A OVERVIEW OF A 132/33 KV SUBSTATION

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of

Bachelor of Science in Electrical and Electronic Engineering

by

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Certification

This is to certify that this project and thesis entitled "**OVERVIEW OF A 132/33 KV SUBSTATION**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 1 January 2020.

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Dedicated to

Our Parents

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List of Abbreviations

CD	Chromatic Dispersion
EMI	Immune to Electromagnetic Interference
FBG	Fiber Bragg Gratings
FWHM	Full Width at Half Maximum
GVD	Group Velocity Dispersion
LED	Light Emitting Diodes
MD	Material Dispersion
NLSE	Nonlinear Schrödinger Equation
PMD	Polarization Mode Dispersion
PUA	Piecewise Uniform Approach
RMS	Root Mean Square
SSMF	Standard Single Mode Fiber
TFBG	Tilted Fiber Bragg Gratings
UV	Ultraviolet
WD	Wave-guide Dispersion
WDM	Wavelength Division Multiplexed

List of Symbols

λ	Wavelength
λ_B	Bragg wavelength
n_{eff}	Effective index
z	Position along the grating
n	Mode index
f	Fundamental Frequency
ω	Angular frequency
M	Modulation Index
T	Fundamental Time Period

ACKNOWLEDGEMENT

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ABSTRACT

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages.

Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. Generally substations are unattended, relying on SCADA for remote supervision and control.

The word substation comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.

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 (e.g. electrical device etc.) used for this purpose is that the sub-station. Similarly, the nearer the localities of the consumer's, the voltage are also stepped right down to the user level. This job is once more completed by appropriate equipment known as ' 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

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 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.

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.

