OVERVIEW OF 132/33 KV SUBSTATION
POWER GRID COMPANY OF BANGLADESH (PGCB)

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

BY

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CERTIFICATION

This is to guarantee that this undertaking and proposal entitled "**OUTLINE OF 132/33 KV SUBSTATION"** is finished by the accompanying understudy under my immediate supervision and this work has been completed by him in the research centers of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in fractional satisfaction of the prerequisites for the level of Bachelor of Science in Electrical and Electronic Engineering. The introduction of the work was hung on 10 October 2019.

Signature of the candidates

_____

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Dedicated to

Our Parents

ABSTRACT

Power Grid Company of Bangladesh Ltd. (PGCB) at kallyanpur in Dhaka capital of Bangladesh was shaped beneath the restructuring method of the facility Sector in Bangladesh with the target of transferal regarding its business atmosphere as well as increasing potency, institution of answerableness and dynamism in fulfilling its objectives. PGCB was incorporated in Gregorian calendar month 1996 with a certified capital of Tk.10 billion. It had been entrusted with the responsibility to work and expand its own national facility. The target of the PGCB is to produce electric power and energy to every space over the country inside its geographical place for irrigation pumping, food process, cottage, industries and alternative little or massive industries, business centers, health, and social services and family dwellings. This objective is to be achieved through the realm coverage rural electrification construct by constructing in operation and maintaining lines up to 132/33 KV potential units and increasing lines from the existing distribution system. Every potential shopper inside the PGCB place could become a member of the PGCB. The membership being obtained by application and payment of nominal subscription fee. Providing electrical power and energy to its shopper members at the bottom value attainable per sound economy and sensible management may be a prime requirement of the PGCB

INDEX

LIST OF ABBREVIATION

EHV -Extra High Voltage

SLD -Single line Diagram

PT -Potential Transformer

CT -Current Transformer

HVCT -High Voltage CT

LVCT -Low Voltage CT

CVT -Capacitor Voltage Transformer

LA -Lightening Arrestors

ES -Earth Switching

CB -circuit Breaker

HV side -High Voltage Side

LV side -Low Voltage Side

PLCC -Power Line Carrier Communication

OLTC -On Load Tap Changer

HG Fuse -Horn Gap Ruse

OTT -Oil Temperature Indicator

WTI -Winding Temperature Indicator

IDMT Characteristics - Inverse Definite Minimum Time Characteristics

LIST OF SYMBOLS

X0 – Zero sequence reactance

X1- Positive sequence reactance

R0- Zero sequence resistance

Ip – Primary current

Np – Primary Winding Turns

Is – Secondary Current

Ns – Secondary Winding Turns

Vp – Primary voltage

Vs – Secondary voltage

Zs – Impedance attached at the secondary side coil

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CHAPTER 1

INTRODUCTION

1.1: INTRODUCTION

The current-day power system is A.C. i.e. electrical power is generated, transmitted and distributed within the type of AC. the electrical power is made at the ability stations that area unit situated in favorable places, sometimes quite aloof from the shoppers. It's delivered to the shoppers through the transmission and distribution of the big network. At several places within the line of the ability system, it should be fascinating and necessary to vary a number of the characteristics (voltage, AC to DC, frequency, power issue etc.) electrical offer. This can be accomplished by appropriate equipment known as sub-station. General Chat Lounge, for instance, the generation voltage (11KV or six.6KV) at the ability station is stepped up to high voltage (say 220KV or 132KV) for transmission of electrical power. The assembly of equipment (eg electrical device etc.) used for this purpose is that the sub-station. Similarly, the nearer the localities of the consumer's, the voltage is also stepped right down to the user level. This job is once more completed by appropriate equipment known as ' sub-station.

Figure 1.1: Sub-station

1.2: COMPANY PROFILE

Company name: Power Grid Company of Bangladesh

Head office: Power Grid Company of Bangladesh Ltd.

PGCB Building, Zahurul Islam City, Avenue-1, Aftab Nagar, Badda, Dhaka-1212

Date of start: Established in 1972

Transformer capacity: 3*50/75 MVA

Total capacity: 225 MVA

Grid Circle: Dhaka North

1.3: OBJECTIVE OF THE INTERNSHIP

The first objective is to complete the EEE400 course that is a vital a part of finishing a Bachelor in EEE at DIU. Before doing this place we tend to had solely theoretical data on these topics but on completion of associate place in Kallyanpur we've attained sensible data too. The following list summarizes our place goals.

* Standing Understanding official management
* Getting sensible data concerning the ability Distribution System.
* Getting sensible data concerning varied protection.
* Getting data concerning safety

1.4: SCOPE

This report relies on the office program wherever we tend to reviewed the fundamental method of power distribution and station of Kallyanpur. It additionally contains descriptions of assorted electrical equipment's that area unit wont to distribute power in Kallyanpur. The report contains alternative relevant info regarding the Kallyanpur that we tend to ascertained throughout the internship program

1.5: METHODOLOGY

Both primary and secondary knowledge area unit collected for this report. This report is focused of 132/33 KV sub-station of Kallyanpur near about Shymoli,Dhaka north city, Dhaka

* Primary information: the knowledge is gathered by personal observation and dealing with the sub-station engineers at Kallyanpur substation.

* Secondary information: the corporate web site and varied single line diagrams provided by the engineers whom we tend to worked with

1.6: VISION AND MISSION

Vision

The Rural Electrification Board of our country has been giving service to rural member consumers for over 40 years. Continuing support from the govt of Bangladesh, the donor community, consulting partners, and member-consumers can facilitate this program still expand, providing the gift of electricity to millions a lot of Bangladeshi households, businesses, and industries.

Mission

* To deliver quality full electrical line to people door at reasonable and affordable prices with outstanding professional services
* To bring all the people of the country into electrical service
* Electricity for all within 2021

CHAPTER 2
SUB-STATION

2.1: INTRODUCTION

An electrical substation could be a place wherever high-voltage electricity is "stepped-down" to low voltage and probably "rectified" from AC to DC. The typical parts are transformers, switchgear (isolators) and optionally rectifiers. Often there'll be systems to remotely monitor and management the instrumentality likewise. Long distance transmission power is a lot of economical and fewer expensive victimization terribly high-voltage AC (AC) however that has to be reborn into lower voltages and generally into DC utilized by motors in trains. As long as the trains need heaps of power, the parts within the train for a station are going to be massive and need area. At low voltages the losses within the railway power distribution system become fairly distant, and then substations are placed each few miles on the track to make sure power is distributed equally and with efficiency.

2.2: CLASSIFICATION OF SUB-STATION

There are many ways of classifying substation. Here we discussing two most important ways of classifying sub-station are according to service requirement and constructional features.

2.2.1 ACCORDING TO SERVICE REQUIREMENT

A sub-station might be called upon to change voltage level or improve factor or convert air conditioning power into dc control and so on. As per the administration prerequisite, sub-station might be arranged into:

* **Transformer Sub-Station:** Those sub-station which change the voltage level of electric stock are called transformer sub-station.5
* **Exchanging Sub-Station:** An exchanging sub-station is a sub-station which doesn't contain transformer and works just at a solitary voltage level. Exchanging sub-station are here and there utilized as gatherer and conveyance station.
* **Power Factor Redress Sub-Station:** This sub-station which improve the power factor of the framework are called power factor amendment sub-station.

* **Changer Sub-Station:** This sub-station which change the inventory recurrence are known as recurrence changer sub-station.
* **Changing over Sub-Station:** Those sub-station which change the exchanging current into direct current are called changing over sub-station.
* **Modern Sub-Station:** This sub-station which supply capacity to individual mechanical concern are known as modern sub-station.

2.2.2: ACCORDING TO CONSTRUCTIONAL FEATURES

* **Indoor Sub-Station:** For voltage up to 11kv, the instrumentation of the station is installed indoor owing to economic thought.
* **Outdoors Sub-Station:** For voltage on the far side 33kv, instrumentation is strict put in outdoor. It's as a result of for such voltages, the clearness between conductors and therefore the area required for switches, circuit breakers and therefore the different instrumentation becomes thus nice.
* **Underground Sub-Station:** In thickly inhabited areas, the area on the market for equipment and building is restricted and therefore the price land is high. This kind of sub-station is created underground.
* **Pole-mounted sub-stations:** this is often an out of doors sub-station with instrumentation put in overhead on H-pole or 4-pole structure. It's the most affordable kind of sub-station for voltages not extraordinary eleven potential unit

2.2.3: COMPONENT OF SUB-STATION

* **Approaching Circuit:** Lightning arrestor, Overhead earth wire, Isolator, Wires, Earth switch and so forth approaching lines.
* **Transformer:** Transformer is a static bit of electric hardware which transformer air conditioning electric forces starting with one circuit then onto the next by venture up or step-down the voltage at the equivalent recurrence.
* **Low Voltage Change gear Board:** Transport bars, Isolator, Breakers, Attractive temporary workers, Air break switch, Different kinds of no-combine breaker, Showing instruments, Different defensive transfers and so forth and PFI capacitor.
* **Active Lines:** To another switchgear and defensive gadget appropriate for the heaps taking power.

2.3: COMPARISON BETWEEN OUTDOOR AND INDOOR SUBSTATION

Sl No	Particular	Outdoor substation	Indoor substation
1	Space required	More	Less
2	Time require for erection	Less	More
3	Future extension	Easy	Difficult
4	Fault location	Easier because the equipment in full view	Difficult because equipment is enclosed
5	Capital cost	Low	High
6	operation	Difficult	Easier
7	Possibility of fault escalation	Less because greater clearance can be provide	More

