron is called current.
- **Electric Voltage:** Voltage is the potential energy that makes the electrical current flow in a circuit by pushing the electrons around. The unit of voltage is volt.
- **Electric field**: **An** especially simple type of electromagnetic field produced by an electric charge even when it is not moving (i.e., there is nonelectric current) . The electric field produces a force on other charges in its vicinity. Moving charges additionally produce a magnetic field.
- **Electromagnets:** Electrical currents generate magnetic fields, and changing magnetic fields generate electrical currents.

- **Electric potential**: **the** capacity of an electric field to do work on an electric charge, typically measured in volts.

Electric Resistance (R) & Conductance (G): The **electrical resistance** of an electrical element is the opposition to the passage of an electric current through that element; the inverse quantity is **electrical conductance.**

2.3 How Electricity Produces

The fundamental principles of electricity generation were discovered during the 1820s and early 1830s by the British scientist Michael Faraday. His basic method is still used today. Electricity is generated by the movement of a loop of wire, or disc of copper between the poles of a magnet. The ***basic theory*** of electricity production is *–If a*

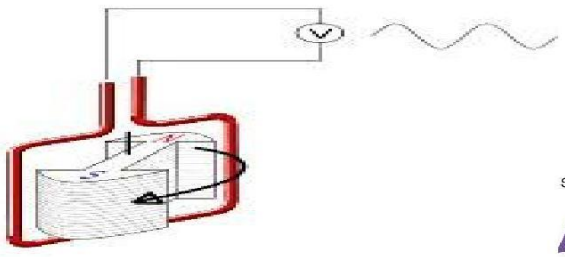


Fig: 2.1 Rotating fields

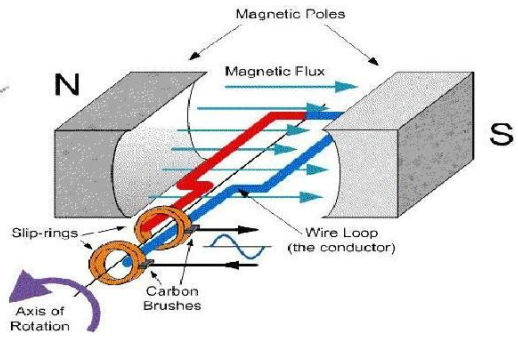


Fig: 2.2 Rotating Conductor

Conductor rotates inside the magnetic fields, or magnetic fields rotate around the conductor in both cases the electric current flows through the conductor, thus the electricity is produced. But the must condition is either conductor or magnetic field must be rotate.

2.4 Types of Electric current

There are two types of electrical currents:-

- Direct currents (DC)
- Alternating currents (AC)

Alternating currents (AC): In alternating current (AC) the movement of electric charge periodically reverses direction. This current generate by AC generator.

Direct currents (DC): Direct current (DC) is the unidirectional flow of electric charge. Direct current is produced by sources such as batteries, thermocouples, solar cells, & commentator type electric machines of the dynamo type.

2.5 How AC & DC Generate?

There must also be some way to transfer the current to the rest of the circuit. In an AC generator, having a ring on each end of the wire does this. A metal contact or brush rubs or slides against each ring, allowing the electricity to flow through the circuit. In a DC generator, this is done using one split-ring called a commutator, Normally AC is produce inside every generator to make it DC we use split-ring commutator instead of slip ring, this split-ring commutator make DC from AC . An AC generator uses two slip rings as shown in figure.

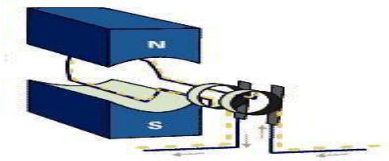


Fig: 2.3 AC Generator

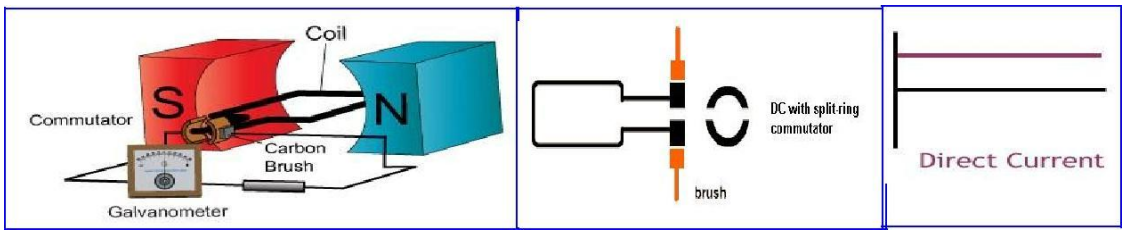


Fig: 2.4 DC Generator

2.6 Some important terms

Magnetic field: The space around a magnet where its influence is felt.

Magnetic flux: The total number of lines of force around a magnet is called magnetic flux.

Electromagnet: It is an arrangement of a soft iron piece inside a solenoid. The magnet loses its property when the current in the solenoid ceases.

Galvanometer: The device used to detect the presence and direction of a feeble current.

2.7 Basic Principle of AC generator

We know when a conductor cuts magnetic flux then an emf is induced on the conductor. This emf is induced by ***Faradays law*** of electromagnetic induction-

"The induced emf is directly proportional to the time rate of change of magnetic flux linked with it"

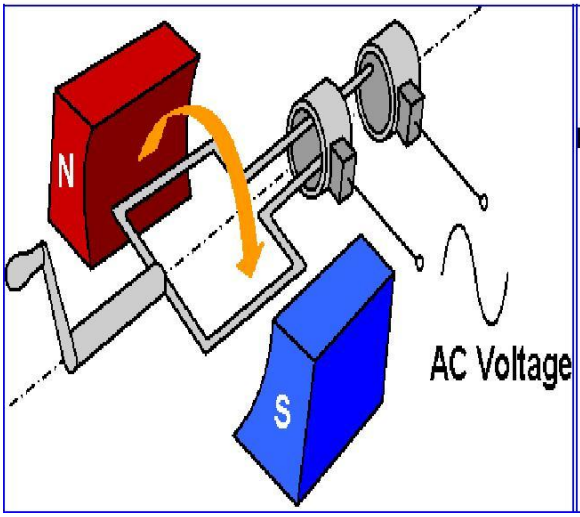


Fig: 2.5 AC Generator

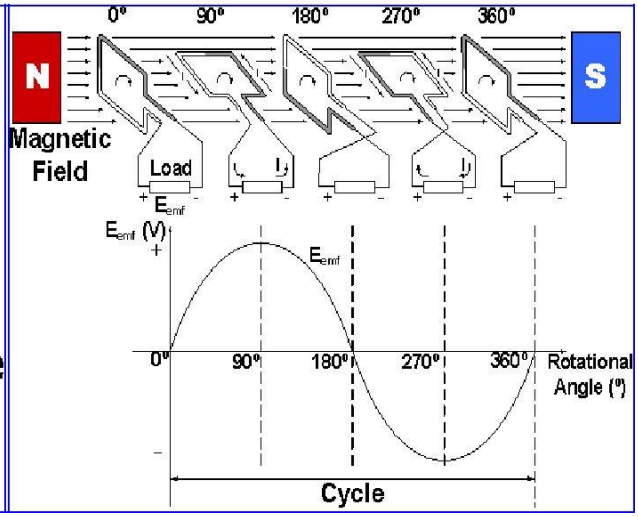


Fig: 2.6 How Alternating Current Produce

The armature is initially at the vertical position. No magnetic flux is cut and hence no induced current exists.

When the armature rotates, the change in magnetic flux increases and the induced current increases until its maximum value at the horizontal position.

As the armature continues on its rotation, the change in magnetic flux decreases until at the vertical position, no induced current exists.

Subsequently upon reaching the horizontal position again, the induced current is maximum, but the direction of the induced current flowing through the external circuit is reversed.

The direction of the induced current (which flows through the external circuit) keeps on changing depending on the orientation of the armature. This induced current is also known as alternating current. The current is positive (+) in one direction and negative in the other (-). The slip rings play a critical role in the generation of alternating current.

2.8 Basic Principle of DC generator

Most common electrical appliances (*e.g.*, electric light-bulbs and electric heating elements) work fine on AC electrical power. However, there are some situations in which DC power is preferable. For instance, small electric motors (*e.g.*, those which power food mixers and vacuum cleaners) work very well on AC electricity, but very large electric motors (*e.g.*, those which power subway trains) generally work much better on DC electricity. Let us investigate how DC electricity can be generated.

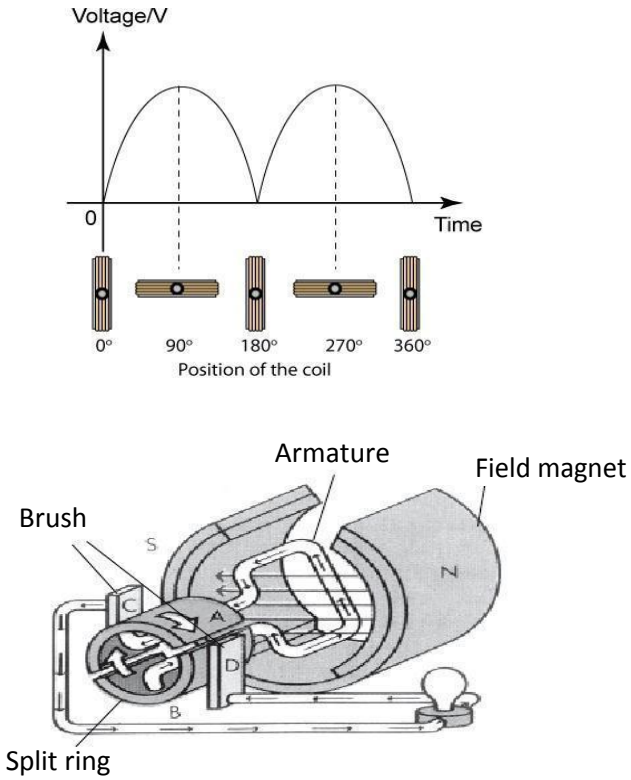


Fig: 2.7 DC Generator

Initially the armature is vertical. No cutting of magnetic flux occurs and hence induced current does not exist.

When the armature rotates, the change in flux increases and the induced current correspondingly increases in magnitude.

After rotating by 90°, the armature is in the horizontal position. The change in magnetic flux is maximum and hence the maximum induced emf is produced.

When the armature continues to rotate, the change in flux decreases. At the 180° position, there is no change in flux hence no induced current exists. The induced current achieves

its maximum value again when the armature is at 270°. After rotating 360°, the armature returns to its original position.

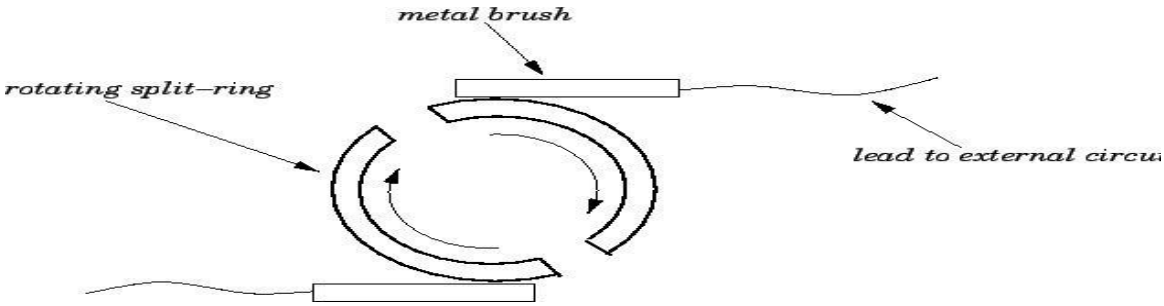


Fig: 2.8 How Direct Current Produce

2.9 How are they used?

In our country we have no DC transmission or distribution system. We use DC in batteries, solar cells, IPS, UPS & lower voltage applications today. But we have the AC transmission and distribution system in Bangladesh. AC electricity currently provides the majority of the domestic power supply.

2.10 Why use AC?

AC power can be controlled using transformers to increase or decrease the strength of the current, while DC power is much harder to transform. DC electricity also loses much more voltage when transmitted.

2.11 Electrical circuits

☞ In terms of source basically there are two types of circuit

i) **AC circuit:** The electrical circuit which is powered by AC source.

ii) **DC circuit:** The electrical circuit which is powered by DC source.

☞ In terms of connection basically there are two types of circuit

i) **Series circuit:** The electrical circuit where there is only one path for current flow is known as series circuit.

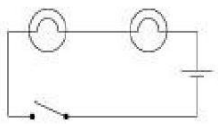


Fig: 2.9 Commutator of DC generator

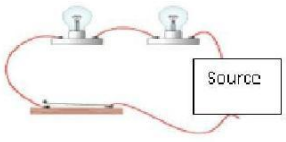


Fig: 2.10 Pulsating DC

Parallel circuit: The electrical circuit where there is more than one path for current flow is known as parallel circuit.

Chapter-03

Over view of Electrification system

3.1 Basic Content of Electrical system

3.2 Generation

3.3 Transmission

3.4 Distribution

3.5 Palli Bidyut Samitys‘ name and ma

3.6 Map of PBSs Location

3.1 Basic Content of Electrical system

The electrical system consists of three main sectors

1) Power stations that produce electricity from combustible fuels (coal, natural gas, biomass) or non-combustible fuels (wind, solar, nuclear, hydro power);

2) Transmission lines that carry electricity from power plants to demand centers; and

3) Transformers that reduce voltage so distribution lines carry power for final delivery. Now we go for a brief discussion about the Electrification system. As we know before that for a complete electrification system we need three steps/sector, these are:-

i) Generation. ii) Transmission. iii) Distribution.