Fig 2.1: Sub-Station

2.2 Single Line Diagram of a sub-station

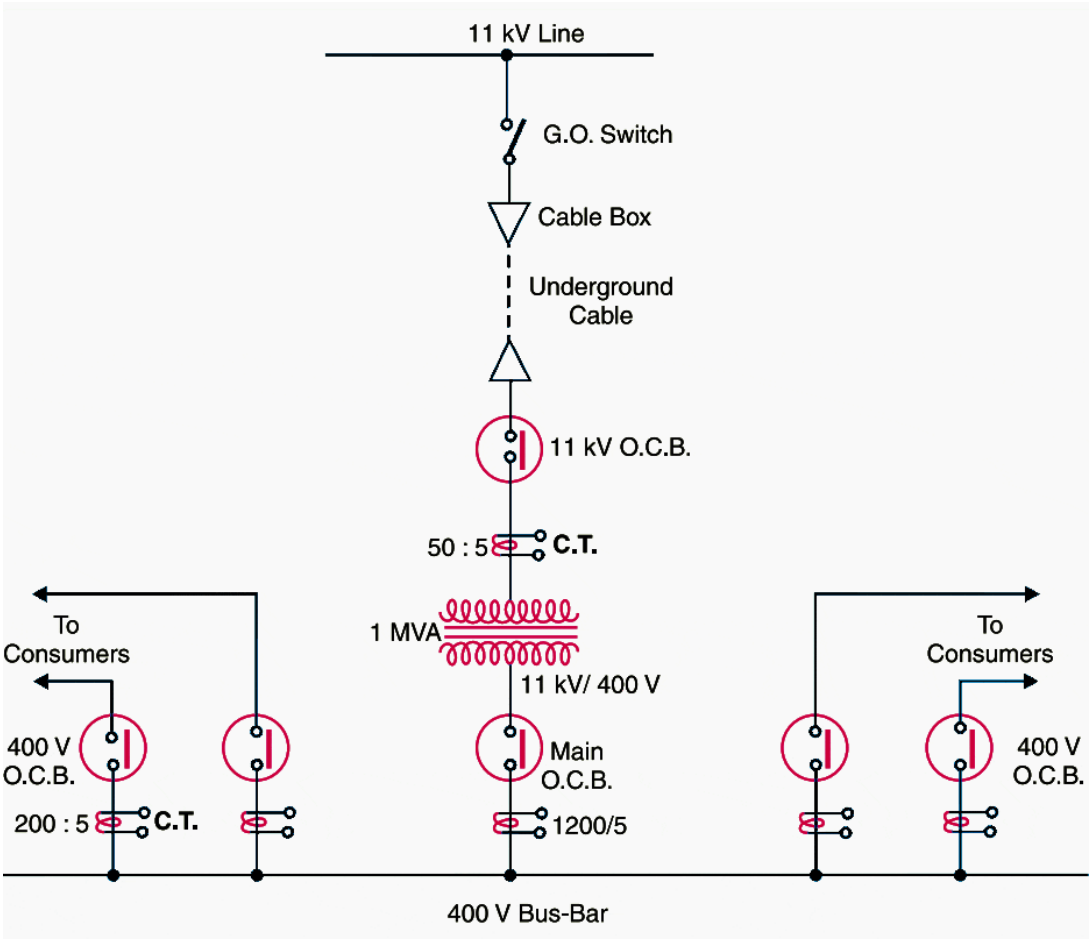

Fig 2.2: Single Line Diagram of a sub-station

2.3 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.

- ❖ According To Service Requirement
- ❖ According To Constructional Features

2.3.1 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
- Exchanging Sub-Station
- Power Factor Redress Sub-Station
- Changer Sub-Station
- Changing over Sub-Station
- Modern Sub-Station

2.3.2 According To Constructional Features

- Indoor Sub-Station
- Outdoors Sub-Station
- Underground Sub-Station
- Pole-mounted sub-stations

2.4 Component of Substation

- Instrument Transformers
- Current Transformer
- Potential Transformer
- Power Transformer
- Automatic Circuit Recloser
- Conductors
- Insulators
- Isolators

- Bus bars
- Lightning Arrestors
- Circuit Breakers
- Relays
- Capacitor Banks
- Wave Trapper

2.5 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.

2.6 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%

2.7 Difference 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

CHAPTER 3

Component of Substation

3.1 Instrument Transformer

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 menstruation instruments for the measuring of such high-level voltage and current. Typically menstruation instruments are designed for five Amps and one hundred ten Volts. The measuring of such terribly massive electrical quantities will be created attainable by victimization the Instrument transformers with these little rating menstruation instruments. Thus these instrument transformers square measure extremely popular within the fashionable grid.

Fig 3.1: Instrument Transformer

3.2 Current Transformer

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.

Fig 3.2: Current Transformer

Fig 3.3: Connection of Current Transformer

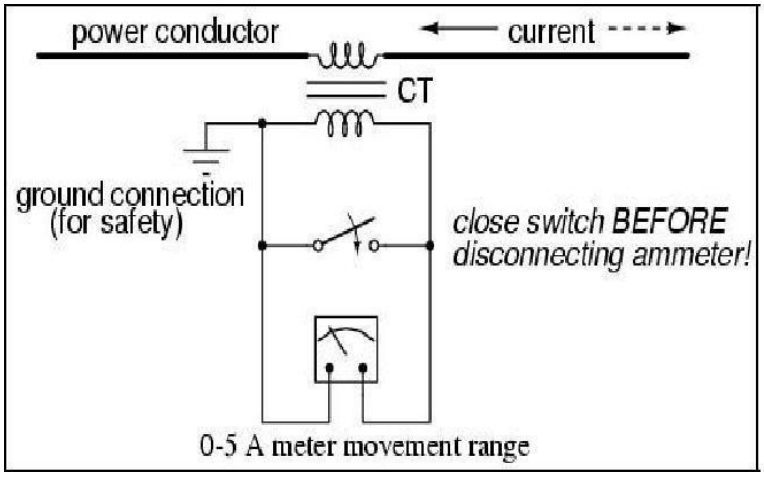

Fig 3.4: Connection Diagram of C.T

3.3 Voltage Transformer

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

Vp/Vs = Np/Ns

Thus Ns×Vp = Np × 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.

Fig 3.5: Voltage Transformer

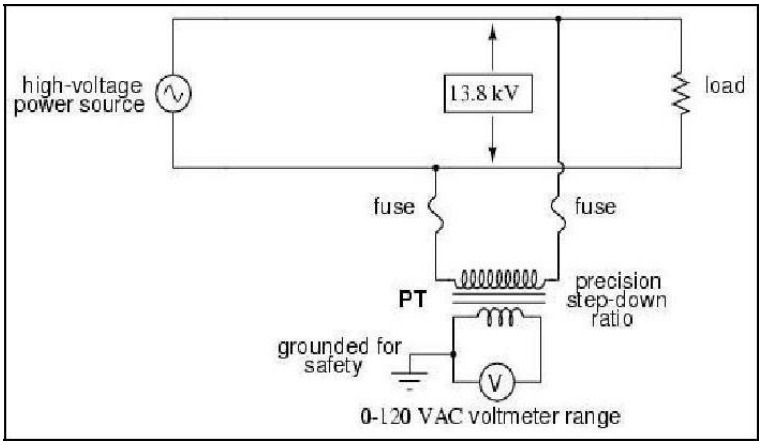

Fig 3.6: Connection Diagram of V.T

3.4 Potential Transformer

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.