Table No 2.1: comparison between outdoor and indoor substation

2.4: PRESENT STRUCTURE OF POWER SECTOR IN BANGLADESH

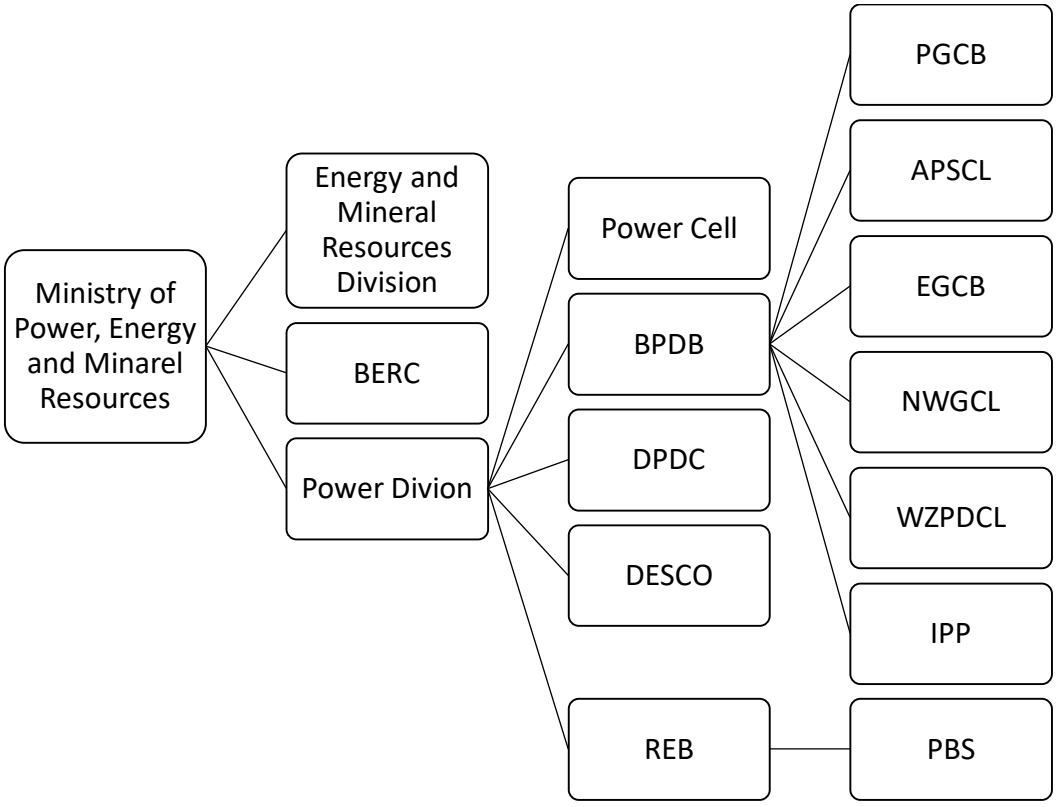

Figure 2.1: Present Structure of Power Section in Bangladesh

2.5: PRESENT POWER GENERATION

Bangladesh Power Sector	:	2019
Electricity Growth	:	7.00%
Installed capacity (MW)	:	20,000
Maximum Generation(MW)	:	MW as on
Total Consumers (in Millions)	:	19293.84
Transmission Lines (Km)	:	11311.302
Distribution Lines (km)	:	3,051,281
Per capita generation (including captive)	:	433
Access to electricity (including off-Grid Renewable)	:	93%

Table 2.2: Present Power Generation

2.6: SELECTION OF SITE

Primary concerns to be considered while choosing the site for EHV Sub-Station are as per the following:

- The site picked ought to be as close to the heap focus as could reasonably be expected.
- It ought to be effectively congenial by street or rail for transportation of equipment's.
- Land ought to be reasonably leveled to limit advancement cost.
- The sub-station site ought to be as close to the town/city yet ought to be clear of open spots, aerodromes, and Military/Police establishments.
- The land ought to be have adequate ground zone to suit substation equipment's, structures, staff quarters, space for capacity of material, for example, store yards and store sheds and so on with streets and space for future development.
- Set back good ways from different streets, for example, National Highways, State.
- While choosing the land for the substation inclination to be given to the Govt. land private land.

There are a few different ways of characterizing sub-stations. In any case, the two most significant methods for ordering them are as indicated by (1) administration necessity and (2) constructional highlights.

CHAPTER 3

EQUIPMENT OF KALLYANPUR SUBSTATION

The electricity station may be a network of electrical instrumentation that is connected during a structured approach so as to produce electricity to finish shoppers. There are various electrical station parts like outgoing and incoming electronic equipment every of that having its circuit breakers, isolators, transformers, and bus system etc. for the graceful functioning of the system. The ability system has various ingredients like distribution, transmission, and generation systems and Substations act as a necessary ingredient for operations of the ability system. The substations are entities from that shoppers have gotten their electrical provide to run their hundreds whereas needed power quality is delivered to the purchasers by ever-changing frequency and voltage levels etc.

Whatever more commonly equipment are

* Instrument Transformers
* Potential Transformer
* Insulators
* Bus Bars
* Circuit Breakers
* Capacitors Bank
* Wave Trapper
* Metering And Indication Instrument
* Prevention From Surge Voltage
* Current Transformer
* Conductors
* Isolators
* Lightning Arrestors
* Relays
* Batteries
* Switchyard
* Equipment For Carrier Current
* The Outgoing Feeders

3.1: INSTRUMENT TRANSFORMERS

Instrument Transformers are utilized in the AC system for measuring of electrical quantities i.e. voltage, current, power, energy, power issue, frequency. Instrument transformers are used with

protecting relays for defense of the ability system. Basic perform of Instrument transformers is to step down the AC System voltage and current. The voltage and current level of the ability system is incredibly high. It's terribly tough and expensive to style the mensuration instruments for the measuring of such high-level voltage and current. Typically mensuration instruments are designed for five Amp and one hundred ten Volt.The measuring of such terribly massive electrical quantities will be created attainable by victimization the Instrument transformers with these little rating mensuration instruments. Thus these instrument transformers square measure extremely popular within the fashionable grid.

3.1.1: ADVANTAGE OF INSTRUMENT TRANSFORMER

i. The enormous voltage and current of the AC Power framework can be estimated by utilizing little appraising estimating instrument for example 5 A, 110 – 120 V.
ii. By utilizing the instrument transformers, estimating instruments can be institutionalized. Which results in a decrease in expense of estimating instruments. All the more ever the harmed estimating instruments can be supplanted simple with solid institutionalized estimating instruments.
iii. Instrument transformers give electrical separation between high voltage power circuit and estimating instruments. Which diminishes the electrical protection prerequisite for estimating instruments and defensive circuits and furthermore guarantees the security of administrators.
iv. A few estimating instruments can be associated with a solitary transformer to control the framework.
v. Because of low voltage and current level in estimating and defensive circuit, there is low power utilization in estimating and defensive circuits.

3.1.2: TYPES OF INSTRUMENT TRANSFORMER

I) Current Transformer (C.T.)

The current electrical device is utilized to step down this of the ability system to a lower level to create it potential to be measured by small rating meter (i.e. 5A ammeter). A typical association diagram of a current device is shown inside the figure below. The first of C.T. has solely some turns. Usually bar primary is to boot used. The primary is connected serial with the ability circuit. Therefore, usually it jointly observed as a series electrical device. The secondary has large no. of

turns. The secondary is connected on to associate meter. As a result of the meter has really small resistance. Hence, the secondary of this electrical device operates nearly during a} very short-circuited condition. One terminal of the secondary is earthed to avoid the massive voltage on secondary with connection earth. That in turns reduces the chances of insulation breakdown and jointly protects the operator against high voltage. extra ever before disconnecting the meter, secondary is short-circuited through a switch 'S' as shown inside the figure over to avoid the high voltage build-up across the secondary.

3.1.3: CURRENT TRANSFORMER (C.T)

Current transformer is an electrical device could be a current measuring system wont to measure this in high voltage distribution lines directly by stepping down the currents to measurable values by means that of magnetic attraction circuit.

3.1.4: BASIC DESIGN PRINCIPLE OF CURRENT TRANSFORMER

The basic principle induced of current transformers is primary ampere turns = Secondary ampere turns.

$$Ip \times Np = Is \times Ns$$

Where, Ip - Primary current

Np - Primary Winding Turns

Is - Secondary Current

Ns - Secondary Winding Turn

- Ampere turn plays important role in designing current transformer.
- Current transformer must be connected in series only.
- Current transformer has loss no turns in primary and more no of turns in secondary.
- The secondary current is directly proportional to Primary current.
- The standard applicable to CT's is IEC – 60044-1 and IS -2705.

Figure 3.1: Connection of Current Transformer

3.1.5: Simple Connection Diagram of Current Transformer

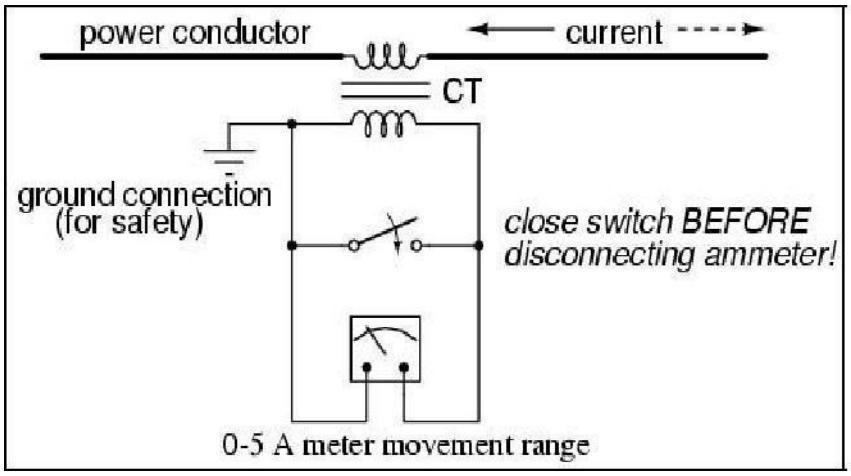

Figure 3.2: Simple Connection of CT

II) Potential Transformer (P.T.)

Potential transformer is and electrical device is used to step down the voltage of facility to a down level to create is feasible to be measured by very little rating meter i.e. 100 and 10 – 100 twenty V meter. A typical affiliation diagram of a doable potential transformer which is an electrical device is showing figure below. Primary of P.T. has large no. of turns. Primary is connected across the road (generally between on line and earth). Hence, usually it's together referred to as the parallel electrical device. Secondary of P.T. has few turns and connected on to a meter. As a result of the meter has large resistance. Thence the secondary of a P.T. operates nearly in open circuited

condition. One terminal of secondary of P.T. is earthed to stay up the secondary voltage with connection of earth. That assures the protection of operators.

3.2: BASIC DESIGN PRINCIPLE OF VOLTAGE TRANSFORMER

The basic principle involved in the design in of Voltage Transformer is Voltage Ratio = Turns Ratio

$$Vp/Vs = Np/Ns$$

$$\text{Thus } Ns \times Vp = Np \times Vs$$

As heavy primary voltage will be reduced to low secondary voltage, it will have more turns in the primary 7 less turns in the secondary. It must always be connected in parallel only. Even if we connect it directly from high voltage to earth, it is not going to be a short circuit as its primary winding has very high resistance. Its core is asset of assembled laminations. It operates at constant flux density. The standards are IEC -600044-2 and IS -02153.