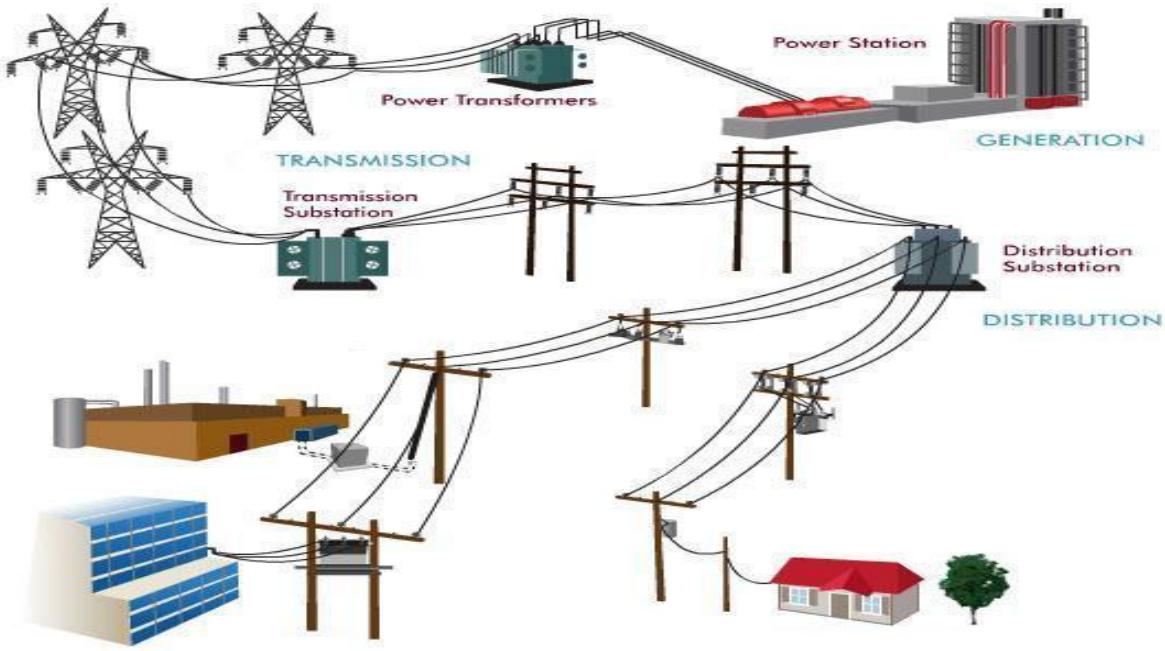


Fig: 3.1 Electrification System

3.2 Generation

Electric power is generated by Electric Power Generating plants; they are usually located near a source of water, and away from heavily populated areas. They are u sually quite large to take advantage of the economies of scale. The electric power which is generated is stepped up to a higher voltage-at which it connects to the transmission network.

3.3 Transmission:

Fig: 3.2 Overhead Transmission line

Fig: 3.3 Underground Transmission line

After producing the electric power it transmit through the country by the transmission line system. Electric utilities are tied together by transmission lines into large systems called power grids. They are thus able to exchange power so that a utility with a low demand can assist another with a high demand to help prevent a blackout, which involves the partial or total shutdown of a utility. There are two types of electric power transmission-

i) Overhead transmission

ii) Underground transmission

A major goal of overhead power line design is to maintain adequate clearance between energized conductors and the ground so as to prevent dangerous contact with the line, and to provide reliable support for the conductors, resilient to storms, ice load, earthquakes and other potential causes of damage. Today overhead lines are routinely operated at voltages

exceeding 765,000 volts between conductors, with even higher voltages possible in some cases.

Transmission lines, when interconnected with each other, become transmission networks, these are typically referred to as "power grid," the network is known as the "National Grid.," and the sub-station at which the transmission lines are linked is called
―Grid Sub- Station.‖

3.4 Distribution:

Electricity distribution is the final stage in the delivery of electricity to end users. A distribution system's network carries electricity from the transmission system and delivers it to consumers. Typically, the network would include medium-voltage (less than 50 KV) power lines, substations and pole-mounted transformers, low-voltage (less than 11 KV) distribution wiring.

3.5 Palli Bidyut Samitys'name and map of REB across Bangladesh

Electricity distribution sub-stations throughout the country are given below of REB whose are connected to a 33 KV line coming from grid sub-stations. The location, name, map of the sub-stations are shown below.

SL. No.	PBSs Name	SL. No.	PBSs Name	SL. No.	PBSs Name
1.	Dhaka PBS-1	24.	Chittagong PBS-1	47.	Faridpur PBS
2.	Tangail PBS	25.	Bogra PBS	48.	Jhenaidah PBS
3.	Comilla PBS-1	26.	Thakurgaon PBS	49.	Rajshahi PBS
4.	Chandpur PBS	27.	Madaripur PBS	50.	Kur-Lalmoni PBS
5.	Hobigonj PBS	28.	Barisal PBS-2	51.	Magura PBS
6.	Moulvibazar PBS	29.	Chittagong PBS-2	52.	Brahman Baria PBS
7.	Pabna PBS-1	30.	Meherpur PBS	53.	Mymensingh PBS-2
8.	Pabna PBS-2	31.	Noakhali PBS	54.	Nilphamari PBS
9.	Sirajgonj PBS	32.	Bagerhat PBS	55.	Gopalgonj PBS
10.	Jessore PBS-1	33.	Narsingdi PBS-1	56.	Bhola PBS

11.	Jessore PBS-2	34.	Kishoreganj PBS	57.	Rajbari PBS
12.	Natore PBS-1	35.	Narsingdi PBS-2	58.	Sylhet PBS-2
13.	Natore PBS-2	36.	Naogaon PBS	59.	Shariatpur PBS
14.	Rangpur PBS-1	37.	Sylhet PBS-1	60.	Munshigonj PBS
15.	Satkhira PBS	38.	Laximipur PBS	61.	Dhaka PBS-2
16.	Feni PBS	39.	Barisal PBS-1	62.	Sunamgonj PBS
17.	Mymensingh PBS-1	40.	Patuakhali PBS	63.	Sherpur PBS
18.	Dinajpur PBS-1	41.	Manikgonj PBS	64.	Mymensingh PBS-3
19.	Kushtia PBS	42.	Comilla PBS-2	65.	Gaibandha PBS
20.	Joypurhat PBS	43.	Cox's Bazar PBS	66.	Jhalakati PBS
21.	Pirojpur PBS	44.	Dinajpur PBS-2	67.	Khulna PBS
22.	Rangpur PBS-2	45.	Netrokona PBS	68.	Chittagong PBS-3
23.	Jamalpur PBS	46.	ChapaiNawabgonj PBS	69.	Gazipur PBS
				70.	Narayangonj PBS

3.6 Map of PBSs Location

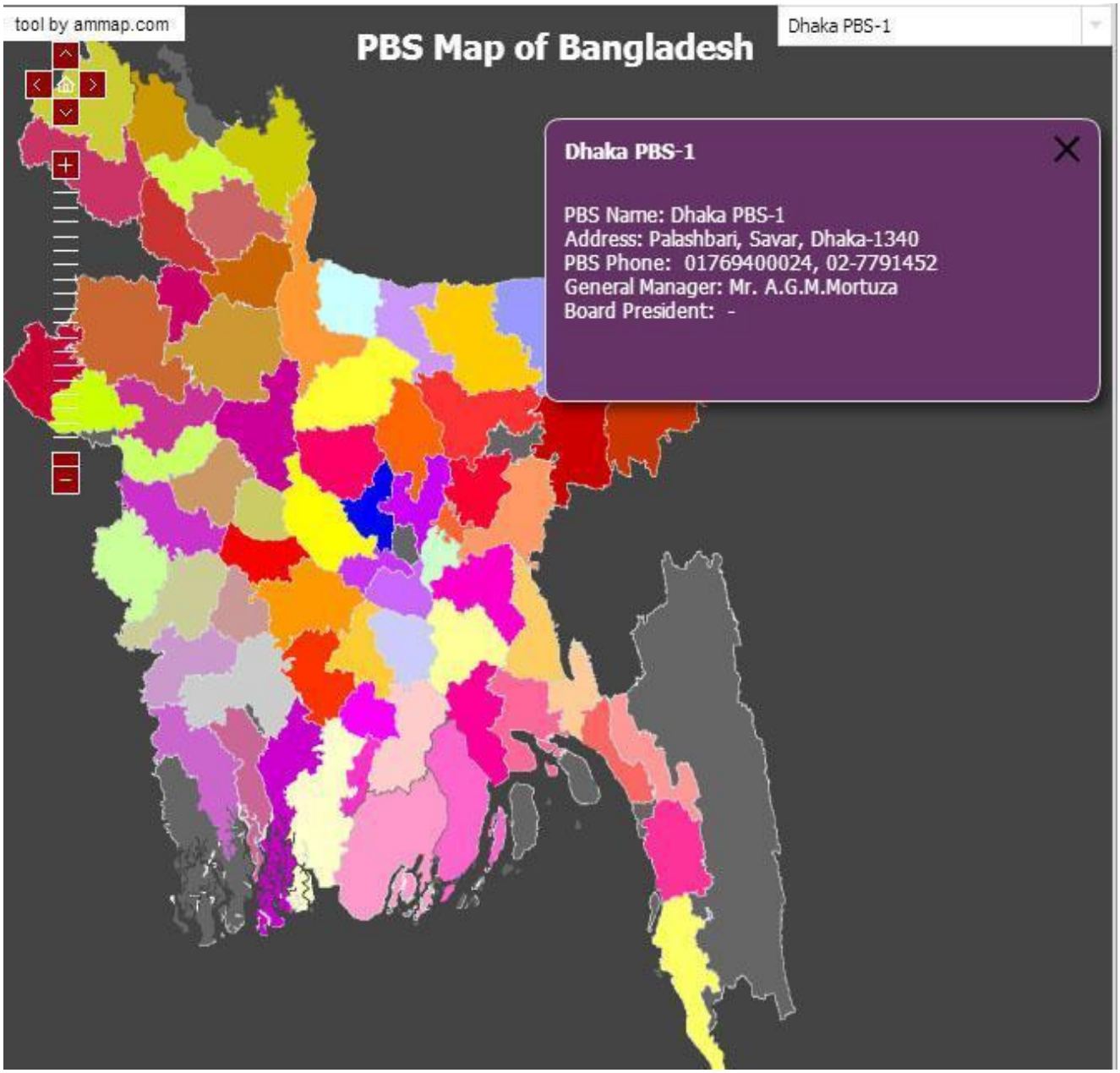


Fig: 3.4 PBSs of REB

Chapter-04

Electrical Sub-Station

4.1. Definition of sub

4.2. Types of Sub

4.1. Definition of sub-station:

The assembly of apparatus used to change some characteristics (e.g. Voltage AC to DC frequency, Power factor, etc) of electric supply is called sub-station.

4.2. Types of Sub-Station:

Substations may be described by their voltage class, their applications within the power system, the method used to insulate most connections, and by the style and materials of the structures used. These categories are not disjoint; to solve a particular problem a transmission substation may include significant distribution functions, for example.

i) **Transmission substation**

ii) **Distribution substation**

iii) **Collector substation**

iv) **Converter substation**

v) **Switching substation**

vi) **Classification by Insulation substation**

vii) **Classification by Structure substation**

i) Transmission substation

A **transmission substation** connects two or more transmission lines. The simplest case is where all transmission lines have the same voltage. In such cases, the substation contains high-voltage switches that allow lines to be connected or isolated for fault clearance or maintenance. A transmission station may have transformers to convert between two transmission voltages, voltage control/power factor correction devices such as capacitors, reactors or static VAR compensators and equipment such as phase shifting transformers to control power

ii) Distribution substation

A distribution substation transfers power from the transmission system to the distribution system of an area. It is uneconomical to directly connect electricity consumers to the main transmission network, unless they use large amounts of power, so the distribution station reduces voltage to a value suitable for local distribution.

iii) Collector substation

In distributed generation projects such as a wind farm, a collector substation may be required. It resembles a distribution substation although power flow is in the opposite direction, from many wind turbines up into the transmission grid. Usually for economy of construction the collector system operates around 35 kV, and the collector substation steps up voltage to a transmission voltage for the grid.

iv) Converter substations

Substations may be associated with HVDC converter plants, traction current, or interconnected non-synchronous networks. These stations contain power electronic devices to change the frequency of current, or else convert from alternating to direct current or the reverse. Formerly rotary converters changed frequency to interconnect two systems; such substations today are rare.

v) Switching substation

A switching substation is a substation which does not contain transformers and operates only at a single voltage level. Switching substations are sometimes used as collector and distribution stations. Sometimes they are used for switching the current to back-up lines or for parallelizing circuits in case of failure. An example is the switching stations for the HVDC Inga-Shaba transmission line.

vi) Classification by insulation

Switches, circuit breakers, transformers and other apparatus may be interconnected by air-insulated bare conductors strung on support structures. The air space required increases with system voltage and with the lightning surge voltage rating. For higher voltages, gas-insulated switchgear reduces the space required around live bus. Instead of bare conductors, bus and apparatus are built into pressurized tubular containers filled with

sulfur hexafluoride (SF6) gas. This gas has a higher insulating value than air, allowing the dimensions of the apparatus to be reduced. In addition to air or SF6 gas, apparatus will use other insulation materials such as transformer oil, paper, porcelain, and polymer insulators.

vii) Classification by structure

Outdoor, above-ground substation structures include wood pole, lattice metal tower, and tubular metal structures, although other variants are available. Where space is plentiful and appearance of the station is not a factor, steel lattice towers provide low-cost supports for transmission lines and apparatus. Low-profile substations may be specified in suburban areas where appearance is more critical. Indoor substations may be gas insulated switchgear (at high voltages), or metal-enclosed or metal-clad switchgear at lower voltages.