Fig 3.7: Potential Transformer

3.5 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.

Fig 3.8: Power Transformer

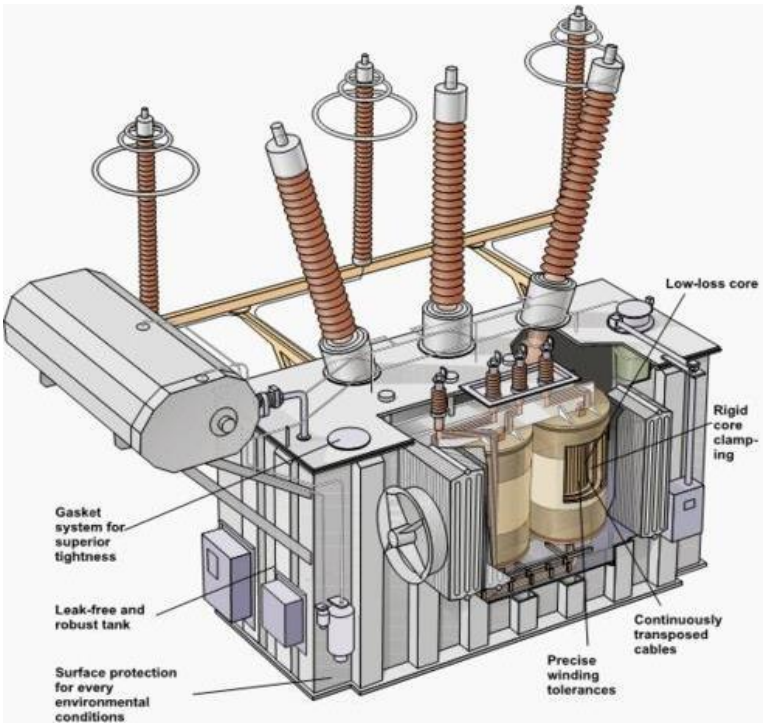

Fig 3.9: Difference part of Power Transformer

3.6 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.

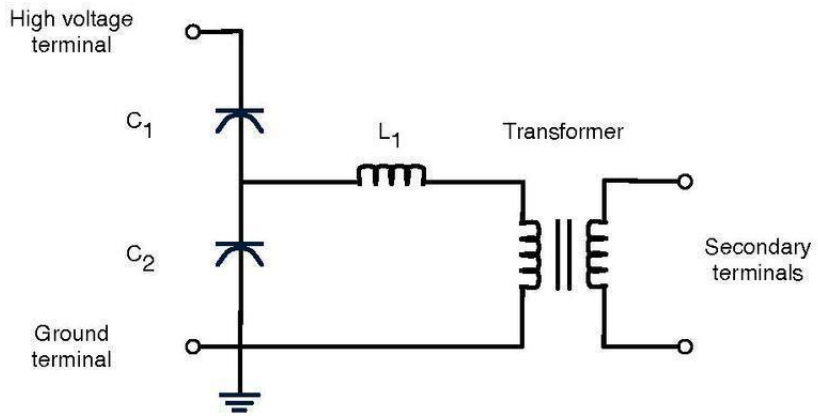

Figure 3.10: Capacitor Voltage Transformer Diagram

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.

3.7. Main Parts of a Transformer

- 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

3.8 Difference between Current and Potential 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.

3.9 Insulator

An electrical protector is a material whose inside electric charges don't stream uninhibitedly; next to no electric flow will move through it affected by an electric field. This diverges from different materials, semiconductors and channels, which transmit electric flow all the more effectively. The property that recognizes a separator is its resistivity; protectors have higher resistivity than semiconductors or conductors. The most widely recognized models are non metals. 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 5 types of insulators:

1. Pin Insulator
2. Suspension Insulator
3. Strain Insulator
4. Stay Insulator
5. Shackle Insulator

Fig 3.11: Insulators

3.10 Conductor

Conductors are the materials which permit flow of electrons through it. The best conductors are copper and aluminum etc. The conductors are utilized for transmission of energy from place to place over substations.