Figure 3.3: Voltage Transformer

3.2.1: SIMPLE CONNECTION DIAGRAM OF VOLTAGE TRANSFORMER

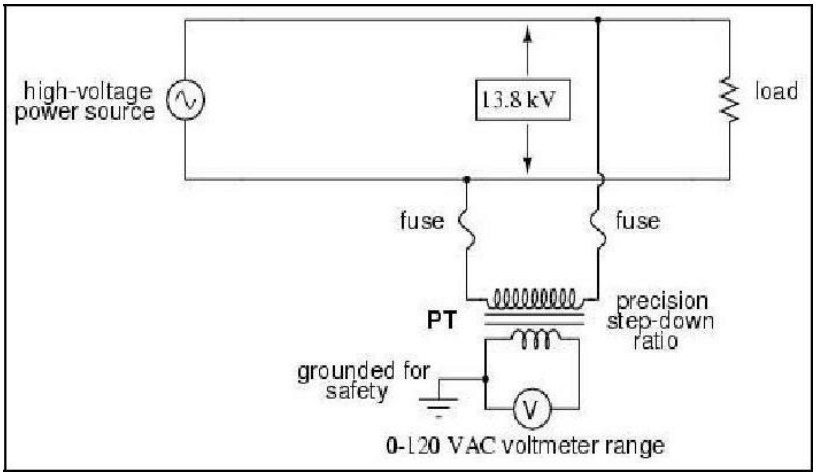

Figure 3.4: Simple Connection Diagram of Voltage Transformer

3.2.2: DIFFERENCE BETWEEN POTENTIAL AND CURRENT TRANSFORMER

Sl. No	**CURRENT TRANSFORMER (C.T.)**	**POTENTIAL TRANSFORMER (P.T.)**
1	Connected in series with power circuit.	Connected in Parallel with Power circuit.
2	Secondary is connected to Ammeter.	Secondary is connected to Voltmeter.
3	Secondary works almost in short circuited condition.	Secondary works almost in open circuited condition.
4	Primary current depends on power circuit current.	Primary current depends on secondary burden.
5	Primary current and excitation vary over wide range with change of power circuit current	Primary current and excitation variation are restricted to a small range.
6	One terminal of secondary is earthed to avoid the insulation break down.	One terminal of secondary can be earthed for Safety.

Table 3.1: Difference between P.T and C.T

3.2.3: SPECIFICATION OF 132KV/33KV AUTO T/F (KALLAYANPUR SUB-STATION)

Rated MVA	: 3*50/75MVA
No of phase	: 3
Insulation level	: HV LI 900AC 395
	: HVN LI 95AC 38
	: IV LI 550 AC 230
	: LV LI 170 AC 70
Type of cooling	: ONAN DNAF
	: 75 100
	: HV 132 KV –
	: LV 33 KV –
Line Amperes	: HV 168.8 262.4
	: IV 328.0 437.4
	: LV 1299.0 1732.1
Temperature Rise ◦C	: top oil -50◦C
Avg. WDG	: -550C
Impedance volts	: HV-IV 7.667 10.222
Normal Tap conditions	: IV-LV 17069 23.53

3.3: INSULATORS

The insulators serve 2 functions. They support the conductors and confine this to the conductors. The foremost usually used material for the manufacture of insulators is ceramic ware. There are many sorts of insulators like pin kind, suspension kind, post nonconductor etc. and there use within the sub-station can rely on the service demand. For instance, post nonconductor is used for bus-bars.

Figure 3.5: Insulator

3.4: ISOLATOR

An electrical isolator that is often called isolator or dis-connector could be a piece of apparatus that's employed in electric devices associate degreed power systems with the most operate of effectively uninflected 2 totally different components of an instrument. By definition, isolation is that the method of complete separation of varied components of associate degree equipment and this separation will either be physical or electrical or each. As already mentioned the most purpose of associate degree isolator is safety as a result of if a fault happens in one section of a circuit or power provide then the electrical isolator is employed as a switch to stay apart that section from different sections of the system to perform repair work. During a similar situation, isolators additionally make sure the safety of employees in regular maintenance and repair of the ability system. Isolators separate a precise circuit from the electricity mains and discharge any residual current, left within the circuit, to the bottom.

Figure 3.6: Electrical Isolator

3.4.1: TYPES OF ISOLATOR

There are different types of isolators, such as:

- Double Break Isolator: The turning isolator is a triple post twofold break isolator, which is a pivoting type pack worked and has been worked and intended for any benevolent requesting outside application.
- Single Break Isolator: It is typically open blade change to open under a circuit load. The fundamental reason for utilizing the isolator is to disengage one piece of the circuit from the other.

In light of the situation of the isolator, it very well may be arranged in three different ways:

- **Line Isolator:** Isolator is an incoming or outgoing line from the bus.
- **Bus Isolator**: Isolator has two sections of the bus.
- **Transformer Isolator:** Isolate the transformer from the bus or the lines.
- **Pantograph Type Isolator:** The pantograph isolator installs on the support insulator and transfer the movement of the movement rod to the insulator to the pantograph of the arms isolator.

3.4.2: USE OF ISOLATOR

An isolator switch has no insurance ability and is utilized to physically separate any circuit when fixes and so on are being finished. In a sub-station switchyard an isolator switch would be utilized to physically disengage any approaching high voltage lines to permit deal with the transmission line be performed.

3.4.3 TYPE OF ISOLATOR WHICH USE IN SUB-STATION

Generally, pantograph and HCB type isolators are used at 400 kV and 220 kV sub-stations which are operated by remote or manually. Double break type isolators are used at 33 kV sub-station

3.4.4 COMPARISON OF ISOLATOR AND CIRCUIT BREAKER

ISOLATOR	CIRCUIT BREAKER
Isolator is meant only for interrupting the power during maintenance or repair.	Circuit breakers are meant for protection of a circuit or Equipment from short circuit and overload faults while they are in operation.
Isolators can be operated only during offload.	Circuit breakers can be operated during both on-load and offload.
Breaking capacity of isolators is very less. Breaking capacity of isolators is very less.	Breaking capacity of circuit breakers is high.

Table 3.2: difference between isolator and circuit breaker

3.5: BUS BAR

An electrical bus bar is outlined as a conductor or a gaggle of conductor used for assembling wattage from the incoming feeders and distributes them to the outgoing feeders. In alternative words, it's a sort of electrical junction during which all the incoming and outgoing electrical current meets. Thus, electrical the electrical bus bar collects the electric power at one location. The bus bar system consists the isolator and therefore the electrical fuse. On the prevalence of a fault, the electrical fuse is tripped off and therefore the faulty section of the bus is definitely disconnected from the circuit. The electrical bus bar is on the market in rectangular, cross-sectional, spherical and plenty of alternative shapes. The oblong bus bar is generally utilized in the facility system. The copper and Al are used for the producing of the electrical bus bar.

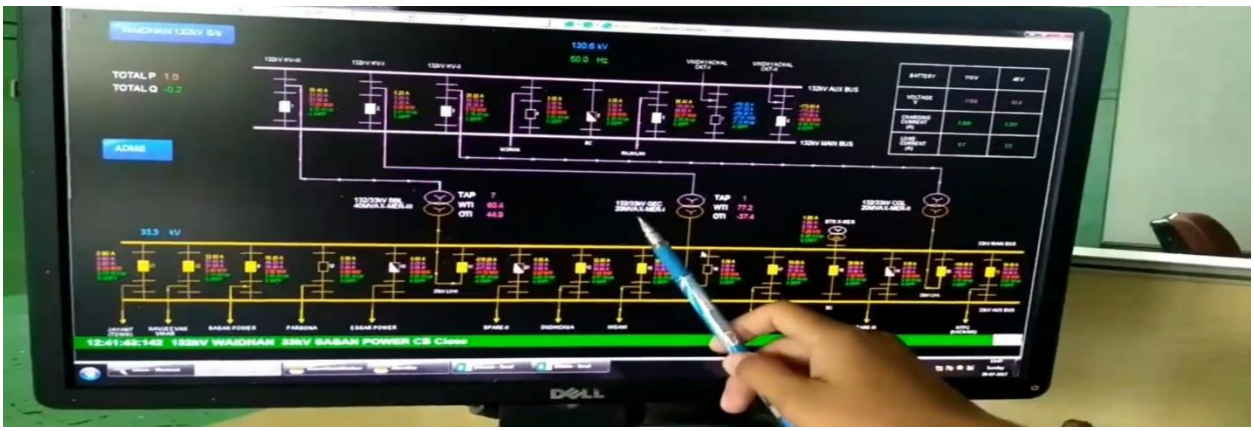

Figure 3.7: Bus-Bar Schematic in Substation

The most commonly used bus bar arrangement in a substation are

* Single bus bar
* Single bus bar with sectionalized bar
* Double bus bar

3.6: POWER TRANSFORMER

The power transformer may be a reasonably transformer that's accustomed transfer power to any a piece of the electrical or electronic circuit between the generator and hence the dispersion of the primary circuits. They're little power transformers, medium power transformers and enormous power transformers.

Figure3.8: Power Transformer in Sub-Station

3.6.1: MAIN PARTS OF THE TRANSFORMER

According to construction of a transformer consists of including the below parts

* Windings
* Main tank
* Laminated core
* Oil temperature meter
* Tap changing switch
* Transformer oil

* Conservator
* Radiator
* Cooling system of transformer
* Breather
* Bushing
* Buchholz relay
* Pressure relief vent

3.6.2: MAIN TANK

It's the primary piece of the transformer .its steel made box. The transformer center is set inside this tank windings and other supportive gadgets are put inside this tank. It's loaded up with protecting oil (mineral oil). It has typically round and hollow or cubical shape contingent upon transformer development. It's covered inside and remotely with shading for a security perspective.

3.6.3: LAMINATED CORE

The center isn't intended to possess any flows to move through it. It's nevertheless a leading circle that encounters a dynamical transition, it'll so have little flows incited in it - this zone unit alluded to as 'vortex flows'. The center is covered to downsize these to a base as they meddle with the efficient exchange of vitality from the primary curl to the auxiliary one. The vortex flows cause vitality to be lost from the electrical gadget as they warm up the center - that implies that voltage is being squandered as undesirable warmth. Covered implies that 'made of protecting layers of iron 'stuck' together' rather than being during a solitary strong 'bump'. A covered center joins a higher opposition than a non-overlaid one with a steady assortment of areas. It so doesn't get such immense flows prompted in it.

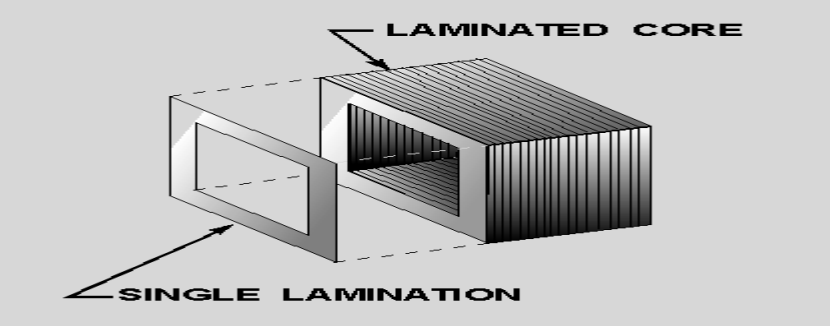

Figure3.9: Laminated Core of Transformer

3.6.4: WINDINGS

In a singular stage two winding transformer, two windings would be accessible as showed up. The one which is related to the voltage source and makes the alluring movement called the fundamental winding, furthermore, the ensuing winding considered the discretionary in which a voltage is impelled as a result of the regular acknowledgment

3.6.5: OIL TEMPERATURE METER

It is utilized to gauge the temperature of the oil. In high power transformers, the thermometer is likewise utilized inside windings which measure the temperature of windings. At whatever point the temperature increments up to perilous level, it actuates the caution signal. Dial type thermometers are normally utilized for the actuation of cautions in anomalous conditions. It gives perusing legitimately through a sensor. At whatever point oil Temperature increments to explicit level, it gives the sign to alert circuit. The thermometer is normally put near the transformer nameplate

3.6.6: TRANSFORMER OIL

Transformer oil or protecting oil is an oil that is steady at high temperatures and has fantastic electrical protecting properties. It is utilized in oil-filled transformers, a few sorts of high-voltage capacitors, and a few kinds of high-voltage switches and circuit breakers. Its capacities are to protect, stifle crown release and arcing, and fill in as a coolant. Transformer oil is regularly founded on mineral oil, yet elective plans with better building or Environmental properties are developing in prevalence

3.6.7: TAP CHANGING SWITCH

* Tap changer switch is utilized to manage optional voltage if there should be an occurrence of low voltage in the essential side of transformer Tap changing switch is associated with the high voltage side of the transformer. Two kinds of tap changing switches are utilized:
* Offload switch: It is utilized to change the winding voltage proportion. As its name proposes off burden tap changing switch is utilized distinctly in transformer off condition.14
* On Load Switch: On burden tap changer switch can be utilized with an on-load transformer.