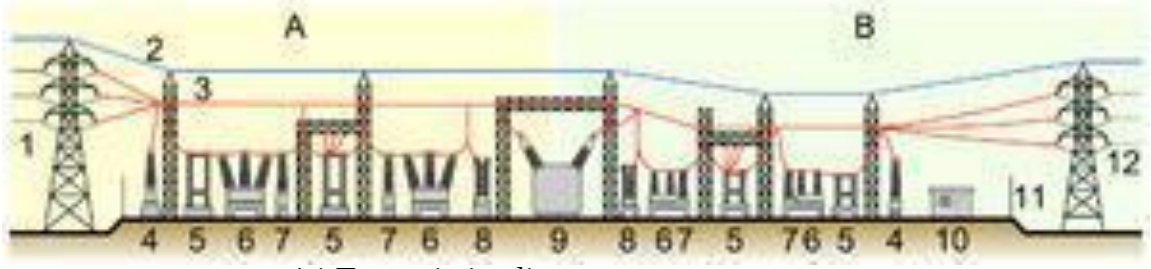
A: Primary power lines' side B: Secondary power lines' side

1. Primary power lines 2. Ground wire

3. Overhead lines 4. Transformer for measurement of electric voltage

5. Disconnect switch 6. Circuit breaker

7. Current transformer 8. Lightning arrester



4.1 Transmission line

Chapter-05

My Practicum Sub-Station

5.1 DHAKA PALLI BIDYUT SAMITY-1, SAVAR

5.2 Single Line Diagram

5.3 Configuration of the Sub-Station

5.1 DHAKA PALLI BIDYUT SAMITY-1, SAVAR

33/11 kV DHAKA PALLI BIDYUT SAMITY-1, sub-station is one of the important power sub-stations of Dhaka, because it supplies power to the Industrial area in Saver & locality. Kabirpur and Savar Grid-Substations are the original source for DHAKA PALLI BIDYUT SAMITY-1, sub-station. The Sub-Station is AIS (Air Isolated Sub-Station) Capacity of the Sub-Station is 35 MVA. There are three power transformer of 5/6.25 MVA, there are also six transformers rating 3.333 MVA whose are connected in parallel. Maximum load of the Sub-Station is 30 MW. There are six 11kV outgoing feeder in

DHAKA PALLI BIDYUT SAMITY-1. It‘s incoming feeder is con but the 11 KV outgoing feeders are controlled it.

Fig: 5.1 33/11 KV Sub-Station ,DHAKA PALLI BIDYUT SAMITY-1,SAVAR

5.2 Single Line Diagram:

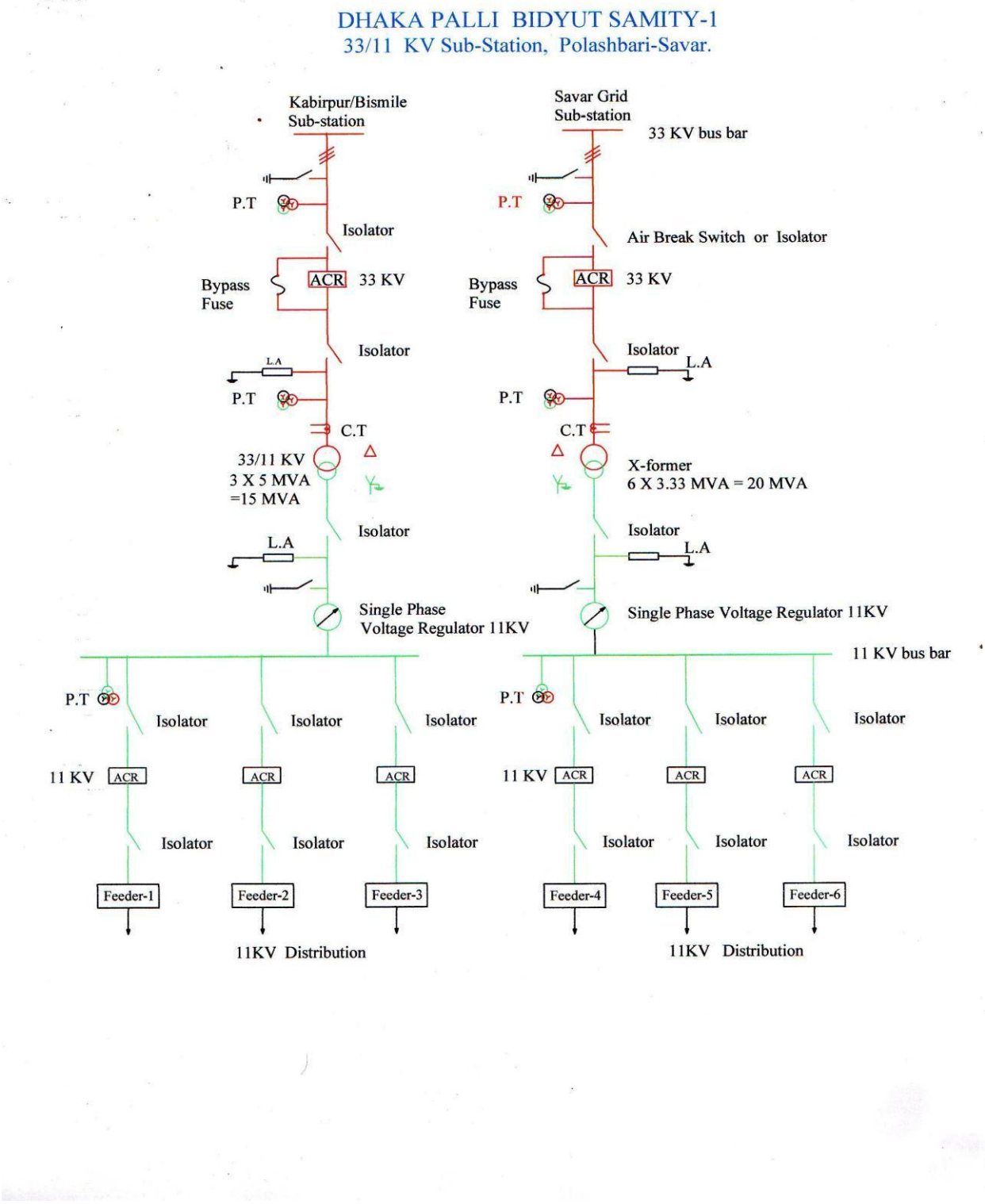


Fig 5.2: Single line Diagram 33/11 KV sub-station

5.3 Configuration of the Sub-Station

Sl NO	PARTICULERS	
1	TYPE OF SUB-STATION	33/11 KV OUT DOOR/ IN DOOR
2	SUPPLIER & CONSULTING ENGINEERIN	CHINA NATIONAL ELECTRIC WIRE & CABLE IMP./EMP. CORPORATION
3	POWER TRANSFORMERS NOS. CAPACITY	Three(03)NOS.33/11KV , 5/6.25MVA(EACH) Six (06) NOS.33/11 KV, 3.333MVA (each)
4	POWER TRANSFORMERS MANUFACTURER	ENERGYPAC ENGINEERING LTD, BANGLADESH.
5	OVER ALL CAPACITY	35/39 MVA
6	DATE OF COMMISSOIONING	02/06/1980
7	CIRCUIT BREAKER TYPE	33 KV and 11 KV SF6
8	SF6(33KV)	1250Amp
9	A.C.R(11KV)	630 Amp
10	NAME OF NOS OF FEDDER 11KV	FEEDER-1, FEEDER-2, FEEDER-3, FEEDER-4, FEEDER-5, FEEDER-6
11	CONDUCTOR SIZE,	For 33 kv conductor size 477MCM For 11 kv conductor size 4/0 ACSR For lateral line 1/0 ACSR For sub-lateral line #3 For pole to pole 4/0,1/0,#3,#6
12	BUS TYPE	SINGLE BUS
13	FIRE FIGHTING EQUIPMENT TYPE, CAPACITY & NOS	NO
14	LIGHTING ARRESTER	36KV
15	ISOLATOR (33KV)	1250 Amps
16	ISOLATOR	1250 Amps
17	C.T RATIO	400:5
18	COVERAGE AREA UNDER THIS SUB-STATION	911 Sq. Km

Table 5.1: Configuration of the Sub-Station

Chapter-06

Sub-Station Equipment'sDescription

6.1 Power Transformer.

6.2 Parallel operation of transformer

6.3 Instrument Transformer

6.4 Definition of Switchgear

6.5 Insulator

6.1 Power Transformer.

There are three transformers whose are used in parallel of same ratings, i.e 5/6.25MVA. So each transformer can provide 5* 0.8 = 4 MW to Maximum 6.25*0.8= 5 MW load. By operating three transformer in parallel the sub-station capacity is 4*3= 12 MW to 5*3= 15 MW, so the substation capacity is 15 MW Maximum for one side. There are six extra power transformers are used, two for per phase whose are rated as 3.333 MVA . so each two transformer can provide 3.333x2 MVA=6.666 MVA. By operation six transformers as parallel operation 6.666 x 3 MVA = 20MVA. The total maximum capacity for this sub-station is 15+20 MVA=35 MVA load.

Basic Principle:

The transformer is based on two principles; firstly, that an electric current can produce a magnetic field (electromagnetism) and secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil(electromagnetic induction).Charging the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil. The two circuits are electrically isolated but magnetically linked through a low reluctance path. If one coil is connected to a.c supply, an a.c is setup in both of these circuits. This helps to transfer the voltage from one side to another. We have observed two at DPBS-1 long with two station transformers. They carry rated voltage 5KVA. These transformers are used to supply power to the station at night or emergency case. All the transformers are 33/11 KV and d-y mode and each transformer is properly grounded.

Accessories of transformers : Core & Winding:

Fig: 6.1 Transformer core

It may be of various shape i.e. core, shell. It is made of cold-rolled-grain-oriented Siliconsteel of varnish insulation on the lamination. The core is laminated to reduce the core loss. The laminations are made in steps &try to give circular cross section. Bolts 7 nuts secure the lamination. The core is placed at the bottom of the tank. The tanks are constructed from sheet steel for small tank & boiler sheet for large tank. There are thermometer pockets, radiator tubes for increasing cooling surfaces. A 3-phase transformer has six separate windings, three primary & three secondary wound iron cores. Enameled copper with insulation is used for winding. Insulated papers are used for interlayer insulation.

Transformer Oil

The tank is filled with transformer oil; & sealed. It is a mineral oil obtained by refining crude petroleum. It serves the following purposes:-

- Provides additional insulation
- Carries away the heat generated in the core & oils Good transformer oil should have high dielectric strength.
- Low viscosity to provide good heat transformation.
- Free from inorganic acid, alkali & corrosive Sulfur
- Free from sludging under normal operating condition.
- It is Important to check the oil in regular intervals.

Conservator

It consists of an airtight metal drum fixed above the level of the top of the tank & connected with the tank is completely filled with oil. The conservator is partially is filled with oil. The function of conservator is to take up construction & expansion of oil without allowing it to come in contact with outside air. Transformer oil will expand due to the heat generated because of losses.

Breather

When the temperature changes, expansion of contacts & there is a displacement of air . When the transformer cools the oil level goes down 7 air is drawn in. The oil should not be allowed to come in contact with the atmospheric air as it may take moisture, which may spoil its insulating properties. Air may cause acidity or sledging of oil, so, the air coming in is passed through an apparatus called breather for extracting moisture. The breather consists of a small vessel, which contains a drying agent like Silica gel crystal.

Bushing

It is fixed on the transformer tank and these connections is made to the external circuits. Ordinary porcelain insulators can be used as bushing up to voltage of 33 kV. Above 33kv oil filled type bushings are used. In filled bushings, the conductor is passed through the hollow porcelain insulator which is filled with oil.

Tap Changing

Mainly 132/33 kV transformer uses on-load tap changing &33/11 kV transformer is used of load off-load tap changing. The tap changer is generally done on H.V side because current flow is less than LV side. Which reduces the flashing during the tap changing. Here tap changed in 132/33 kV transformer.

Technical data

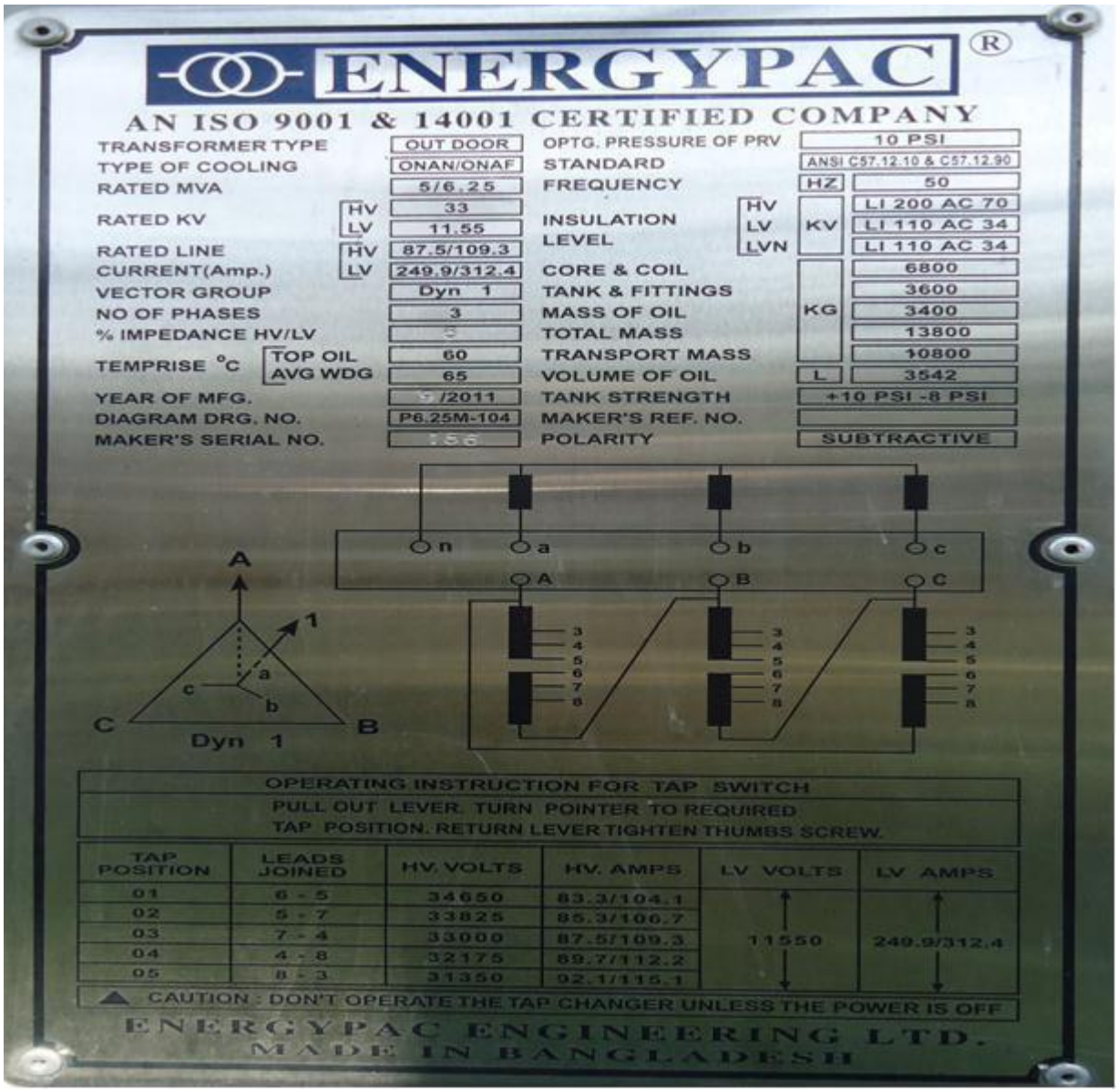


Fig 6.2: Transformer rating

LV Voltages and Currents in different tap position

Tap Position	LEADS JOINED	H.V VoltS	H.V AMPS	LV VOLTS	LV AMPS
1	6-5	34650	83.3104.1	11550	249.9/312.4
2	5-7	33825	85.3/106.7	11550	249.9/312.4
3	7-4	33000	87.5/109.3	11550	249.9/312.4
4	4-8	32175	89.7/112.2	11550	249.9/312.4
5	8-3	31350	92.1/115.1	11550	249.9/312.4