3.11 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.

There are different types of isolators used for different applications such as single-break isolator, double-break isolator, bus isolator, line isolator, etc.

Fig 3.12: Double break type isolator

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.

3.12 Circuit Breaker

The electrical switch is utilized to break the circuit if any shortcoming gathers in any of the instrument. These electrical switches 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.

Fig 3.13: Circuit Breaker in Substation

- 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.

3.13 Comparison of Circuit Breaker and Isolator

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.

3.14 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.

Fig 3.14: Bus bar in Sub-station

The most commonly used bus bar arrangements in a substation are

1 Single busbar system. Single busbar system.

2 Main & transfer busbar system.

3 Double bus bar single breaker system.

4 Double bus bar with double breaker system.

5 Double main bus & transfer busbar system.

6 One & half breaker scheme.

7 Ring or mesh arrangement.

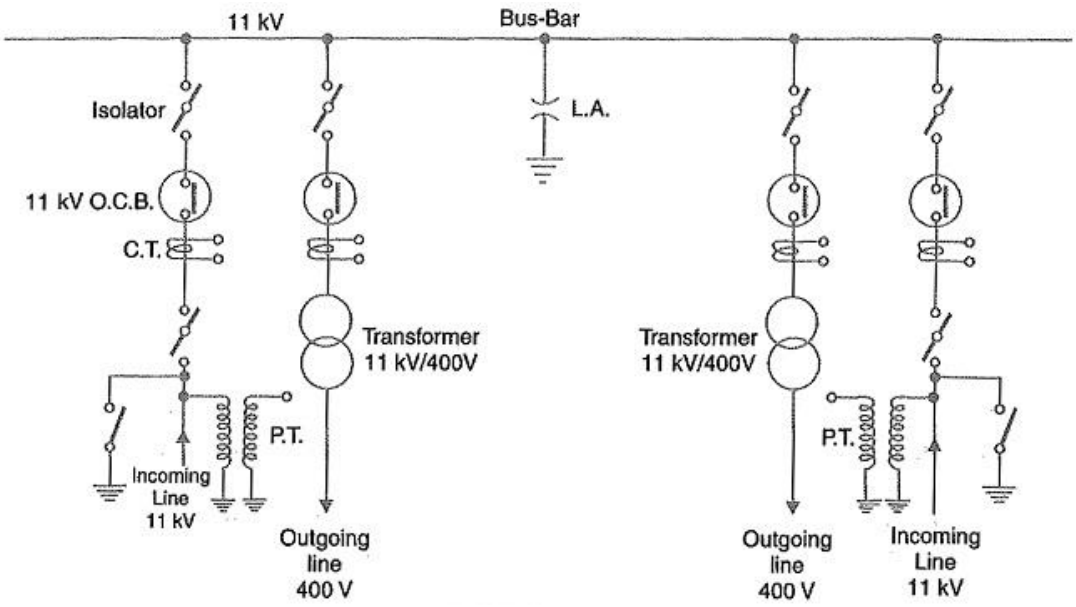

Fig 3.15: Bus bar Arrangement in Sub-station.

3.15 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.