3.6.8: CONSERVATOR OF TRANSFORMER

A conservator is that the most important a part of the electrical device as a result of the Conservator tank takes up the growth & contraction of oil throughout running operation. Once the load of the electrical device is augmented, the temperature of oil additionally will increase, thus the overall volume of the oil will increase and absorbs the augmented volume of oil within the higher area of the conservator tank. If the conservator tank isn't fitted to the electrical device, the electrical device can burst out because of high pressure at the complete loading condition of the electrical device. The outer and inner portion of the conservator tank is shown within the figure.

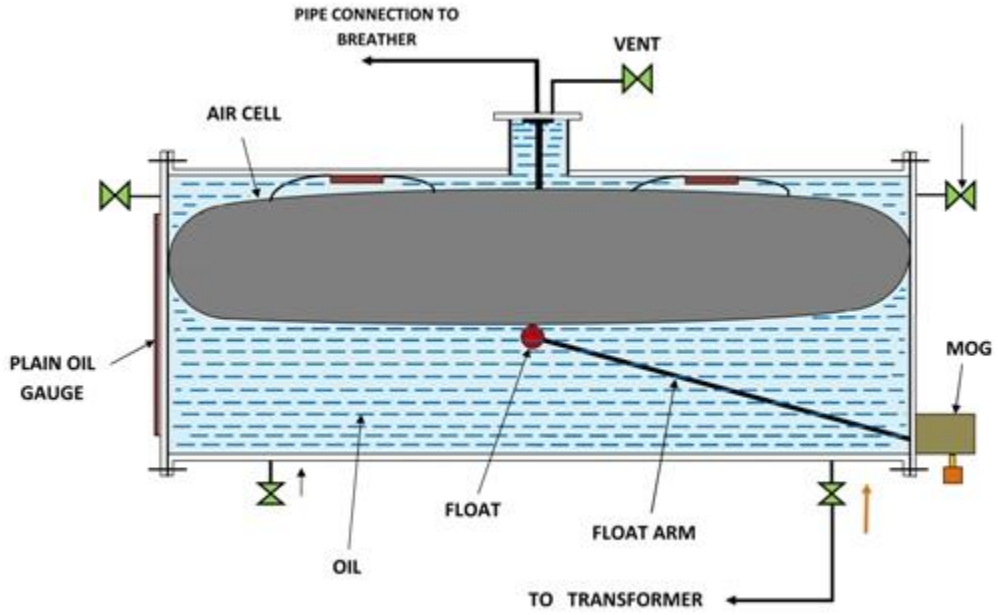

Figure 3.10: Conservator of Transformer

3.6.9: RADIATOR

The radiator is a bank of a hollow pipeline that is used to transfer the thermal energy from one medium to cooling for another purpose. Some bank is used at the power transformer cooling the transformer oil as well as reduces the winding temperature under loading condition. The radiators are connected to the transformer through the pipeline at the upper and lower side's transformer. In transformers above 50KVA, radiators are utilized with the primary tank of the transformer to cool purposes. Radiator makes cooling in the transformer progressively powerful. This technique for cooling is called ONAN (oil common air characteristic). In 26MVA or more transformers, cooling fans are likewise utilized on a radiator. At the point when the temperature ends up more noteworthy

than 75º, temperature oil check turns on cooling fans. This strategy is cooling called ONAF (oil common and air constrained)

Figure 3.11: Radiator Bank

3.7: LIGHTENING ARRESTERS

Lightning arrester is the instrument that is utilized in the approaching feeders so that to keep the high voltage from entering the primary station. This high voltage is extremely perilous to the instrument utilized in the substation. Indeed, even the instruments are exorbitant, so to avert any harm helping the arrester is utilized. The lightning arresters don't let the lightning to fall on the station. On the off chance that some helping happens the arrester pulls the helping and ground it to the earth. In any substation, the weak is of insurance which is right off the bat done by this lightning arrester. The lightning arrester is grounded to the earth with the goal that it can destroy the lightning to the ground. These are situated at the passage of the transmission line into the substation and as close as conceivable to the transformer terminals. The lightning arrester or flood diverters give assurance against such. A lightning arrester or flood diverters is a defensive gadget, which directs the voltage of flow on the power framework to the ground

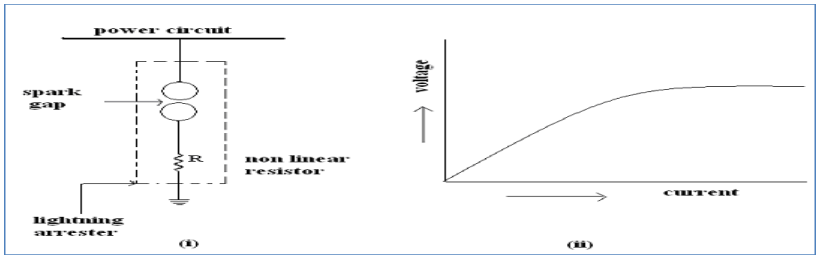

Figure 3.12 Lightening Arrester

Demonstrates the fundamental type of flood diverter. It comprises of a sparkling hole in arrangement with a non-direct resistor. One finish of the diverter is associated with the terminal of the hardware to be secured and the opposite end is adequately grounded. The length of the hole is set to the point that ordinary voltage isn't sufficient to cause a bend however a perilously high voltage will separate the air protection and structure a circular segment. The property of the non-direct opposition is that its obstruction increments as the voltage (or current) increments and the other way around. This is obvious from the volt/amp normal for the resistor

Figure 3.13: Lightening Arrester in Sub-Station

3.7.1: THE ACTION OF THE LIGHTING ARRESTER OR SURGE DIVERTER IS AS UNDER

- Under ordinary activity, the helping arrester is of the line, for example, it leads no current to earth or the hole is non-directing
- In the event of over-voltage, the air protection over the hole separates and a circular segment is shaped giving a low obstruction part to the flood is innocuously led through the arrester to the ground as opposed to being sent back over the line.
- Ti is advantageous to make reference to the capacity of the non-straight resistor in the activity of the arrester. As the whole flash over due4 to over voltage, the circular segment would be a short out on the power framework and many case-control pursue current in the arrester. Since the normal for the resistor is to offer low protection from high voltage or current, it gives the impact of a short out. After the flood is finished, the resistor offers high protection to make the whole non-leading.

3.8: GUIDE FOR SELECTION OF LA

Before choosing the LA it ought to be found out whether the framework is successfully earthed, non-adequately earthed or having disconnected nonpartisan. The framework neutrals are viewed as successfully earthed when the co-proficient of earthling doesn't surpass 80%. For this situation, the reactance proportion X0/X1 (zero arrangement reactance/positive grouping reactance) is certain and under 3 and simultaneously, the obstruction proportion RO/X1 (zero successions opposition/positive arrangement reactance) is under 1 anytime on the framework. For this framework, the arrestor rating will be 80% of the most noteworthy stage to stage framework voltage.

The LA voltage rating comparing to the framework voltages are shown underneath.

Rated system voltage (KV)	High system voltage (KV)	Arrester rating in KV Effectively earthed system
11	12	9
33	36	30
66	72.5	60
132	145	120/132 (later)
220	245	198/216 (later)
400	420	336

Table 3.3: Guide for Selection of La

3.8.1 PLATE EARTHLING:

EHT Substation - 1.3 M x 13 M.Ms cast iron plates 25mm thick Plates are to be covered vertically in pits and encompassed by finely isolated coke, squashed coal or burn coal in any event 155 mm all-round the plates. Plates ought not to be under 15 m separated and ought to be covered to adequate profundity to guarantee that they are constantly encompassed by damp earth.

3.8.2 PIPE EARTHING:

EHT substations Cast iron channels 125 mm in distance across 2.75 m long and at the very least 9.5 mm thick pipes 50.8mm in bite the dust and 3.05m long. Channels are to be put vertically at interims of at the very least 12.2 m in enormous stations encompassed by finely broken coke squashed coal and charcoal at any rate 150 mm around the pipe on the additional profundity. Joints are to be held down to the base number. All joints and associations in the earth framework are to

be brazed, bolted, perspired, shot or welded. For rust insurance, the welds ought to be treated with barium chromate. Welded surfaces ought to be painted with red lead and aluminum paint thusly and thereafter covered with bitumen. Joints in the earthling conductor between the switchgear units and the link sheaths, which may require to in this manner break ought to be blasted and the joint faces tinned. All joints in the steel earthling framework ought to be made by welding with the exception of the focuses for isolating the earthling mat for testing purposes which ought to be darted. These focuses ought to be open and as often as possible administered

3.9: EARTHLING

The earthling practice adopted at generation, Sub-station and line should be in such a manner as to provide in units of ohms.

- Safety to personnel.
- Minimum damage to equipment as a result of flow of heavy fault currents.
- Improver reliability of power supply.

3.9.1: IN ALL SUBSTATIONS THERE SHALL BE PROVISION FOR EARTHLING THE FOLLOWING

- The impartial purpose of earth separate framework ought to have an autonomous earth, which thus ought to be interconnected with the station ground with the establishing mat.
- Equipment edge work and not-current conveying part.
- All superfluous metallic edge work not related with gear (Two associations).
- The earth conductor of the tangle could be covered under earth to prudent profundity of internment of the tangle 0.5 meters.

3.10 THE PRIMARY REQUIREMENTS ARE:

- Large sub-station -1 ohms
- Small sub-station -2 ohms
- Power station -0.5 ohms
- Distribution transformer station -5 ohms
- All exposed steel earthling conductors should be protected with bituminous pain

3.10.1: CAPACITOR VOLTAGE TRANSFORMER

A capacitor voltage transformer (CVT) is a transformer utilized in power framework to step-down additional high voltage flag and give low voltage flag either to estimation or to work a defensive transfer. These are high pass Filters (transporter recurrence 50KHZ to 500KHZ) pass bearer recurrence to transporter boards and power recurrence parameters to switch yard. In its most fundamental from the gadget constants of three sections two capacitors crosswise over which the voltage sign is part, an inductive component used to tune the gadget and a transformer used to isolator and further advance down the voltage.