Table 6.1. LV Voltages and Currents in different tap position

** Principal Tap Position : 5

** Step Voltage 1.25% of 11000 Volt

6.2 Parallel operation of single –phase transformer

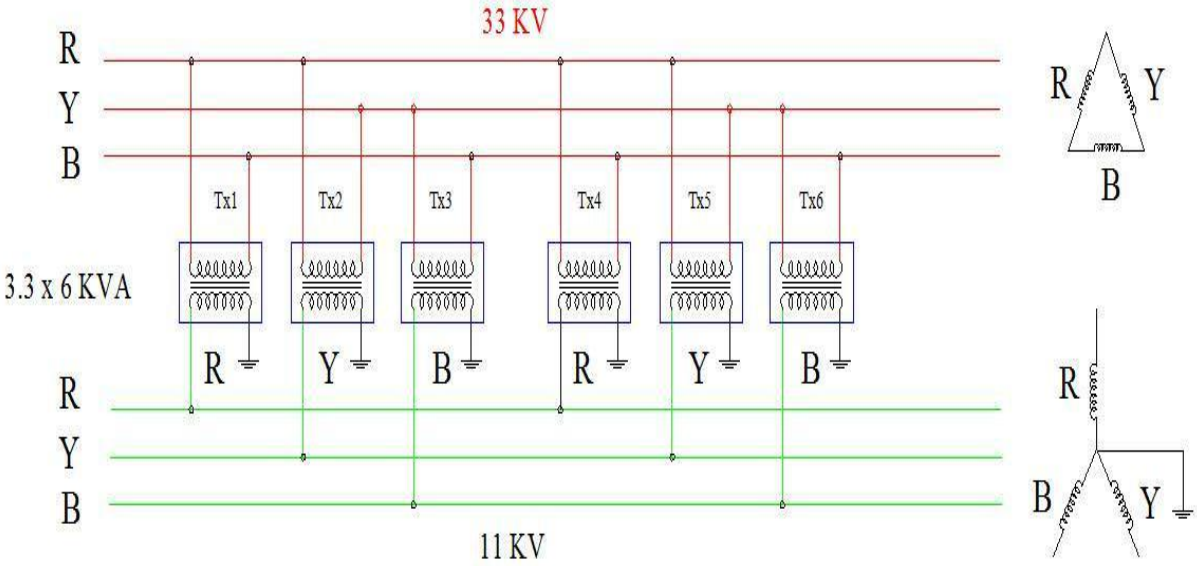


Fig 6.3: Parallel operation of single –phase transformer

Conditions

1. Primary windings of the transformers should be suitable for the supply system voltage and frequency
2. The Transformers should be properly connected with regard to polarity
3. The Transformers should have same turn ratio i.e transformer ration.
4. The percentage impedances should be equal in magnitude and have the same X/R ratio in order to avoid circulation currents.

5. With transformers having different KVA rations the equivalent impedance should be inversely proportional to the individual KVA ratings if the circulating currents are to be avoided.

Parallel operation of three phase transformer

Conditions

1. All the conditions for the single phase transformer are applicable for 3-phase transformer
2. The voltage ration must refer to the terminal voltage of primary and secondary.
3. The phase displacement between primary and secondary voltages must be the same.
4. The phase sequence must be the same
5. All the transformers in the 3-phase transformer bank will be the same construction either core or shell.

6.3 Instrument Transformer

1. Potential Transformer (PT)

Transformers can also be used in electrical instrumentation systems. Due to transformers ability to step up or step down voltage and current, and the electrical isolation they provide, they can serve as a way of connecting electrical instrumentation to high-voltage, high current power systems. Potential transformers are designed to provide as accurate a voltage step-down ratio as possible. To aid in precise voltage regulation, loading is kept to a minimum: the voltmeter is made to have high input impedance so as to draw as little.

Fig 6.4: Potential Transformer (PT)

PT PRODUCT DESCRIPTION:

Technical Data

Type		VTO 36-2
Standard		IEC, ANSI, BS & AS
Connection		Line to line Connection
Operating voltage (max.)	kV	36
Rated power frequency withstand voltage (1 minutes)	kV	70
Impulse test voltage (1,2/50us)	kV	170 - 200
Rated frequency	Hz	50 or 60
Primary Voltage	V	36000
Secondary Voltage	V	100 - 240
Secondary Thermal Burden Current 8h (earth fault winding)	A	6
Rated Voltage Factor		1.2 x U_n Continous
Creepage distance (min.)	mm	1230
Short time load (Mechanical)	N	3750
Weight (approx)	kg	70

2. Current Transformer (CT):

The instrument current transformer (CT) steps down the current of a circuit to a lower value Andy‘s used in the same typesrmer. ofThis is equipmentdone by constructing the secondary coil consisting of many turns of wire, around the primary coil, which contains only few turns of wire. In this manner, measurements of high values of current can be obtained. A current transformer should always be short-circuited when not 5 amperes. For example, a 4000:5 CT would provide an output current of 5 amperes when the primary was passing 4000 amperes. The secondary winding can be single ratio

or multi ratio, with five taps being common for multi ratio CTs. The load, or burden, of the CT should be of low resistance. If the voltage time integral area is higher than the core's design rating, the core goes into saturation towards the end of each cycle, distorting the waveform and affecting accuracy. Following the same line of thinking, we can use a transformer to step down current through a power line so that we are able to safely and easily measure high system currents with inexpensive ammeters. Of course, such a transformer would be connected in series with the power line, like (Figure).

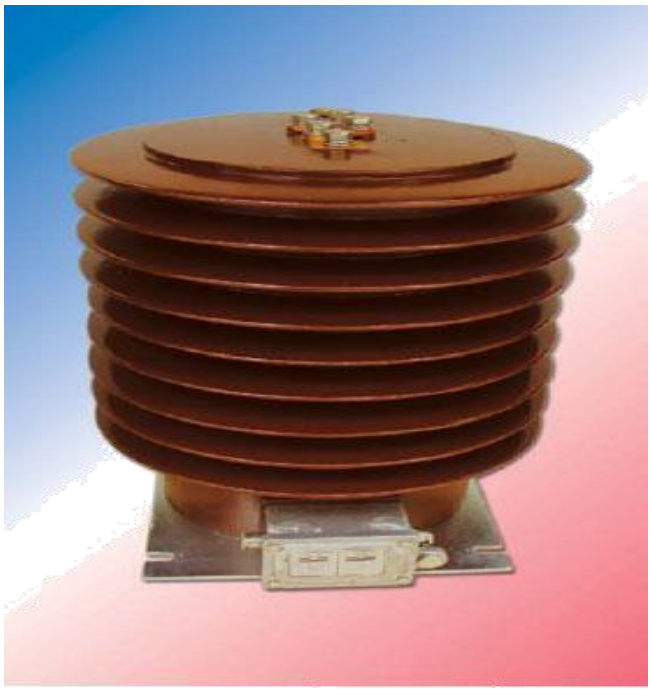


Fig 6.5: Current Transformer (CT)

Technical Data

Type		CTO 36-1
Standard		IEC, ANSI, BS & AS
Operating voltage (max.)	kV	36
Rated power frequency withstand voltage (1 minutes)	kV	70
Impulse test voltage (1,2/50us)	kV	170 ~ 200
Rated frequency	Hz	50 or 60
Primary rated current	A	≤ 600
Maximum rated continuous thermal current	xIn	1.2
Secondary rated current	A	1 or 5
Rated short time thermal current-Ith, 1sec	kA	40
Rated dynamic current (1dyn=2.5xIth)	kA	100
Creepage distance (min.)	mm	1150
Short time load (Mechanical)	N	2000
Weight (approx)	kg	75

Connection Diagram of CT and PT

Connection Diagram of CT & PT:

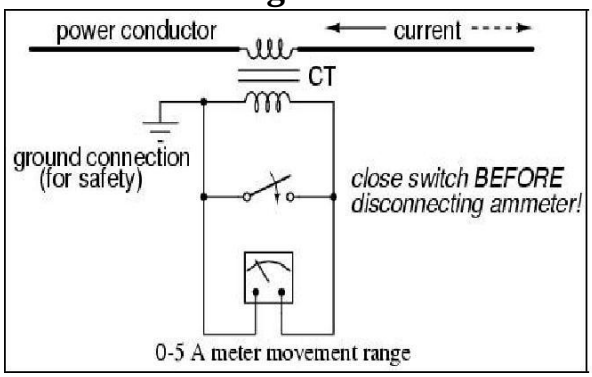


Fig: 6.6 Connection Diagram of CT

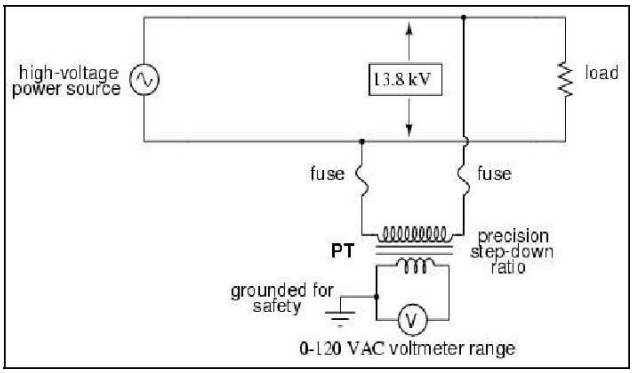


Fig: 6.7 Connection Diagram of PT

CT is connected in series with the circuit.

PT is connected in Parallel with the circuit

6.4. Definition of Switchgear

Switchgear is an arrangement of some apparatus which are used to control & protect the electrical circuits & equipments.

Fig 6.8: Switchgear

Circuit Breaker (CB)

A circuit breaker is equipment which can

1. Make or break a circuit either manually or automatically under normal conditions
2. Break a circuit under abnormal conditions

A circuit breaker has two contacts Fixed & Moving contact-

During the separation of contacts, due to large fault current and high current density at the contact region the surrounding medium ionizes and thus a conducting medium is formed. This is called the ARC.

1.Automatic Circuit Recloser 11KV

U-Series three phase pole mounted auto recloser or circuit breaker uses the latest technology in solid dielectrics, vacuum interruption and insulants. This device does not use any gas or oil insulants. Instead, cyclo-aliphatic epoxy bushings are used to insulate the vacuum interrupters. This type of construction results in a more lightweight unit. The design has been optimised for automation, remote control, and monitoring applications and has built in current and voltage measurement for data logging.

Fig 6.9: Automatic Circuit Recloser

specifications

- Rated voltages: 15kV and 27kV
- Rated short-circuit current up to 12kA
- Rated load current up to 630A
- 316 grade stainless steel tank
- Solid epoxy dielectric
- Vacuum arc interruption
- I-terminal voltage measurement
- Optional X-terminal voltage measurement
- Mechanical lockout
- Three phase current measurement

Applications

- MV overhead network protection
- Substation circuit breakers
- Pole mounted reclosers
- Loop Automation
- Automatic Changeover
- Generator control
- Smartgrid
- Feeder Automation

2. SF6 Circuit Breakers for 11KV or 33 KV

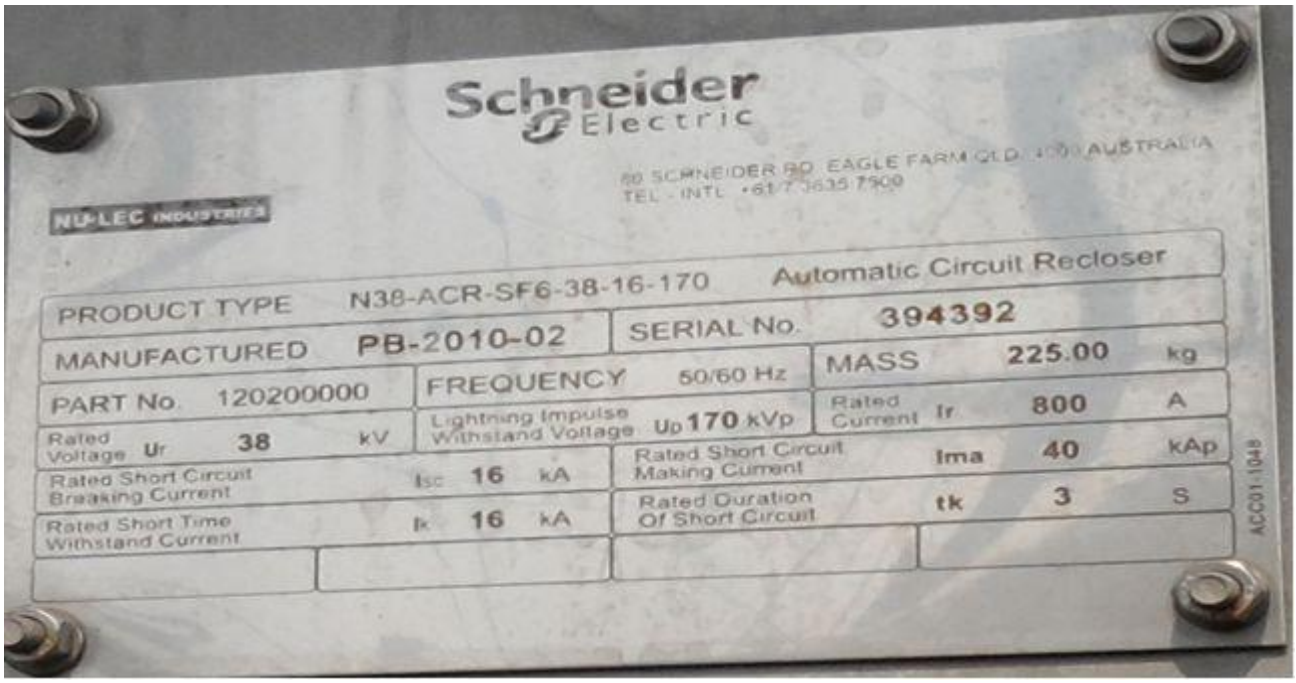
The U-series Automatic Circuit Recloser (ACR) is a state of the art electronically controlled outdoor pole mounted , three phase recloser.The pole top circuit breaker is one of the manufacture‘s family of outdoor circuit b automation schemes.