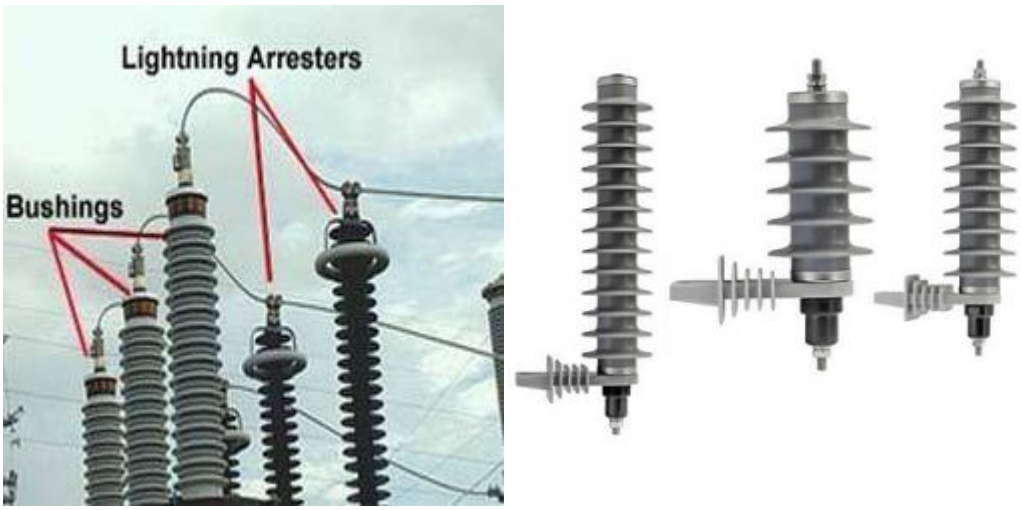

Fig 3.16: Lightning Arresters

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.

3.16 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.
- Improve reliability of power supply.

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.

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.

3.17 Capacitor Banks

The capacitor bank is a material whose inside electric charges don't stream uninhibitedly; next to no electric flow will move through it affected by an electric field. This diverges from different materials, semiconductors and channels, which transmit electric flow all the more effectively. The property that recognizes a separator is its resistivity; capacitor banks have higher resistivity than semiconductors or conductors. The most widely recognized models are non metals.

Fig 3.17: Capacitor Bank in Substation

3.18 Wave Trapper

The wave trapper is one of the substation components which is placed on the incoming lines for trapping of high-frequency waves. The high-frequency waves which are coming from nearby substations or other localities are disturbing the current and voltages; hence its trapping is of great importance. The wave trapper is basically tripping high-frequency waves and is then diverting the waves into telecom panel.

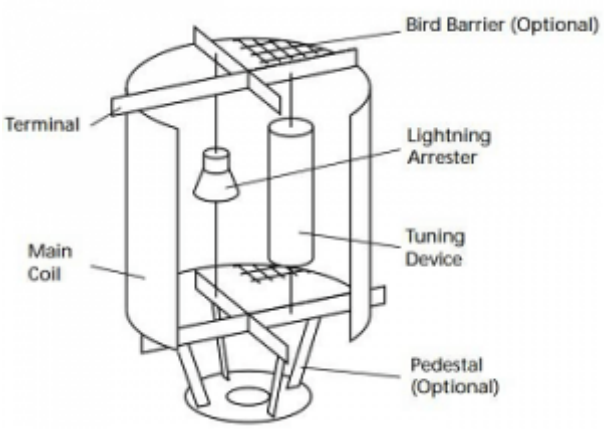

Fig 3.18: Wave Trapper in Substation

3.19 Automatic Circuit Recloser

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.

Fig 3.19: Automatic Circuit Recloser

Benefits of using ACR systems

- Minimizing interruptions in the power supply to the customer,
- Reduction of operational costs during damage removal,
- Maintenance-free operation of the power substation.

3.20 Oil Circuit Recloser

A recloser is a type of protection device that is used on various electrical distribution networks. Automatic power restoration: Reclosers automatically restore power after an outage occurs with help of oil.

Fig 3.20: Oil Circuit Recloser

3.21 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.

Fig 3.21: Relays

CHAPTER 4

Transmission of Substation

4.1Introduction:

After producing the electric power it transmit through the country by the transmission line system. Electric utilities are tired 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.

1. Overhead transmission

2. 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 voltage 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 substation at which the transmission lines are linked is called Grid substation.

4.2Overhead transmission:

An overhead power line is an electric power transmission line suspended by towers or poles. Since most of the insulation is provided by air, overhead power lines are generally the lowest-cost method of transmission for large quantities of electric power. Towers for support of the lines are made of wood (as-grown or laminated), steel (either lattice structures or tubular poles), concrete, aluminum, and occasionally reinforced plastics. The bar wire conductors on the line are generally made of aluminum (either plain or reinforced with steel or sometimes composite materials), though some copper wires are used in medium-voltage distribution and low-voltage connections to customer premises.

The invention of the Strain insulator was a critical factor in allowing higher voltages to be used. At the end of the 19th century, the limited electrical strength of Telegraph-style Pin insulators limited the voltage to no more than 69,000 Volts. Today overhead lines are routinely operated at voltages exceeding 765,000 volts between conductors, with even higher voltages possible in some cases.