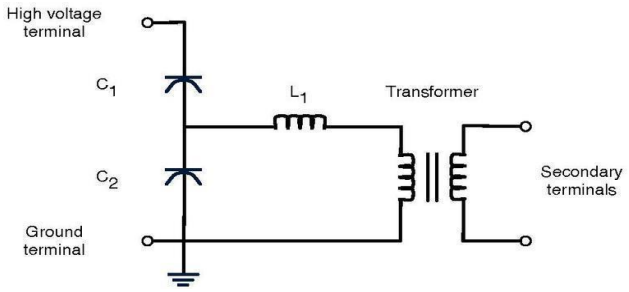

Figure 3.14: Capacitor Voltage Transformer Diagram

The gadget has least four terminals, a high-voltage terminal for association with the high voltage signal, a ground terminal and at any rate one lot of auxiliary terminals for association with the instrumentation or security hand-off. CVTs are ordinarily signal gadgets utilized for estimating voltage more than one hundred KV where the utilization of voltage transformers would be uneconomical. By and by the primary capacitor. C1 is regularly supplanted by a heap of capacitors connector in an arrangement. These outcomes in an enormous voltage drop over the heap of capacitors, that supplanted the primary capacitor and a similarly little voltage drop over the subsequent capacitor, C2, and henceforth the auxiliary terminals.

Figure 3.15: Capacitor Voltage Transformer in Substation

3.11: WAVE TRAP

Wave trap is an instrument utilizing for catching of the wave. The capacity of this wave trap is that it traps the undesirable waves. Its shape resembles a drum. It is associated with the fundamental approaching feeder so that in can traps the wave which might be perilous to the instrument in the substation. For the most part it is utilized to bar undesirable recurrence segments, for example, commotion or other obstruction, of a wave.

Figure 3.16: Wave Trap

Note: Traps are normally incapable to allow the choice of undesirable or meddling sign.

The line trap additionally is known as the Wave trap. What it does is catching the high-recurrence correspondence sign sent on hold from the remote and occupying them to the telecom/story security board in the substation control room through a coupling capacitor. This is important in the Power Line Carrier Communication (PLCC) framework for correspondence among different

substations without reliance on the telecom organization arrange. The sign is fundamentally a story insurance signal and moreover, voice and information correspondence signal. The Line Trap offers high impedance to the high-recurrence correspondence signal subsequently blocks the progression of these sign into the substation transport bars. On the off chance that these are absent in the substation, at that point signal misfortune is more and correspondence will be ineffectual/likely outlandish.

3.12: CIRCUIR BREAKER

The electrical switch is utilized to break the circuit if any shortcoming gathers in any of the instrument. These electrical switch for an issue which can harm other instrument in the station. For any undesirable deficiency over the station we have to breaker the line current. This is just done naturally by the electrical switch.

- Operation mechanism function.
- Arc quenching function.
- **Various operating mechanisms**
  - ✓ Spring charge mechanisms
  - ✓ Phonation mechanism
  - ✓ Hydraulic mechanism
- **Arc quenching medium**
  - ✓ Bulk oil (called bulk oil circuit breaker –BOCB).
  - ✓ Minimum oil (called Minimum oil circuit breaker -MOCB).
  - ✓ Natural air (called air circuit breaker ACB) .
  - ✓ Forced air (called air blast circuit breaker -ABCB).
  - ✓ Vacuum (called vacuum circuit breaker -VCB).
  - ✓ SF6 gas (called Sulphur Hexafluoride –SF6 gas CB).

The present trend is up to 33KV, VCBs are preferred and beyond 33KV, SF6gas circuit breakers are preferred. There are mainly two types of circuit breakers used for any substations. They are

(a) SF6 circuit breaker.

(b) Vacuum circuit breaker.

3.12.1: SF6 CIRCUIT BREAKER

The electrical switch is one of the most significant units in the electrical power framework. The insurance, solidness and coherence of the framework rely upon the circuit breakers capacity to switch line, load and energizing flows and to intrude on flaw flows. The SF6 gas electrical switch guarantees the elevated level of execution required for the dependable activity of the electrical framework by utilizing the incredibly great electrical protecting trademark and amazing circular segment extinguishing properties of sulfur hexafluoride (SF6) gas. The unwavering quality of the framework is additionally expanded by the utilization of a SF6 gas protecting framework and a solitary weight double stream SF6 gas puffer interrupter which diminishes the quantity of moving chamber and assistant frameworks in the circuit breakers. The pressure required to blast the SF6gas against the arc and the interrupt the current is generated by the compression of the gas between the moving cylinder and the stationary position of the interrupter during the opening operation

3.12.2: CONSTRUCTION:

Construction of the breaker is illustrated. The breaker consists basically of three vertical interrupter units (100) which contain puffer type interrupter, spring operating mechanism (500) which is mounted in mechanism housing (400) and frames (300). Opening operation is effected by the opening spring and closing spring is accomplished by the closing spring by the ratchet linked to the motor. Each interrupter unit (100) is filled with SF6 gas and kept at the same pressure through copper gas pipe (301) connecting to the other two interrupter units (100). The same gas pipe (301) also leads to gas pressure gauge (402), temperature compensated gas pressure switch (401) and gas feed port (403). All the moving parts of the three interrupter units (100) are connected mechanically to spring operating mechanism (500) by horizontal rod (302)

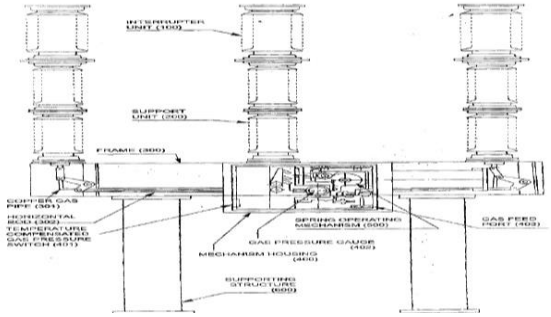

Figure 3.17: Construction of SF6 Circuit Breaker

3.12.3: VACUUM CIRCUIT BREAKER

In such breakers, vacuum is utilized as the circular segment extinguishing medium. Since vacuum offers the most elevated protecting quality, it has far unrivaled curve extinguishing properties than some other medium. For instance, when the contacts of the breaker are opened in vacuum, the interference happens from the outset zero flow with dielectric quality between the contacts working up at the rate a large number of times higher than that got with other circuit breakers.

3.12.4 OPERATION MECHANISM

The operating mechanism has a spring charging device, which can be operated by motor or - manually. The operating device has helical tension spring for closing and opening. The opening spring is charged automatically when the breaker is closed. A closed breaker with charged closing spring can thus be operated OPEN-CLOSE-OPEN without intermediate motorized or manual charging, and the breaker can, therefore, be used for auto re-closing duty cycle. An indication shows whether the closed spring is charged or not, and the number of opening operation are recorded by the counter. The motor can be supplied via station battery, a Network or via transformer with a limit load of at least 500 VA. The motor starts after each closing operation and charges the closing springs within 15 seconds.

3.13: NAME PLATE DETAILS OF 132KV SF6 CB (KALLYANPUR SUB-STATION)

Type	: 200-SFM-40A
Rated Voltage	: 145KV
Lighting Impulse Withstand	: 650KV (Peak)
Rated Frequency	: 50HZ
Normal Current	: 1600A
Rated Short Circuit breaker Current Symmetrical	: 31.5KV
Rated Short Circuit breaker Current Asymmetrical	: 37.2KV
Rated Short Circuit Making Current	: 80KV (peak)
Out-Of-Phase Circuit Breaker Current	: 7.9KV
Rated Break Time	: 60ms (3 Cycles)

Rated Short Time Current	: 40KA for 3Sec
Operating Sequence	: 0-0.03s-CO-3 min-CO
Total Mass of SF6 Gas	: 8.7kg
SF6 Gas pressure AT 20c, 1013pha	: 6.3 bar
Total Mass of the Circuit Breaker	: 1300kg
Reference Standard	: IEC-56

3.14: NAME PLATE DETAILS OF 33KV VACUUM CB (KALLYANPUR SUB-STATION)

Type	: VN369 3AF
Voltage	: 36KV
Frequency	: 50HZ
Normal Current	: 800A
SYM breaking Capacity	: 25KA
Short Time Current	: 25KV
Duration	: 3sec
Making Capacity	: 63KA (peak)
P.F Withstand	: 70KV
Impulse	: 170KV (peak)
Shunt Trip coil	: 220VDC
Total Weight	: 2000kg
Operating Sequence	: 0-3MIN-CO-3MIN-CO

3.15: AUTOMATIC CIRCUIT RECLOSE

It is a 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.

3.15.1: SPECIFICATIONS OF (ACR)

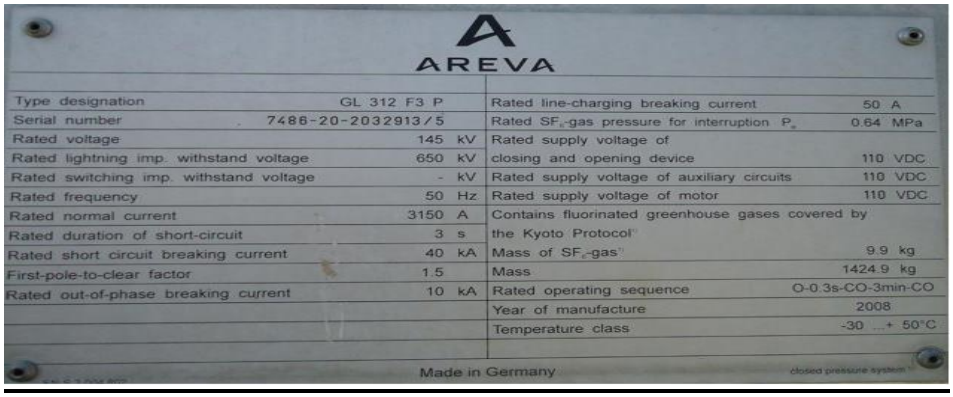

Figure 3.18: Specification of ACR

3.16: PROTECTION FOR VARIOUS EQUIPMENTS

3.16.1: TRANSFORMER PROTECTION

- Station Transformer: HG Fuse protection on HV side and fuse protection on LV side and Vent pipe.
- Power transformers up to 7.5 MVA: HV side: O/L & direction E/L protection with highest element in O/L relays.

  LV side: O/L & E/L protection Buchholz Relay OLTC Buchholz Relay OTI and WTI.
- Power transformers from 8.0MVA and above: HV side O/L & directional E/L protection with high set element set element in O/L relays.

  LV side O/L & E/L protection: differential protection Buchholz Relay OTI, WTI and PRV.
- Power transformers from 31.5MVA and above: over flux protection & LV WTI in addition to protection.