Fig 6.10: SF6 Circuit Breaker

Sulfur hexafluoride (SF6) gas is an alternative to air as an interrupting medium. SF6 is a colorless nontoxic gas, with good thermal conductivity and density approximately five times that of air. The principle of operation is similar to the air blast breakers, except that the SF6 gas is not discharged into the atmosphere. A closed circuit completely sealed and self-contained construction is used. SF6 Circuit Breakers are mostly use in Indoor type Primary sub stations in Sri Lanka and other countries because of its convenience.

1. Good heat transfer quantity
2. Pressure can be checked easily
3. Short arcing time
4. Compartmented SF6 HV load-break isolating switch

Specifications



3. Lightning arrester

Lightning arresters are protective devices for limiting surge voltages due to lightning strokes. A lightning arrester is a device used on electrical power systems to protect the insulation and conductors of the system from the damaging effects of lightning. The typical lightning arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge, which is very similar) travels along the power line to the arrester, the current from the surge is diverted through the arrestor, in most cases to earth.

Fig 6.11: Lightning arrester

4. Air Break switch

Air break switches are used in electrical substations to allow isolation of apparatus such as circuit breakers and transformers, and transmission line for maintenance work to ensure the maximum safety. Air break switches must be used at no load condition.

Fig 6.12: Air break switch

5. Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. With the exception of shunt regulators, all voltage regulators operate by comparing the actual output voltage to some internal fixed reference voltage. Any difference is amplified and used to control the regulation element. This forms a negative feedback servo control loop. If the output voltage is too low, the regulation element is commanded to produce a higher voltage. For some regulators if the output voltage is too high, the regulation element is commanded to produce a lower voltage; however, many just stop sourcing current and depend on the current draw of whatever it is driving to pull the voltage back down. In this way, the output voltage is held roughly constant. The speed of response control loop must be carefully designed to produce the desired tradeoff between stabilityand speed of response.

Fig 6.13: Voltage regulator

6.5 Insulator

The insulator serves two purposes. They support the conductor and confined the current in the conductors. The most commonly used material for the manufacture of insulator porcelain. There are several kinds of insulator and their use in the sub-station will depend upon the service requirement. For example, post Insulator is used for bus bars. A post insulator consists of a porcelain body, cast iron cap and flagged cast iron base. The hole in the cap is threaded so that bus bars can be directly bolted to the cap.

Fig 6.14: Insulator

Types of line Insulator

- Pin type insulator.
- Suspension type insulator.
- Strain insulator.
- Shackle insulator.
- Stay insulator:
- Guy insulator

1. Pin type insulator

Pin type insulators are used for transmission and distribution of electric power voltage up to 33KV.

Fig 6.15: Pin type insulator

2.Suspension type insulator

For high voltage i.e. beyond 33KV transmission line, Suspension type insulators used. This type insulator consists of a number of porcelain discs connected in series by the metal links in the form of strength. The conductor is suspended at the bottom end of this string while the other end of the string is secured to the cross-arm of the tower. Each unit or discs is designed for 11KV. The number of discs in series would obviously depend upon the working voltage.

Fig 6.16: Suspension type insulator.

3. Strain insulator

When there is a dead end of the line or there is corner or sharp curve, the line is subjected to greater tension. In order to relieve the line of excessive tension, strain insulators are used.
For low voltage lines shackle insulators are used as strain insulators. For high voltage transmission lines, strain insulator consists of an assemble of suspension insulator.
The discs of strain insulators are used in vertical plane.

Fig 6.17: Strain insulator

4. Guy insulator

In PalliBiddyutSamity guy insulators are used in low voltage distribution.

5. Stay insulator

For low voltage lines, the stays are to be insulated from ground at a height not less than 13 meters from ground.

6. Shackle insulator

Such insulators can be used either in a horizontal position or in a vertical position. They can be directly fixed to the pole with a bolt or to the cross-arm. The conductor in the groove is fixed with a soft binding wire.

Fig 6.18: Shackle insulator

6.6 Earthing

The word _earth‘ or _ground‘ means many diff electrical installation these words can be used to mean either the protective conductor in a

mains cord; the common bonding network of the building; the earth mass electrodes of the lightning protection system, or the conductor of the mains supply that is connected to an earth mass electrode at the distribution transformer**.**

Chapter-07

33 KV Switching Substation, Savar of DPBS-1

7.1 One line diagram

7.2 Switch yard

This is a switching sub-station from where Dhaka Palli Bidyut Samity -1 and other PBSs are controlled. It has thirteen feeders from where different PBSs are feed power. Actually it is consists of a feeder controlling room and a switching yard. All controlling such as line current each feeder , line and phase voltage for each feeder are measured by many Low Tension (L.T) panel and High tension panel(H.T). Switch yard is the place where the actual equipments are working properly.

7.1 one line diagram:

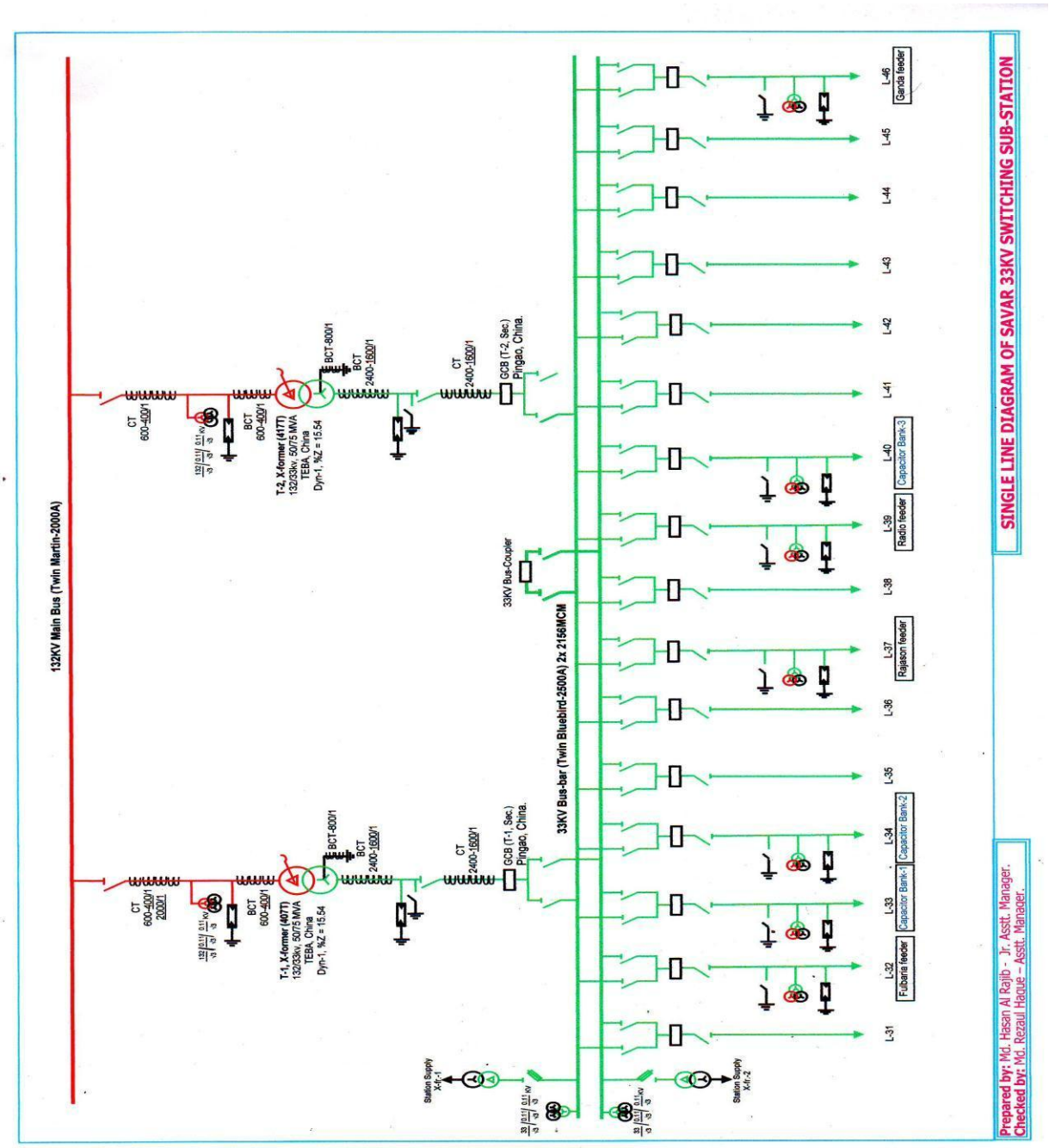


Fig 7.1 One line diagram for 33 KV switching subs-station

This switching sub-station is mainly consists of two parts as below

1. Switchyard
2. Control Room

The main components are described below briefly:

7.2 Switch Yard

This is a large place where switch gear components are paced according to the one line diagram which is provided by an experienced electrical engineer after electrical calculation. The main components are described below:

1. Isolator

In Sub-Station, it is often desired to disconnect a part of the system for general maintenance and repairs. This is accomplished by an isolating switch or isolator. An isolator is essentially a knife Switch and is design to often open a circuit under no load, in other words, isolator Switches are operate only when the line is which they are connected carry no load. For example, consider that the isolator are connected on both side of a cut breaker, if the isolators are to be opened, the C.B. must be opened first. If an isolator is opened carelessly, when carrying high current the resulting arc easily causes flashover to earth. This may batter the supporting insulators & may even cause a fatal accident to the operator, particularly in the high voltage circuit. The operating principle is manual plus one of the following:-

1.Electrical Motor Mechanism

2.Pneumatic Mechanism Isolators cannot be opened unless the Circuit Breakers are opened. Circuit Breakers cannot be closed until isolators are closed.

Fig 7.2: Isolator

2. Automatic Circuit Recloser

It is an one kind of switchgear and protection device. When any type of fault such as ground fault, line fault, short circuit fault etc. it works properly. Besides this due to maintenance of the substation to isolate the line at first it through it line can be isolated where arc is extinguish properly. If the fault is temporary it automatically recloses the line after a few seconds.

Fig 7.3: Automatic Circuit Recloser (ACR)

3.Instrument Transformer

A.Current transformer

The instrument current transformer (CT) steps down the current of a circuit to a lower value Andy‘s used in theentsameaspotentialtypestransformer. ofThis is equipmdone by constructing the secondary coil consisting of many turns of wire, around the primary coil, which contains only few turns of wire. In this manner, measurements of high values of current can be obtained. A current transformer should always be short-circuited when not 5 amperes. For example, a 4000:5 CT would provide an output current of 5 amperes when the primary was passing 4000 amperes. The secondary winding can be single ratio or multi ratio, with five taps being common for multi ratio CTs. The load, or burden, of the CT should be of low resistance. If the voltage time integral area is higher than the core's design rating, the core goes into saturation towards the end of each cycle, distorting the waveform and affecting accuracy. Following the same line of thinking, we can use a transformer to step down current through a power line so that we are able to safely and

easily measure high system currents with inexpensive ammeters. Of course, such a transformer would be connected in series with the power line, like (Figure).

Fig 7.8: Current transformer CT

B. Potential Transformer (PT):

Transformers can also be used in electrical instrumentation systems. Due to transformers' ability to step up or step down voltage and current, and the electrical isolation they provide, they can serve as a way of connecting electrical instrumentation to high-voltage, high current power systems. Potential transformers are designed to provide as accurate a voltage step-down ratio as possible. To aid in precise voltage regulation, loading is kept to a minimum: the voltmeter is made to have high input impedance so as to draw as little. It has an ration such as if the ration is like this 500:5 it means if primary voltage is 500V then the secondary voltage is 5V.

Fig 7.9: Potential Transformer PT

Specifications

35kV Voltage Transformer

TYPE: SINGLE PHASE,OIL IMMERSED,OUTDOOR

MODE:JDXF-35W2

RATED VOLTAGE 36kV,

FREQUENCY:50/60HZ

POWER FREQUENCY WITHSTAND VOLTAGE 95kV

IMPULSE WITHSTAND VOLTAGE 200kV

RATED PRIMARY VOLTAGE 33/ROOT 3 kV

RATED RATIO : 33/ROOT3:0.11/ROOT 3:0.11/ROOT 3 :0.11

ACCURACY CLASS 0.2/0.5/6P

Chapter-08

Savar 132/33 KV Grid-Sub-station of PGCB

8.1 Transmission line

8.2 One line diagram

8.3 Instrument Transformer

8.4 Isolator

8.5 Automatic Circuit Recloser

8.6 Lightning arrester

8.7 Bus-Bar arrangement

8.8 Transformer

8.9 Earthing of Station Transformer

8.10 Grounding Switch

8.11 Capacitor Bank for Sub-Station

As 33KV Savar switching sub-station of REB is feed power by Savar 132/33 KV Grid-Sub-station so authorized sent me to visit the Savar 132/33 KV Grid-Sub-station of PGCB (Power Grid Company of Bangladesh) which is one of the power generation and transmission company. So I am going to discuss about 132/33 kv PGCB sub-station details the main components are discussed below:

8.1 Transmission line

This PGCB Grid sub-station is feed power from Aminbazar-1 and Aminbazar-2 through double circuit transmission line of 132kv.

Fig 8.1: Transmission line

Transmission line- double circuit

Name of Transmission line : Aminbazar-1 and Aminbazar-2

commissioning : 2010

tower : 95 Nos

Route Length : 60 k.m

Conductor size : 635 MCM, ACSR

8.2 One line diagram

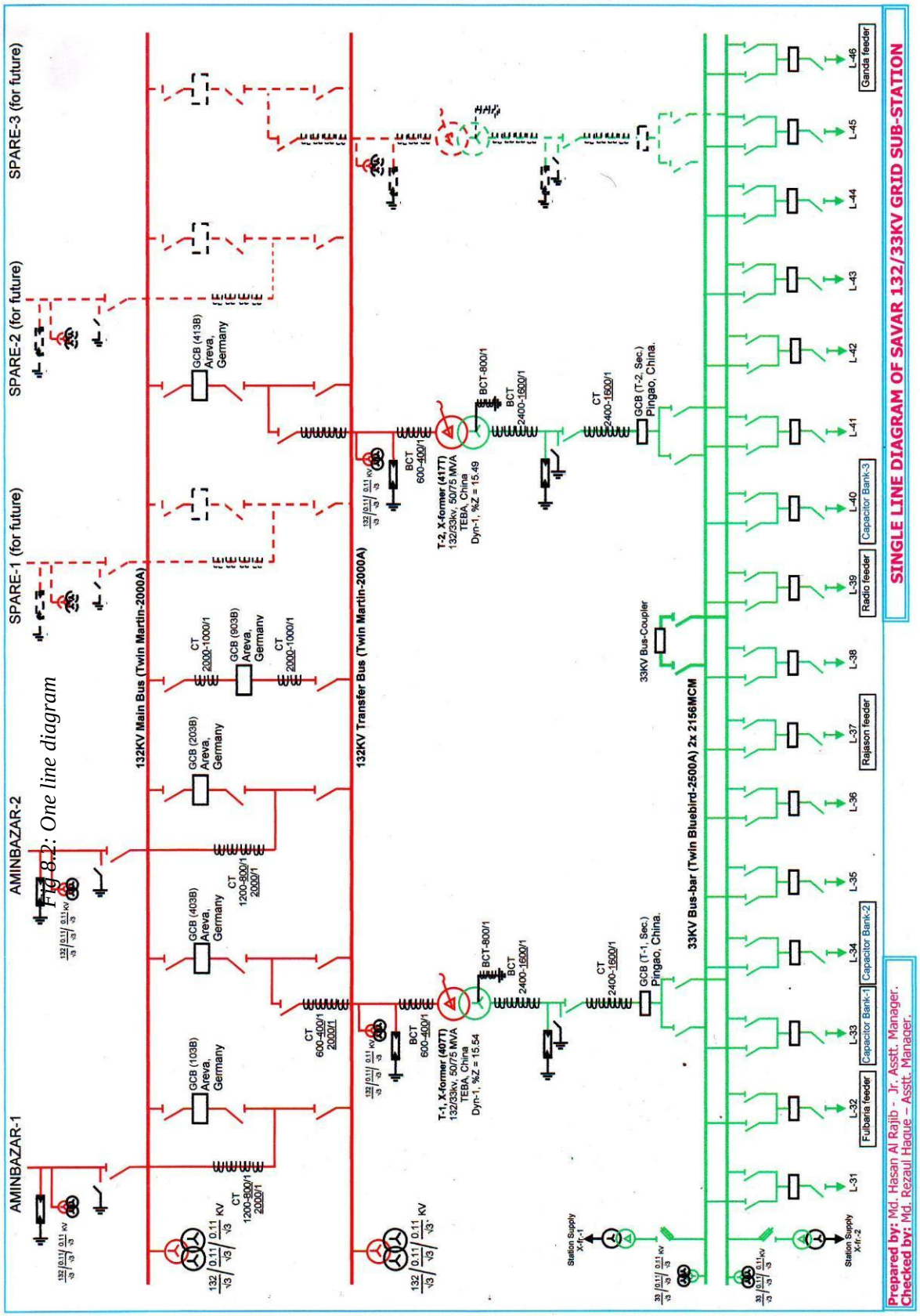


Fig 8.2: One line diagram

Main components of Savar 132/33 KV Grid-Sub-station of PGCB

8.3. Instrument Transformer

1. Potential Transformer

Potential transformer (PT) is used for voltage measurement and power system protection. They are widely used in the power system for over voltage, under voltage, directional and distance protection. The primary of the potential transformer is connected to the power circuit whose voltage has to be measured. The secondary output gives a lower voltage which is very easy to measure by the common voltmeter. The secondary winding turns of PT is designed to produce 110V irrespective of the primary voltage rating.

Fig 8.3: Potential Transformer

Specifications

132KV OIL IMMERSED VOLTAGE TRANSFORMER
TYPE: OUTDOOR, OIL IMMERSED, SINGLE PHASE

MODE:JDC6(F)-132

TECHNICAL DETAILS RATED

VOLTAGE HIGHEST	132KV
VOLTAGE RATED	145/ROOT3KV
FREQUENCY	50 OR 60HZ
RATED VOLTAGE RATIO	132/ROOT3/0.1/ROOT3/0.1KV; 132/ROOT3/0.1/ROOT3/0.1/ROOT3/0.1KV

RATED VOLTAGE FACTOR	1.2TIMES CONTINUOUS,1.5 TIMES 30S
PARTIAL DISCHARGE UNDER 1.2UM/ROOT3KV	NO MORE THAN 5PC
POWER FREQUENCY WITHSTAND VOLTAGE ON PRIMARY WINDINGS"N"TERMINAL TO EARTH	5KV RMS
POWER FREQUENCY WITHSTAND VOLTAGE BETWEEN SECONDARY WINDING AND TO EARTH	3KV RMS
MECHANICAL STRENGTH(THREE DIRECTION)	2000N

2.Current Transformer (CT)

A current transformer (CT) is used for measurement of electric current. When current in a circuit is too high to be measured directly by measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. Current Transformer steps down the current from high value to a low value that can be measured by a measuring instrument or fed to a protective relay for system protection and monitoring. CTs are used extensively for measuring current and monitoring the operation of the power system.

Fig 8.4: Current Transform

8.4 Isolator

Isolator is used to disconnect any section or unit from all live parts of a substation. It is normally a knife switch designed to open a circuit under no load. The main purpose of using isolator is to isolate one portion of a circuit from the other. It should never be opened until the circuit breaker in the same circuit has been opened and should always be closed before the circuit breaker is closed. Isolators are usually placed on either side of the circuit breakers for safety during maintenance and troubleshooting.

Based on the position of the isolator in the system, it can be classified in three ways:

1. Line Isolator : Isolates an incoming or outgoing line from the bus
2. Bus Isolator : Isolates two section of the bus
3. Transformer Isolator : Isolates the transformer from the bus or the lines

Fig 8.5: Isolator

Isolator specification

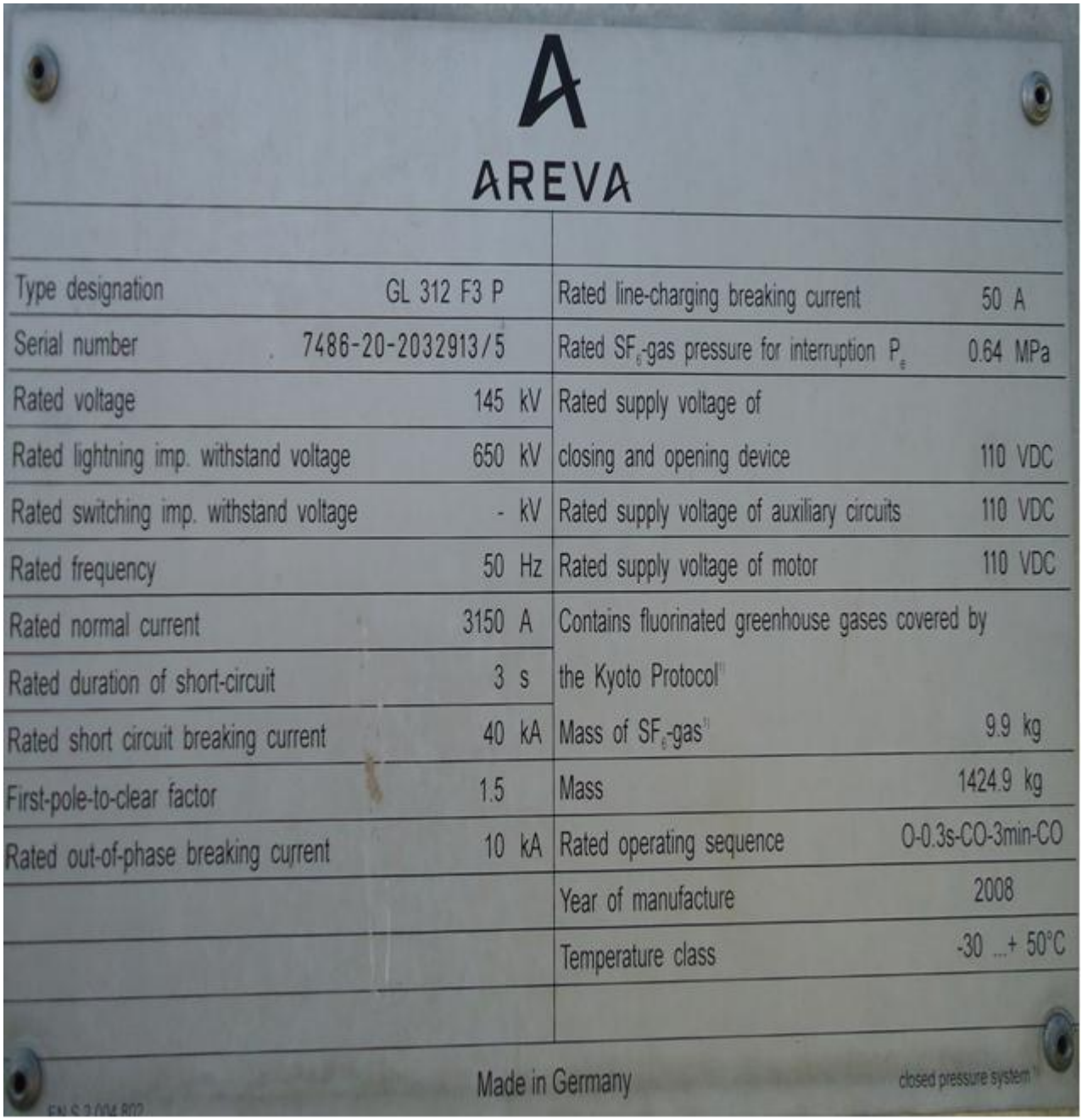
Electromotion operating device	
Type	CJ6B
Operation voltage	110 dc
Operatin current	3.5 a
Control vltage	110 dc
Control current	1a
Numner	0901080
Year	12december, 2008
Weight	50 g

8.5. Automatic Circuit Recloser

It is an one kind of switchgear and protection device. When any type of fault such as ground fault, line fault, short circuit fault etc. it works properly. Besides this due to maintenance of the substation to isolate the line at first it through it line can be isolated where arc is extinguish properly. If the fault is temporary it automatically recloses the line after a few seconds.

Fig 8.6 : Automatic Circuit Recloser

Specifications



AREVA

Type designation	GL 312 F3 P	Rated line-charging breaking current	50 A
Serial number	7486-20-2032913/5	Rated SF_6-gas pressure for interruption P_e	0.64 MPa
Rated voltage	145 kV	Rated supply voltage of	
Rated lightning imp. withstand voltage	650 kV	closing and opening device	110 VDC
Rated switching imp. withstand voltage	- kV	Rated supply voltage of auxiliary circuits	110 VDC
Rated frequency	50 Hz	Rated supply voltage of motor	110 VDC
Rated normal current	3150 A	Contains fluorinated greenhouse gases covered by	
Rated duration of short-circuit	3 s	the Kyoto Protocol[1]	
Rated short circuit breaking current	40 kA	Mass of SF_6-gas[1]	9.9 kg
First-pole-to-clear factor	1.5	Mass	1424.9 kg
Rated out-of-phase breaking current	10 kA	Rated operating sequence	O-0.3s-CO-3min-CO
		Year of manufacture	2008
		Temperature class	-30 ...+ 50°C

Made in Germany

[1] closed pressure system

8.6. Lightning arrester

Lightning arresters are protective devices used to divert the surge voltage due to lightning. It is used in electrical power system to protect the insulation on the system from the damaging effect of lightning. In times of lightening, it conducts the high voltage surges on the power system to the ground.

Fig 8.7: Lightning Arresters

Working Principle of Lightning Arrester : The figure shows a basic form of a surge arrester. It consists of a spark gap in series with a non-linear resistor. One end of the diverter is connected to the terminal of the equipment to be protected and the other end is effectively grounded. The length of the gas is so adjusted that normal line voltage is not enough to cause an arc across the gap but a dangerously high voltage will break down the air insulation and form an arc. The property of the non-linear resistor is that its resistance decreases as the voltage/ current increases and vice-versa.