3.16.2: FEEDER PROTECTION

- 33KV feeders: Non direction O/L & E/L protection with highest and IDMT characteristics.
- 132KV feeders: Main protection: Distance protection. Back up protection: Directional O/L & E/L protection.
- 220KV feeders: Main-1 protection: Distance protection. Main-2 protection: Directional protection, LBB protection, pole discrepancy Relay.

3.16.3: LIGHTNING ARRESTER PROTECTION

Lightening arresters are ensuring gadgets for constraining flow of voltage on account of lightning strikes. A flow defender could be a gadget utilized on power framework to shield the protection and conductors of the framework from the harming impacts of the lightening the standard flood defender includes a high voltage terminal and a ground terminal. When a lightening flood (or move flood, that is unbelievably comparative) goes on the office line to the requirement, the present from the flood is engaged through the arrestor, by and large to protection

3.16.4: FIRE PROTECTION

The fire insurance gadget ought to be kept in store yard for wellbeing of hardware's during stockpiling. It very well may be valuable in the hour of threat. This incorporates fire dousers, steady supply of water and so on.

3.16.5: IMPORTANT POINTS TO BE KEPT VIEW WHILE LAYING OUT THE SUBSTATION

Substations are significant piece of the power framework. The progression of stock depends to a significant degree upon the effective activity of substation. It is, accordingly basic to practice nearly mind while planning and building a substation. Coming up next are the significant focuses which must be kept in while spreading out a substation:

- It ought to be situated at a legitimate site. Quite far, it ought to be situated at the focal point of gravity of the heap.
- It ought to give a protected and solid course of action. For wellbeing, thought must be given to the support of guideline clearances, offices for doing fixes and upkeep, anomalous events, for example, the plausibility of blast or fire and so on for dependability, thought must be given for good structure and development, the arrangement of reasonable defensive rigging and so on.
- It ought to be effectively worked and kept up.
- It ought to include a base capital expense.

3.17: RELAY

A relay may be a device wont to management the operation of a magnetic contactor or alternative device. Relay operate as a perform of current, voltage, heat .and pressure and provide the “intelligence” that's necessary to produce automatic acceleration, defend against overload, below voltage, excessive speed, excessive force, etc.

CHAPTER 4

BUS BAR ARRANGEMENT

4.1 BUS-BAR ARRANGEMENT

In electrical power distribution, a bus-bar may be a trick strip of copper or metal that conducts Electricity among a plug board, distribution board, substation or different electrical equipment. The various styles of bus bar arrangements square measure utilized in the ability system. The subsequent are the electrical considerations governing the choice of anybody specific arrangement.

* The bus bar arrangement is straightforward and simple in maintenance.
* The upkeep of the system didn't have an effect on their continuity.
* The installation of the bus bar is reasonable.

The small substation wherever continuity of the availability isn't essential uses the one bus bar. But in a large station, the extra bus bar is employed within the system in order that the interruption doesn't occur in their provide

4.2 TYPES OF ELECTRICAL BUS-BAR ARRANGEMENT

* Single bus-bar arrangement
* Single bus-bar arrangement with bus sectionalized
* Double bus-bar arrangement
* Double bus-bar arrangement with bus sectionalized
* Ring main bus-bar arrangement

4.2.1 SINGLE BUS-BAR ARRANGEMENT

The system has only one bus bar along with the switch. All the substation equipment like the transformer, generator, and the feeder is connected to this bus-bar only the following figure shows the principle of the solution utilizing only one power transformer and a single bus-bar configuration on the medium-voltage side. The dotted line on the high-voltage side marks for the optional by-pass disconnected placement enabling the HV circuit breaker service.

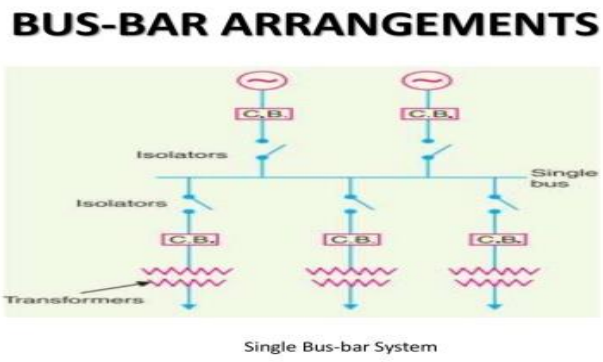

Figure: 4.1 Single Bus-Bar Arrangement

4.2.1.1 ADVANTAGE OF SINGLE BUS-BAR ARRANGEMENT

* Low initial cost
* Less maintenance
* Simple in operation
* Very simple design

4.2.1.2 DISADVANTAGE OF SINGLE BUS-BAR ARRANGEMEN

One however major tough of those styles of arrangement is that maintenance of the apparatus of any bay cannot be done while not interrupting the feeder or electrical device connected thereto bay. The arrangement provides less flexibility and therefore employed in the little station wherever continuity of providing isn't essential.

4.2.2 SIGNAL BUS-BAR ARRANGEMENT WITH BUS SECTIONALIZE AND TWO POWER TRANSFORMER

The following figure shows the only bus-bar arrangement having bus divide breaker within the MV bus. There square measure totally different doable in operation principles with this answer. The MV bus divide may be unbroken open and every a part of the bus-bar may be furnished with its own power electrical device or each bus-bar sections may be furnished with only 1 power trans-former whereas keeping the opposite power electrical device running lazily or de-energized. The facility transformers may also be run in parallel with the bus divide closed. Betting on the

operation principle, the use of automatic bus-bar transfer theme, high speed or de-played, would cater for automatic redundancy just in case of 1 power electrical device failure.

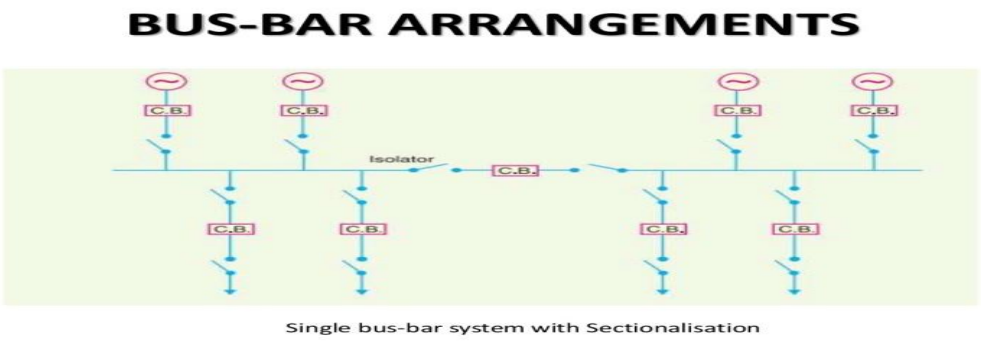

Figure 4.2: Signal Bus-Bar Arrangement with Bus Sectionalize

4.2.2.1 ADVANTAGE OF SINGLE BUS-BAR ARRANGEMENT WITH BUS SECTIONALIZED

- The defective segment is evacuated without influencing the congruity of the stock
- The support of the individual segment should be possible without upsetting the framework supply
- The framework has a present restricting reactor which diminishes the event of the shortcoming

4.2.2.2 DISADVANTAGES OF SINGLE BUS-BAR ARRANGEMENT WITH SECTIONALIZED

- The framework utilizes the extra electrical switch and isolator for which expands the expense of the framework

4.2.3 DUPLE BUS-BAR SYSTEM ARRANGEMENT

The following figure shows the double bus-bar arrangement in a typical operation mode. This type of configuration would have the bus coupler open and line and transformer feeders equally shared between the busses. The bus coupler enables the feeder switching between the busses without load interruption This configuration needs advanced interlocking circuits to prevent forbidden operations like doing bus coupling using any other bay than bus coupler bay.

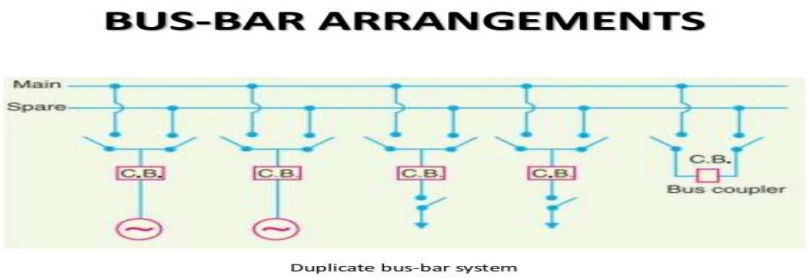

Figure 4.3 Double Bus-Bar Arrangement

4.2.3.1 ADVANTAGES OF DOUBLE BUS-BAR ARRANGEMENT

- ❖ Double transport bar course of action expands the dependability and adaptability of the framework
- ❖ The congruity of the inventory continues as before on the grounds that the heap is transferrable starting with one transport then onto the next on the event of the deficiency.

4.2.3.2 DISADVANTAGE OF DOUBLE BUS-BAR ARRANGEMENT

The arrangement does not permit the breaker maintenance without interruption.

* Their maintenance cost is very high.

4.2.4 DOUBLE BUS-BAR ARRANGEMENT OF SECTIONALIZED

In this style of bus arrangement, the sectionalized main bus bar is employed alongside the auxiliary bus Bar. Any section of the bus bar removes from the circuit for maintenance and it's connected to any of the auxiliary bus-bar. Sectionalizing of the auxiliary bus-bar isn't needed as a result of it'd increase the value of the system.

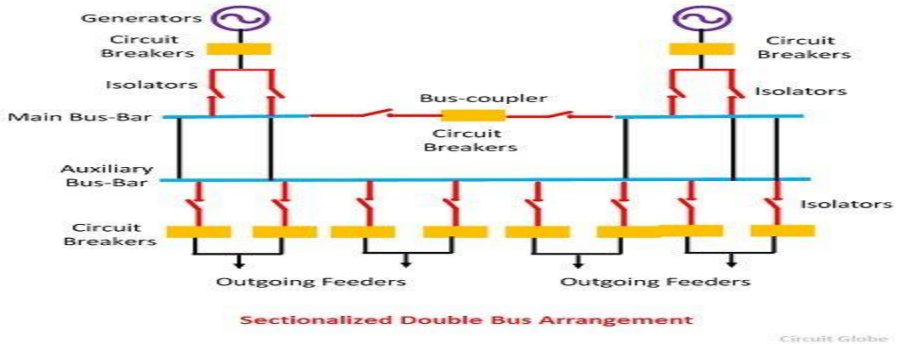

Figure 4.4: Double bus-bar with sectionalized

4.2.5 RING MAIN BUS-BAR ARRANGEMENT

In such type of arrangement the end of the bus-bar is connected back to the starting point of the bus to form a ring

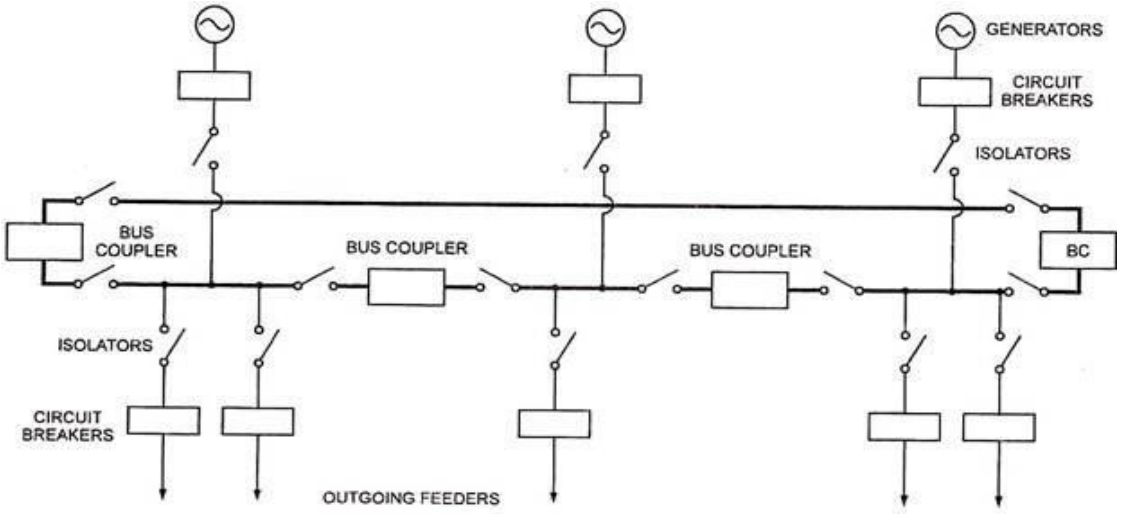

Figure 4.5: Ring Main Bus-Bar

4.2.5.1 BENEFITS OF RING MAIN BUS-BAR ARRANGEMENT

* Such arrangement can offer 2 ways for the provision.
* During this arrangement, an electrical fuse will be maintained while not interrupting the provision.

4.2.5.2 DISADVANTAGES OF RING MAIN BUS-BAR ARRANGEMENT

* Difficulties occur additionally to the new circuit.
* Overloading happens on the system.

4.3 BUS-BAR PROTECTION

If a fault happens on a bus-bar, enough injury and disruption provide can occur whereas some sort of quick-acting automatic protection is provided to isolate the faulty bus-bar. Within the event of fault on any section of the bus-bar, all circuit instrumentality connected to it section should be stripped bent offer complete isolation.

4.3.1 SORTS OF BUS-BAR PROTECTION

The two most typically used schemes for bus-bar protection square measure given below:

* Differential protection
* Fault bus protection

CHAPTER 5

DISTRIBUTION SYSTEM

5.1 DISTRIBUTION TRANSFORMER

A distribution transformer or service transformer could be an electrical transformer that gives a definitive voltage change inside the power dissemination framework, venturing down the voltage used in the conveyance lines to the degree used by the customer.

Figure 5.1: Distribution Transformer

5.2 USES OF DISTRIBUTION TRANSFORMER

Distribution transformer is AN electrical device that's accustomed hold electric power from an essential dissemination circuit to an optional dispersion circuit. Voltage is acknowledged through dissemination transformers to minor high voltage level on circulation position all the way down to endues levels. This will even be accustomed transfer current among a secondary distribution circuit or to the service circuit

5.3 FITTINGS OF DISTRIBUTION SYSTEM

Electric power appropriation transformer is utilized in the last stage in the conveyance of electric power, its conveys power from the transmission framework to singular buyers

Figure 5.2: Fitting Of Distribution System

5.4 MAIN ELEMENTS OF OVERHEAD LINES

An overhead line is additionally wont to transmit or appropriate electrical power. Though building partner overhead line, it should be guaranteed that mechanical quality of the street is such along these lines on give against the premier likely climatic condition. When all is said in done, the most components of partner overhead line are given beneath:

- Conductors
- Supports
- Insulators
- Cross arms
- Miscellaneous things

5.4.1 CONDUCTOR

An electrical channel might be a substance during which electrical charge transporters, once in a while electrons, move effectively from iota to particle with the applying of voltage. Copper, steel, gold, aluminum, and metal are likewise reasonable transmitters.

5.4.2 POLE

The supporting structures for overhead line conductors are various sorts of shafts and towers called line bolsters. By and large, the street bolsters should have the consequent properties:

- High mechanical quality
- Lightweight in weight while not the loss of mechanical quality.
- price in expense
- Economical to keep up.
- Longer life.
- Straightforward availability of conductors for upkeep.

Figure 5.3: Pole of the System

5.4.3 TYPES OF POLE

The line supports utilized for transmission and dissemination of the electric power are of different sorts these are

- Wooden posts
- Steel posts
- SPC posts
- Lattice steel towers

The decision of supporting structure for a specific case relies on the line range x-sectional territory, line voltage, and cost and nearby conditions.

5.5 INSULATOR

The overhead line conducts should be supported on the poles or tower in such way that current from conducts do not flow to earth through supports such as line conducts must be properly insulated from supports. In general, the insulator should have the follows desirable properties

* High mechanical strength
* High electric resistance of insulator material
* High relative permeability of insulator material
* The insulator should be non-porous, free from impurities and cracks otherwise the permeability will be lowered
* High ratio of puncture strength to flashover

5.5.1 TYPES OF INSULATOR

The most commonly used insulators are given below

* Pin type insulators
* Suspension type insulators
* Strain insulators
* Shackle insulator

5.5.1.1 PIN SORT INSULATOR

The pin sort insulator is secured to the cross arm on the pole. There's a grove on the higher finish of the nonconductor for housing conductor. Pin sort insulators area unit used for the transmission and distribution of electrical power at voltages up to 33KV.

Figure 5.4: Pin type insulator

5.5.1.2 SUSPENSION SORT INSULATOR

The cost of the pin sort nonconductor will increase chop-chop because the operating voltage is magnified. Therefore, this type of insulators isn't economical on the far side 33KV. for prime voltage (>33KV), it's a usual practice to use suspension sort dielectric.

Figure 5.5: Suspension type insulator

5.5.1.3 STRAIN INSULATOR

When there is a dead end of the line or there is a correct or shape curve, the line is subjected to Greater tension. For the low voltage (<11KV) shackle insulator is used as strain insulator.

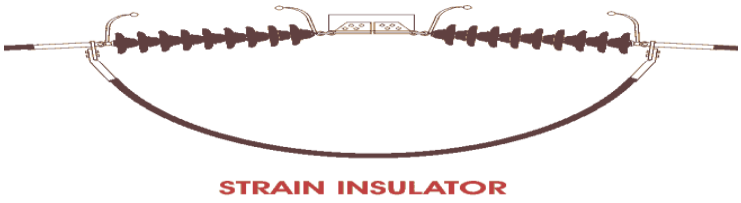

Figure 5.6: Strain Insulator

5.5.1.4 SHACKLE INSULATOR

In the period of time, the shackle insulators were used as strain insulators. However these days they're oftentimes used for low voltage distributions lines. Such stuff are often used either during a horizontal position or during a vertical position.

Figure 5.7: Shackle insulator

5.6 INSTRUMENT TRANSFORMER

For activity high voltage, low vary meter is employed with a high resistance connected serial with them. However it's not convenient to use these ways with AC and voltage instruments. For these functions, specially made correct magnitude relation instrument transformers are employed in conjunction with commonplace low vary A.C instruments.

5.6.1 STYLES OF INSTRUMENT TRANSFORMER

* Potential electrical device
* Current electrical device

5.7 REPAIR

In each plant, there ar innumerable components that require to be tested on a routine basis. Moreover, electrical components have to be compelled to be repaired properly so as to create lasted for an extended time. So, there are bound testing and maintenance procedures that we have a tendency to were told regarding.

A brief discussion of them is in below

Figure 5.8: Transformer repairing in workshop

5.8 HEATING CHAMBER OF TRANSFORMER

The transformer warming and drying framework comprise of 2 drying/oil filling vacuum chambers. These chambers can be worked either physically through touch screens provided by the maker, or remotely from the PC. Each chamber comprises of 3 stations for transformers. An I2R framework is added to these chambers so as to diminish process duration by utilizing electric capacity to warm transformers to target vacuum and oil filling temperatures. The I2R comprises of three autonomous sub-frameworks that can be associated with either chamber. The I2R frameworks named System1, System2, System3 is appraised for units up to 4MVA and thusly will sustain station 1/2/3 of either chambers.

Figure5.9: Heating Chamber of Transformer

5.9 FEEDER

In power building, a feeder line is a piece of an electric circulation arrange, normally a spiral circuit of middle of the road voltage. The idea of feeder lines is additionally significant in open transportation

Figure 5.10: Feeding system of transformer in sub-station

CHAPTER 6
POWER FACTOR

6.1 POWER FACTOR

In AC circuits, the facility issue is that the quantitative relation of the $64000 power that's accustomed work and therefore the apparent power that's provided to the circuit. The power issue will get values within the vary from zero to one. When all the facility is reactive power with no real power (usually inductive load) - the facility issue is zero. When all the facility is real power with no reactive power (resistive load) - the facility issue is one.

6.2 POWER FACTOR IMPROVEMENT (PFI)

The power factor is that the quantitative connection between the kilowatt and furthermore the KVA drawn by an electrical burden any place the power unit is that the genuine burden control and furthermore the KVA is that the obvious power. it's alive off anyway viably the current is being reawakened into accommodating work yield a great deal of parts could be a brilliant marker of the effect of the heap current on the power of the provisioning framework. A heap with an impact issue of one.0 prompts the principal practical stacking of the arrangement and a heap with a PF of zero.5 can prompt plentiful higher misfortunes inside the supplier framework. A poor power issue is the aftereffects of either a major segment qualification between the voltages and furthermore the current at the heap terminals, or it is a direct result of a superior symphonious substance or contorted/spasmodic current wave. The specific power issue is zero.95. Receptive current after inside the give is referred to as responsive power and is here and there communicated in VARs or KVARs. A volt-ampere is that the result of responsive current and furthermore the applied voltage

Figure 6.1: PFI Control Board

6.3 POWER FACTOR PLANT CONSTRUCTION

* Capacitor bank
* Magnetic contactor
* Panel box
* PFI relay
* Trap
* Connecting wire
* Switch board
* HRC fuse

6.4 POWER TRIANGLE

We know that the reactive load like inductors and capacitors dissipate zero power, however the very fact that drop voltage and draw current offers the deceptive impression that they really do dissipate power. This "Phantom power" referred to as is named is termed} reactive power and it's measured in an exceedingly unit called Volt46 Amps-Reactive (VAR) instead of watts. The particular quantity of power being employed in an exceedingly circuit is called true power and it's measured in watts. Apparent power is measured within the unit of Volt-Amps (VA). Reactive power may be a perform of a circuits electrical phenomenon (X). Apparent power is that the perform of a circuits total ohmic resistance (Z). The power triangle is relating apparent power to true power and reactive power. Victimization the laws of trigonometry, we are able to solve for the length of any aspect, given the lengths of the 2 sides, or the lengths of 1 aspect AN angle.