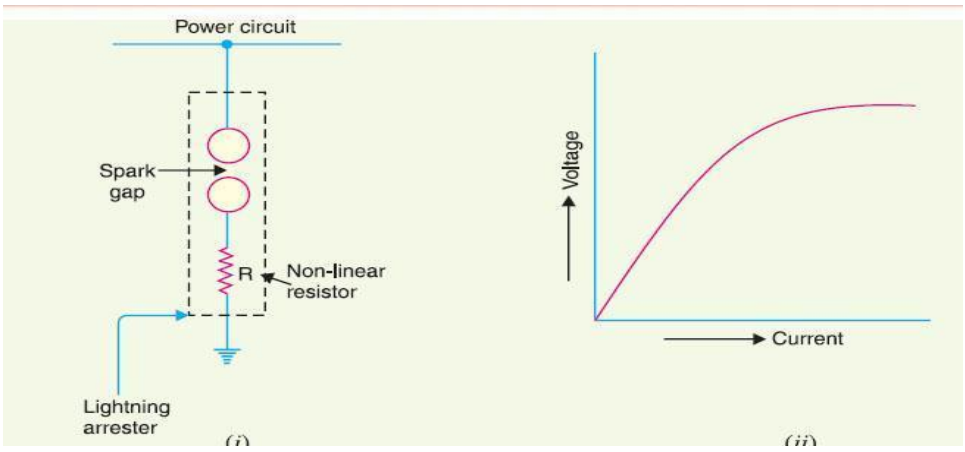


Fig 8.8 : Lightering Arrester working principle

8.7 Bus-Bar arrangement

When a number of generators or feeders operating at the same voltage have to be directly connected electrically, bus-bars are used as the common electrical component. Bus-bars are copper rods or thin walled tubes and operate at constant voltage. Below three types of bus-bar system are mentioned

I. Single bus-bar system

II. Single bus-bar system with sectionalisation

III. Duplicate bus-bar system

Fig 8.9: Bus-bar arramgement

8.8 Transformer

Electrical Power Transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual induction between two windings. It transforms power from one circuit to another without changing its frequency but may be in different voltage level.

Fig 8.10 : Power transformer

1. **Transformer Tank** –This holds the transformer windings and its insulating medium (oil-filled). Transformer tanks must be air-tightly sealed for it to isolate its content from any atmospheric contaminants.

2. **High Voltage Bushing** – this is the terminals where the primary windings of the transformer terminates and serves as an insulator from the transformer tank. Its creapage distance is dependent on the voltage rating of the transformer.

3. **Low Voltage Bushing** –like the high voltage bushing, this is the terminals where the secondary windings of the transformer terminates and serves as an insulator from the transformer tank. Low voltage bushing can be easily distinguished from its high voltage counterpart since low voltage bushings are usually smaller in size compared to the high voltage bushing.

4. **Cooling Fins/Radiator** –in order for the transformer to dissipate the heat it generated in its oil-insulation, cooling fins and radiators are usually attached to the transformer tanks. The capacity of the transformer is dependent to its temperature that is why it is imperative for it to have a cooling mechanism for better performance and higher efficiency.

5. **Cooling Fans** –can be usually found attached to the cooling fins. Cooling fans can be either be a timer controlled or a winding/oil temperature controlled. Cooling fans helps raises the transformer capacity during times when the temperature of the transformer rises due to its loading. Cooling fans used on the transformer are actuated by the help of a relaying device which when senses a relatively high temperature enables the fan to automatically run.

6. **Conservator Tank** –An oil preservation system in which the oil in the main tank is isolated from the atmosphere, over the temperature range specified, by means of an auxiliary tank partly filled with oil and connected to the completely filled main tank.

7. **Oil level indicator** –through this analog indicator oil can be measured. Actually it indicates the oil level if the oil level inside the transformer is below the margin level then the transformer oil is fed by the power transformer.

8.**Temperature indicator**—through this analog indicator temperature of the oil is measured. If the temperature of the oil is below the margin , the force cooling system is run automatically or manually to keep the oil temperature below the margin temperature level.

9. **Bushing CT**- this bushing CT is use to measure the current of the primary winding of the transformer. This measured value is monitored at the control room.

10. **Control box**- this box is used to control the transformer such as tap changing etc.

8.9 Earthing of Station Transformer

Two earthing transformer having provided in the 33 kV side of 132kV transformer. Power transformers are using Delta-Star connection. So if any fault occurs in secondary side, the earthing transformer grounds those current due to star connection. So a neutral provided to power Trans formers. Also it provides power for substation. In this type of transformer zigzag star and normal star connections are used. Zigzag star is used in H.V sides & normal stars are used in L.V side. Here in the H.V side zigzag stars used, because it reduces the heating effect of fault current & makes it robust.

8.10 Grounding Switch

Grounding switch provide safety during maintenance work. For any maintenance work the safety steps that must be taken is-

Step 1: Load CB must be open

Step 2: Isolator must be open

Step 3: Grounding switch must be close

When maintenance work is done the reveres processes must be done

Grounding Switch is in close position

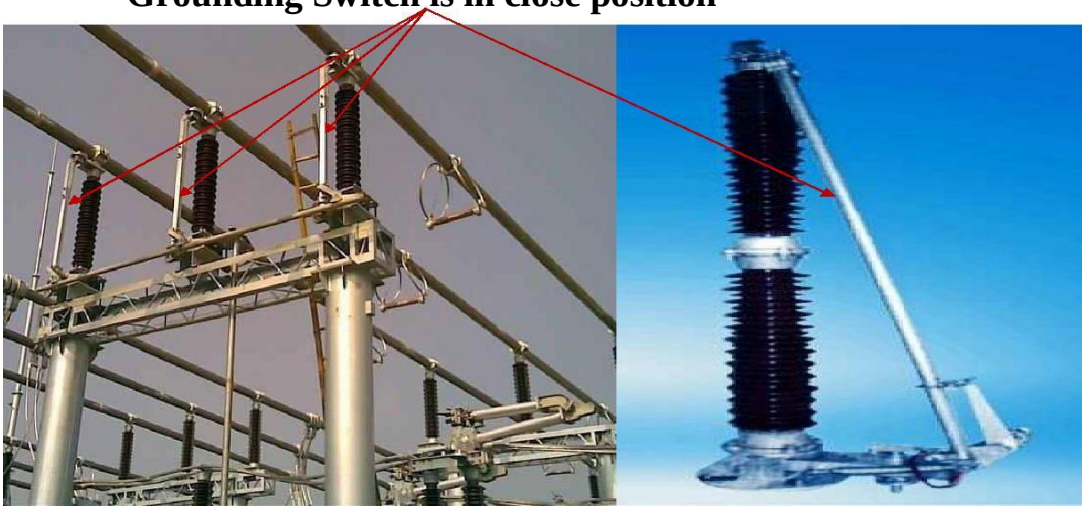


Fig 8.11: Grounding Switch in close position

Specifications

Type	: RD 303/S12668
Manufacturer	: Hawker Siddeley, UK
Commissioning	: 1994
Rated Voltage	: 132 KV
Max Voltage	: 145 KV
Rated Current	: 1250 Amps
Short Time Current	: 31.5 KA for 3 Sec
Rated Lighting Impulse Withstand	: 650 KV

8.11 Capacitor Bank for Sub-Station

The capacitor banks are used across the bus so that the voltage does not get down below the required voltage. When the inductive property of the line increases then the voltage lags behind current & causes loss of money, so to raise the voltage up &prevent loss of money capacitor banks are used. It raises the voltage, raises power factor as well.

Fig 8.12: Capacitor Bank

Normally, the power factor of the whole load on a large generating station is in the region of 0.8 to 0.9. However, sometimes it is lower and in such cases it is generally desirable to take special steps to improve the power factor, This can achieved by the following equipment.

- **i** Static capacitors
- **ii** Synchronous condenser
- **iii** Phase advancers

Static capacitor

Power factor can be improved by connecting capacitors in parallel with the equipment operating at lagging power factor. The capacitor (generally known as static capacitor) draws a leading current and partly or completely neutralizes the lagging reactive component of load current. This raises the power factor of the load. For three phase loads the capacitors can be connected in delta or star as shown in fig:04 .Static capacitors are invariably use for power factor improvement in factories.

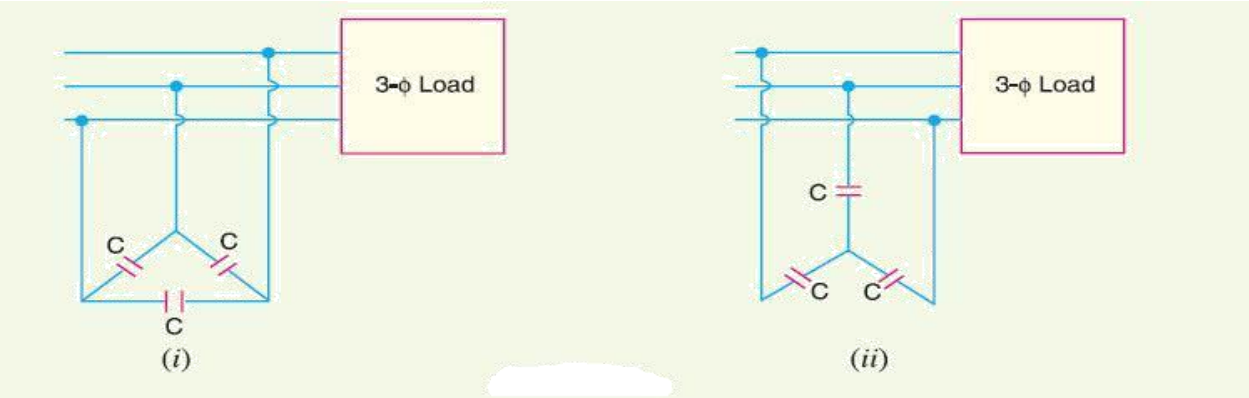


Fig 8.13: power factor improvement

Chapter-09

Control Room

9.01 Main equipments of Control Room

9.01 Main equipments of control room

It is a room from where all the switchgear equipments are controlled. Here all the equipments are connected through grounding wire or underground cable. When any operation is done , the associated operation is done by motor control. This room is equipped with high tension panels (H.T)and low tension panels (L.T) whose are connected with the associated switchgear equipments. The line voltage , line current, phase voltage , power factor etc. values are monitored in this room. These values are recorded in a note book. It has also a battery backup section which works when is fail. There is also a battery charger. These batteries arrangement supplies about 110 V and high ampere. So the main equipments installed in control room are listed below:

1. High tension panel
2. Low tension panel
3. Bus-bar coupling
4. Power factor improvement coupling panel
5. Back up battery
6. Battery charger
7. Relay panel

Fig 9.1: Control Room for 33KV Switching sub-station

1. High Tension Panel-this is a panel where 132kv or 33 kv switchgears are operated. The line voltage, line current, phase voltage, power factor etc. values are measured and monitored. Due to fault condition it automatically operates the high tension switchgears. For each feeder the is a H.T panel.

2. DC system of the Sub-Station

Storage Battery:

A cell is a device in which an electrical difference of potential is established between the two electrodes as a result of chemical reaction between the electrode & electrolyte. There are two types of cell:-

1. Primary cell
2. Secondary or storage cell.
   A) Lead acid cell
   B) Alkaline cell

Working Principle:

When the +ve plate of Lead per Oxide & -ve plates of spongy lead are immersed in dilute & H2SO4 & connected together by means of external circuit, current flows round the circuit. The cell works until the per Oxide is used up & under this condition the cell is said to be discharging. The cell under fully discharged condition: Positive Plate=PbO_2

Negative plate=Pb Electrolyte=dil. H_2SO_4 (sp. Gravity=1.25)

During discharge: The chemical action can be represented by the following chemical equation.

At +ve condition : - $PbO_2+H_2+H_2SO_4=PbSO_4+2H_2O$

At–ve condition:- $Pb+SO_4=PbSO_4$

During Charging:- When a direct current from an external source is passed through it from positive to negative, the following, the following changes will occur:-

At +ve plate:- $PbSO_4+So_2+2H_2O=PbSO_4+2H_2O$

At–ve plate:-$PbSO_4+H_2=Pb+H_2SO_4$

Color of the plate at the end of the charge becomes:-Positive plate:-Dark Brown Negative plate:-Slate Gray The batteries are connected to the circuit breaker for tripping the circuit breaker. Here trip is used through type relays.

3. Protective relay

Relay Definition

A protective relay is a device that detects the fault and initiates the operation of the C.B. is to isolate the defective element from the rest condition in the electrical circuit by constantly measuring the electrical quantities, which are

different under normal and fault condition. The electrical quantities which may change under fault condition are voltage, current, frequency and phase angle. Having detected the fault, the relay operates to close the trip circuit of C.B. There are two principle reasons for this; firstly, if the fault is not cleared quickly, it may cause unnecessary interruption of service to the customer. Secondly, rapid disconnection of faulty apparatus limits the amount of damage to it & a prevents the effects from speeding into the system.

Working pricipal of relay with circuit breaker

From the symbolic diagram we can see from the source line Electric power is coming through

the CB to the Bus Bar. Now if a fault _F' i through the line. Now we can see before CB a CT is there for protection. CT ratio is designed

to detect the fault current ie; if the current is more than the CT ratio then it is treat as fault current. When such type of current is flow through line then CT secondary energized

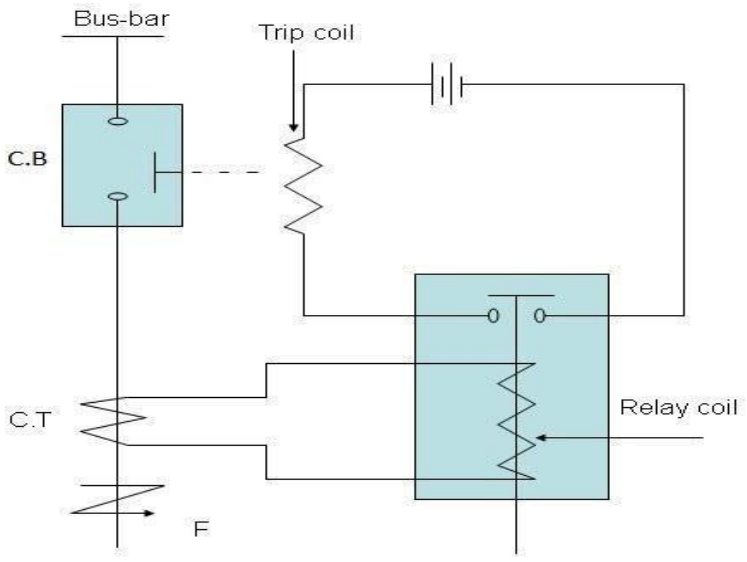


Fig 9.2: Schematic diagram of relay with circuit breaker

The relay coil, this relay coil close the path of trip circuit, trip circuit get power by the DC source which energized the trip coil, this trip coil give the trip pulse to the CB, and CB is operate to open so the switchgear equipment‘s stay safe.

Fig: block diagram of operation of Circuit breaker

Classification of Relay:

The following important types of relays are generally used in electrical distribution & transmission line:

i) Induction type over current relay.
ii) Induction type over voltage relay.
iii) Distance relay.
iv) Instantaneous relay.
v) Differential relay.
vi) Earth Fault relay.
vii) Numerical relay.
viii) Lock out relay.

Numerical Relay

The numerical transformer protection unit RET316*4 is designed for the fast, selective protection of two- or three-winding transformers. In addition the application for the protection of auto-transformers and block generator-transformer units is possible. The relay will detect different kinds of faults

Fig 9.3 : Numerical

Fig: 9.4: Numerical Relay

Chapter -10

Sub-Station Protection

10.1 Protection against Lightning

10.1 Protection against Lightning:

Transients or Surges on the power system may originate from switching or other causes, but the most important& dangerous surges are those which caused by lightning. The lightning surges may cause serious damage t transmission lines that reach the ssaryequipmentto

provide a protection against lightning surges, they are:-

1. Earth Screen.
2. Overhead Ground Wire.
3. Lightning Arrestor.
4. The Fire Protection

1. Earth Screen:

The power stations & the substations are ge
These stations can be protected from direct lightning strikes by providing earthing screens.

It consists of a network of Copper conducto in the substation or Power station. The screen is properly connected to earth on at least two

points through low impedance. On the occurrence of direct stroke on the station the screen provides a low resistance path by which lightning surges are connected to the ground. In this way station equipment‘sning. are protected a

2. Overhead Ground Wires

The most effective method of providing protection against direct lightning strokes is by the use of overhead ground wires. The ground wires are placed over line conductors at such position that practically all lightning strokes are intercepted by them. The ground wire is ground at each tower or pole through as low resistance as possible. When the direct lightning strokes occur on the transmission line will be taken u by the ground wire. The heavy current flows to the ground through the ground wire, so it protects the line from harmful effects of lightning.

3. Lightning arrester

Lightning arresters are protective devices for limiting surge voltages due to lightning strikes. A lightning arrester is a device used on electrical power systems to protect the insulation and conductors of the system from the damaging effects of lightning. The typical lightning arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge, which is very similar) travels along the power line to the arrester, the current from the surge is diverted through the arrestor, in most cases to

Technical Specification

Type	: 2MB120X Max Rating 120 KV 10 KA Heavy Duty Station Class Pressure Relief Class B Long Duration Discharge 1 Unit Sections 2
Manufacturer	: Bowthorpe, England
Year of Manufacture	: 1991

4. Fire Protection

The fire protection device should be kept in store yard for safety of equipment‘s during storage. It can be useful in the time of danger. This includes fire extinguishers, constant

supply of water etc.

Chapter -11

Operation & Maintenance of S/S

11.1 Operation

11.2 Transformer test

11.3 Transformer test on Annual maintenance for PGCB substation, Savar

11.4 Transformer Vector Group

11.5 Maintenance of Circuit breaker

11.1 Operation

To operate a grid substation there are some operation engineers under the supervision of the grid in charge. In Tongi grid substation there are eight operation engineers, & 4 technical staff.

Shutdown work: In the electrical system for any kinds of maintenance work on any section, the must prerequisite is to assure the proper shutdown for that section. For this the maintenance engineer will submit written request to the authority for shutdown of the specific part of the electrical system where maintenance is required. After that the authority will take necessary steps to assure the proper shutdown of the specific part of the system.

All load feeders CB must be open which belongs to that transformer.

1) Transformer secondary side (33kV) CB ie; Incoming CB open.
2) Transformer 132kV side CB ie; primary side CB open.
3) Isolator open from both 132KV & 33kV side.
4) Grounding Switch Close from both 132kV & 33kV side.
5) Make additional grounding if required.
6) Now the maintenance work can be started

Shifting Duty

i. Make record of Power (MW) flow in each hour

ii. Make record of Energy (MWh) flow in each hour

iii. Switchgear equipment'snpection

iv. Shutdown work

v. Load Management

Fig 11.1 :PGCB Duty

Routine inspection & cleaning

Routine inspection is done by the shift engineers & routine cleaning is done by the technical stuffs. Measuring the temperature of every joint is a part of daily inspection, a thermo gun is use to measure the temperature. It emits red laser light on the specific joint & temperature reading is shown on its display. Temperature reading is taken below-

Fig 11.2: Routine inspection

i. **Emergency Maintenance:** Emergency maintenance is required when any uncertain hazard is occurred in the electric system.

ii. **Annual Maintenance:** In PBS-1,PGCB every end of the year they arrange annual maintenance schedule for every grid substation with a specific annual maintenance order.

11.2 Transformer test

Routine Tests:

1. Measurement of winding resistance
2. Measurement of voltage ratio and check of phase displacement
3. Measurement of short-circuit impedance and load loss
4. Measurement of no-load loss and current
5. Dielectric tests
6. Separate source AC withstand voltage test
7. Induced AC voltage test
8. Partial-discharge measurement

Type Tests:

9. Temperature-rise test
10. Lightning-Impulse tests

Special Tests:

11. Switching impulse voltage test
12. Measurement of dissipation factor (tan **δ**) and capacitance
13. Measurement of zero sequence impedance(s)
14. Determination of sound level
15. Measurement of harmonics of the no-load current

A good transformer should have unbalances less than:

1. Resistance: Not more than 5% unbalance above 0.250 Ohms and 7.5% below 0.250 Ohms.
2. Impedance: < 2% unbalance
3. Inductance: < 5% unbalance
4. Phase Angle: Not more than 1 degree between phases

5. I/F: Not more than 2 digits difference and the readings should fall between 15 and 50.

6. A shift in readings should be flagged for further testing or trending. For instance, a winding that tests as I/F:

-48; -48; -46 and Phase Angle: 70^{o}; 70^{o}; 69^{o}, should be checked further.

Normally, a winding is beginning to experience inter-turn shorts when the Phase Angle and I/F begin to shift. A corresponding unbalance in inductance and impedance indicates a severe fault. A change in Phase Angle with a fairly balanced I/F normally indicates a phase short.

For three phase transformer testing:

1. All of the leads on the side opposite of the side being tested must be grounded to an earth ground.

2. Test the primary from H1 to H2, then retest to verify that the readings are repeatable. If they are not repeatable, check the ground and continue.

3. Test from H1 to H3, then H2 to H3, and, finally a ground insulation test.

4. Save the readings and check condition.

5. Test the secondary winding by first checking X1 to X2, then retest to verify that the readings are repeatable. If they are not repeatable, check the ground and continue.

6. Test from X1 to X3, then X2 to X3, and, finally, a ground insulation test.

7. Save the readings and check condition.

For single phase transformer:

Single-phase transformers are tested slightly differently and require a known reading for the primary to be compared to, such as with a similar transformer or a past test on the same transformer. The basic steps for single phase transformer testing are as follow:

1. All of the leads on the side opposite of the side being tested must be grounded to an earth ground.

2. Test the primary from H1 to H2, then retest to verify that the readings are repeatable. If they are not repeatable, check the ground and retest

3. Ground the primary then test X1 to X2, then retest to verify that the readings are repeatable. If they are not, then check the ground and retest. .

These procedures can be used on three phase pad mount and single phase pole mount transformers regardless of connection type.

11.3 Transformer test on Annual maintenance for PGCB substation, Savar Transformer Rating Sheet Job Description:

50/75 MVA, 132/33 KV 3-phase, 50Hz Power Transformer

Number of Phase(s)	:	**3 (Three)**	
Rated Frequency	:	**50 Hz**	
Vector Group	:	**Dyn1**	
Connections	**:**	Three-Phase	
Type of Tap Changer	**:**	ON-Load Tap Changer	
Winding Designation	:	*HV*	*LV*
Terminal Notation	:	**A B C**	**n a b c**
Rated Capacity in MVA			
ONAN	:	**50**	**50**
ONAF	**:**	60	60
OFAF	**:**	75	75
Rated Voltage (in kV)	:	**132**	**33**
Rated Current (in Ampere)			
ONAN	:	**153.08**	**612.35**
ONAF	**:**	218.69	874.79
OFAF	**:**	24 0.56	962.27
Basic Insulation level (in kV)			
Line Terminals	**:**	LI-650, AC-275	LI-200, AC-70
Standard	**:**	BS –171 / IEC - 76	

LV Voltage	**:**	33000 Volts in all Tap Positions.
Serial No.	**:**	163843

****** **ONAN :** Oil Natural Air Natural.

** **ONAF :** Oil Natural Air Forced.
** **OFAF :** Oil Forced. Air Forced.

11.4 Transformer Vector Group

The phase windings of a poly phase transformer can be connected internally in different configurations, depending on what characteristics are needed from the transformer. For example, in a three-phase power system, it may be necessary to connect a three-wire system to a four-wire system, or vice versa. Because of this, transformers are manufactured with a variety of winding configurations to meet these requirements.

Different combinations of winding connections will result in different phase angles between the voltages on the windings. This limits the types of transformers that can be connected between two systems, because mismatching phase angles can result in circulating current and other system disturbances.

Symbol Designation:

The vector group provides a simple way of indicating how the internal connections of a particular transformer are arranged. In the system adopted by the IEC, the vector group is indicated by a code consisting of two or three letters, followed by one or two digits. The letters indicate the winding configuration as follows:

1. D: Delta winding, also called a mesh winding. Each phase terminal connects to two windings, so the windings form a triangular configuration with the terminals on the points of the triangle.

2. Y: Wye winding, also called a star winding. Each phase terminal connects to one end of a winding, and the other end of each winding connects to the other two at a central point, so that the configuration resembles a capital letter *Y*. The central point may be connected outside of the transformer.

3. Z: Zigzag winding, or interconnected-star winding. Basically similar to a star winding, but the windings are arranged so that the three legs are "bent" when the phase diagram is drawn. Zigzag-wound transformers have special characteristics and are not commonly used where these characteristics are not the transformer at all, and must be connected externally.

11.5 Maintenance of Circuit breaker

Yearly the circuit breakers are required to maintain. It is required to measure the ohms between the two conductors whose are namely fixed contact and moving contact. If the measuring value is small, it is good for the system.

Fig 11.3: Fixed contact is taken out for to maintenance

Chapter -12

Supplementary Part

12.1 Recommendation

12.2 Conclusion

12.1 Recommendation

The following points should be developed -

- All instruments should be clearance between two equipment.
- Bus-bar should be used 20% or 30% ampere greater than the load current.
- Every circuit breaker really has time setting option from 0-1sec.If circuit breaker is more than one the time setting should be from 10ms to 80ms or 10ms to 1sec from load circuit breaker to generator circuit breaker.
- Transformer oil and silica gel should be checked after one month or any types of fault occurs any time . Oil should be changed if it is decomposed.
- All cable should be cheek before use or any kinds
- They use manually based equipment, if they use PLC based equipment then the system will be easier.
- If they use new technology then the system loss will be reduce.
- High system loss, it will be reducing.

12.2 Conclusion

For a technical service provider plant O&M activities are very important as its service mostly depends on the availability of its equipment. To maintain properly it requires very efficient O&M activities with minimum costing. By using proper O&M schedule of substation cost can be reduced and supply can be increased. O&M is traditionally classified as a part of output that comes from the system. There are many diverse ways of evaluating O&M of power system, as well as different objectives. O&M comprises all measures for maintaining and restoring the target condition as well as determining and assessing the actual condition of the technical equipment in a system. During this study, it has been observed from the organizational point of view where it has been implemented. There are so many improvements and applications that can be offered through this substation which of course would have direct benefit for the organization.

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Appendix

A

AC : Alternating Current
Alternator :A synchronous AC generator
Alternator rotor: The rotor consists of a coil of wire wrapped around an iron core

B

Bus-bar : The metal (often copper) bar system which is the distribution media for the 3phase high voltage system in the power plant

C

Current Transformer: In electrical engineering, a current transformer (CT) is used for measurement of electric currents. Current transformers are also known as instrument transformers.

Capacitor :A device capable of storing electric energy. It consists of two conducting surfaces separated by insulating material. It blocks the flow of direct current while allowing alternating current to pass.

Conductor :A wire or cable for carrying current.

CT : Short for Current Transformer. An AC current measuring the generators to share the reactive component of the

Current: The rate of flow of electricity. The unit of the ampere (A) defined as 1 ampere = 1 coulomb per second.

Circuit Breaker: An automatic switch that stops the flow of electric current in a suddenly overloaded or otherwise abnormally stressed electric circuit.

D

DPBS: DHAKA PALLI BIDYUT SAMITY-1

F

Frequency: Number of cycles over a specified time period over which an event occurs.

Feeder : The temperature to which oil must be heated in order to give sufficient vapor to form a flammable mixture with air under the conditions of the test. The vapor will ignite but will not support combustion

G

Generator: A device that produces electric current, usually by rotating a conductor in a magnetic field, thereby generating current through electromagnetic induction.

H

Hertz (Hz): Units in which frequency is expressed. Synonymous with cycles per second values. Machine language programs are often written in hexadecimal notation.

HT
High Temperature (cooling water circuit)

I

Isolator: A passive attenuator in which the loss in one direction is much greater than that in the opposite direction; a ferrite isolator for waveguides is an example.

L

Load: The electrical demand of a process expressed as power (watts), current (amps) or resistance (ohms).

Load sharing: The way in which two or more alternators are run to accommodate the load demands from the electrical network

LT side: Low tension side

M

O

O&M: Operation and Maintenance

P

Parallel operation : More than one unit supplying power to the same network.

Phase line: A line in an electrical network having system voltage potential.

PLC : Programmable Logic Controller.

Power factor : The extent to which the voltage zero differs from the current zero. (p.f = kW / kVA)

PT : Potential Transformer

PGCB: Power Grid Company Of Bangladesh Ltd.

R

REB: Rural Electrification Board

S

SF6: SulphurHexa Fluoride Circuit Breaker

V

Voltage droop: The difference in voltage at no-load and full-load expressed as a percent of the full-load value.

Voltage regulator :A device which maintains the voltage output of a generator by other electrical equipment.

Y

Y-connection: An interconnection of the phases of a three-phase system to form a configuration Resembling the letter Y. A fourth neutral wire.