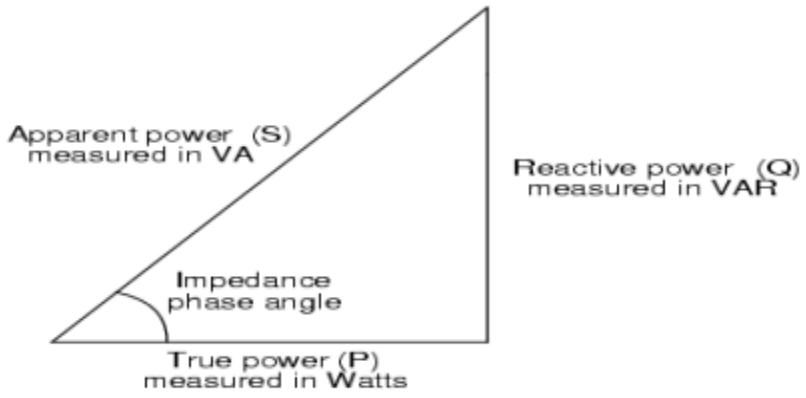

Figure 6.2: Power Triangle

6.5 DISADVANTAGE OF LOW POWER ISSUE

* Massive kVA rating of the instrumentality.
* Bigger conductor size. Massive copper losses. Reduced The reduced handling capability of the system
* Poor voltage regulation

6.6 REASON BEHIND LOW POWER ISSUE

* Most of the a.c motors area unit indicator sort that has low insulating material power issue. These sorts of motors work an influence issue that is very tiny at light-weight load (0.2 to 0.3) and rises to zero.8 or 0.9 at full load.
* Arc lamps electric arc lamps and industrial heating furnaces operate at low insulating material power issue.
* Load The load on the facility system is changing; Being high throughout morning and evening and low at different times. Throughout the low load amount, the provision voltage is multiplied that will increase the magnetization current. This leads to a reduced power issue.

6.7 POWER ISSUE IMPROVEMENT INSTRUMENTALITY

* Static capacitors
* Synchronous condenser
* part advancers

6.7.1 STATIC CAPACITORS

The power issue might be improved by interfacing the capacitors in parallel with the instrumentality usable at the slacking force issue. The capacitor pulls in a main current and plainly or completely kills the heap of the protecting material receptive component. Static capacitors are perpetually utilized for power issue improvement in processing plants.

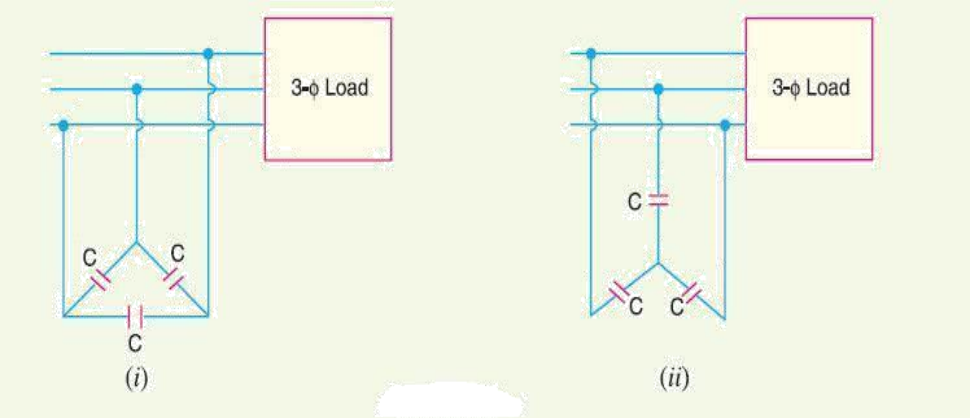

Figure 6.3: Static Capacitor

6.7.1.1 ADVANTAGES OF STATIC CAPACITORS

* Low loss
* Required little maintenance
* Can be easily installed
* Require no foundation
* They can work under ordinary atmospheric conditions

6.7.1.2 DISADVANTAGES OF STATIC CAPACITORS

* They have sort service life ranging from 8 to 10 years
* Can be easily damage
* Once the capacitors are damaged, their repair is uneconomical.

6.7.2 SYNCHRONOUS CONDENSER

The asynchronous engine takes the main current when over-energized known as a synchronous condenser when such a machine is associated in parallel with the stock, it take the main current which mostly kills the slacking responsive segment of the heap, subsequently the power factor

improved.

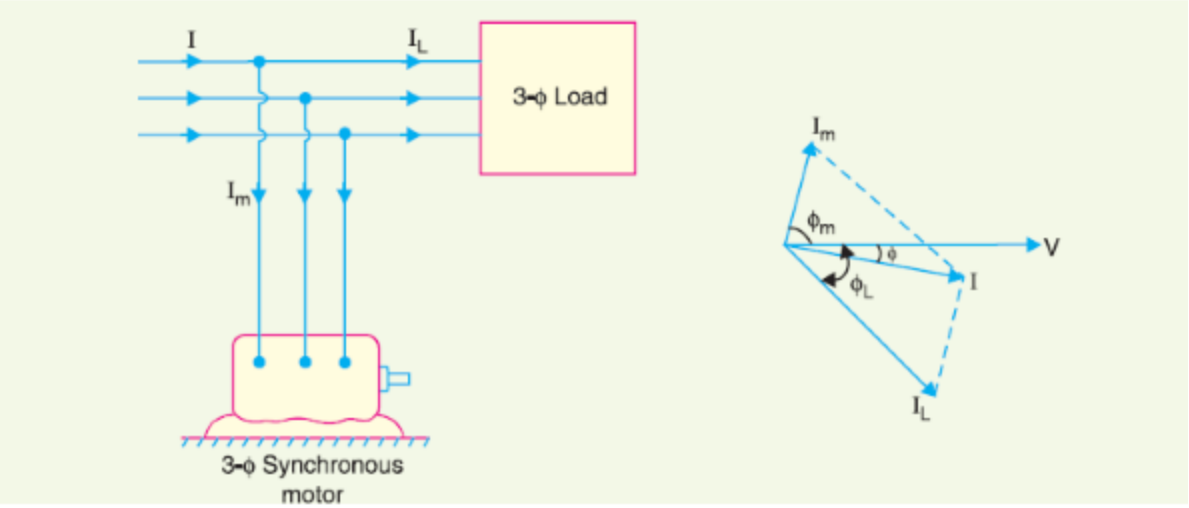

Figure 6.4 Synchronous Condenser with Load of Motor

6.7.2.1 ADVANTAGES OF SYNCHRONOUS CONDENSER

* Motor windings have thermal stability
* Fault can be remove easily

6.7.2.2 DISADVANTAGES OF SYNCHRONOUS CONDENSER

* Considerable losses in the motor
* Maintenance cost is high
* It produces noise

6.7.3 PHASE ADVANCERS

They are utilized to improve the power factor of acceptance engines. The low power factor of an enlistment engine is because of the way that its stator winding draws energizing current. On the off chance that the energizing ampere diverts can be given from some other air conditioning sources, at that point the stator windings will be soothed of energizing current in this way the power factor of the engine can be improved

CHAPTER 7
PROTECTION PART

Substations regularly have exchanging, assurance and control instrumentation and one or plenty of transformers. In a monster station, circuit breakers are won't interfere with any short-circuits or over-burden flows which will happen on the system. Littler circulation stations may utilize reclose circuit breakers or wires for the insurance of dispersion circuits. Substations don't once in a while have generators, however, an impact plant may have a station close. Various gadgets like power issue revision capacitors and voltage controllers can likewise be settled at a station.

7.1 NEUTRAL GROUNDING RESISTANCE (NGR)

Nonpartisan establishing obstruction is utilized to confine the planet deficiency current all through issue condition beneath an express worth. this can be done high voltage angle because of gratitude to high voltage and low winding obstruction shortcoming current is amazingly high and furthermore the windings aren't intended to hold such an outsized current, along these lines, it's the spot any place impartial establishing opposition includes play. Impartial establishing obstruction is utilized in 11KV producing station is to constrain the issue current inside as far as possible.

7.2 EARTH SCREEN

The power station and therefore the sub-station are usually having a lot of overpriced instrumentality. These stations will be protected against direct lighting strikes by providing earth screens. It consists of a network of copper conductors mounted everywhere the electrical equipment’s within the sub-station or power plant. The screen is correctly connected to the planet on a minimum of 2 points through an occasional resistance. On the prevalence of the direct stroke on the station, the screen provides a coffee resistance path by that lighting surge is connected to the bottom.

7.3 LIGHTING ARRESTOR

Lighting arrestor’s area unit protecting devices for limiting surge voltage thanks to lightning strikes. A surge protector may be a device used on the electric power system to safeguard the

insulation and conductors of the system from the damaging effects of lighting. The everyday surge protector incorporates a high voltage terminal and a ground terminal.

7.4 SURGE ABSORBENT

Flood retentive might be a securing gadget that decreases the sharpness of the wave front of a flood by riveting flood vitality. Albeit each flood diverter and flood retentive take out the flood, the style during which it's done is very surprising inside the 2 gadgets. The flood diverter redirects the flood to earth anyway the flood retentive ingests the flood vitality.

7.5 FIREPLACE PROTECTION

The fire protection device ought to be unbroken within the store yard for the protection of items of kit throughout storage. It will be helpful within the time of danger. This includes fireplace extinguishers, constant provide of water.

CHAPTER 8
CONCLUSION

Transmission and distribution stations exist at different scales all through a power framework. All in all, they speak to an interface between various levels or areas of the power framework, with the ability to switch or reconfigure the associations among different transmission and circulation lines. Sub-station instrumentality exists at various scales all through an impact framework. As a rule, they speak to Associate in the Nursing interface between totally various levels or areas of the capacity framework, with the possibility to change or reconfigure the associations among various transmission and dissemination lines The significant stations encapsulate an effect region from that activities are composed. Littler appropriation substations pursue the steady rule of accepting force at the upper voltage on one aspect and causing out the assortment of dissemination feeders at the lower voltage on the inverse, be that as it may, they serve a great deal of limited local space and territory unit typically unstaffed. The focal piece of the station is that the electrical gadget since it gives viable enface between the high-and low-voltage components of the framework. Diverse essential components are circuit breakers and switches. Breakers capacity ensuring gadgets that open precisely inside the occasion of a flaw, which is before a securing transfer demonstrates extreme current gratitude to some condition. Switches territory unit the board gadgets that might be opened or shut intentionally to decide or break an alliance. a fundamental important} qualification between circuit breakers and switches is that breakers region unit intended to hinder unusually high flows (as they happen exclusively in those very things that circuit assurance is required), while customary switches territory unit intended to be operable underneath conventional flows. Breakers square measure set on each the high-and low-voltage feature of transformers. At long last, substations may likewise encapsulate capacitance banks to supply voltage support.

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.

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