Fig:4.1 Overhead transmission line

Electricity is carried round the country on overhead lines at various voltages. All overhead lines produce electric and magnetic fields. The field is highest directly under the line and falls to the sides.

4.3Classification

Overhead power transmission lines are classified in the electrical power industry by the range of voltages:

Low voltage	less than 1000 volts	used for connection between a residential or small commercial customer and the utility.
Medium Voltage (Distribution)	between 1000 volts (1 kV) and to about 33 kV	used for distribution in urban and rural areas.
High Voltage (Sub transmission if 33-115kV and transmission if 115kV+)	between 33 kV and about 230 kV	used for sub-transmission and transmission of bulk quantities of electric power and connection to very large consumers.
Extra High Voltage (Transmission)	over 230 kV, up to about 800 kV	used for long distance, very high power transmission.
Ultra High Voltage	higher than 800 kV	

Lines classified as "low voltage" are quite hazardous. Direct contact with (touching) energized conductors still present a risk of electrocution. 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. This is extremely dependent on the voltage the line is running at.

4.4Overhead power transmission lines components

An OHTL comprises of many several components, the utmost important remain both: supports and conductors. Other components are insulators, insulator and conductor fittings, overhead ground wire, spacers and brackets. Following figure 4 shows samples of OHTL designs with supports and some other components indicated.

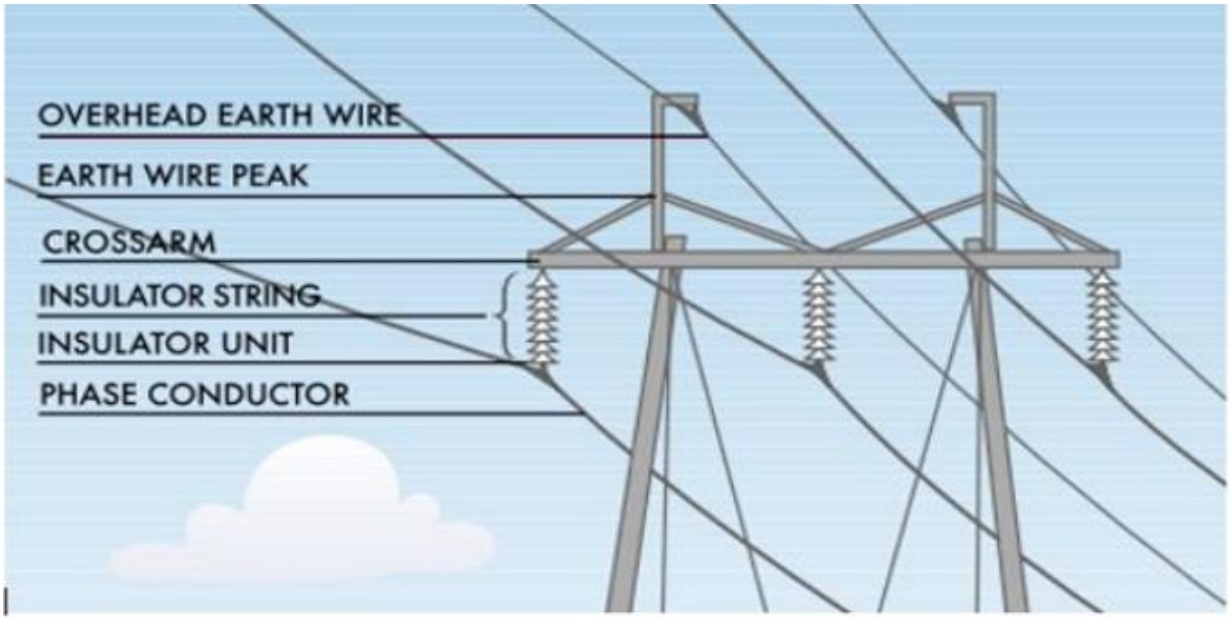

Fig:4.2 Components of overhead transmission lines.

4.5 Types of OHTL Supports

The main function of the of the OHTL supports (also named: towers, structures or pylons) is to provide the necessary mechanical support for the transmission conductor at the design electrical clearance from ground and also from other phase conductors. In addition to that all towers have to withstand all kinds of environmental effects.

OHTL supports can be made using different types of materials such as wood, concrete, steel, metal alloys and recently fiber reinforced polymers were introduced but still rarely used.

OHTL supports according to their mechanical design are classified into two types:

1. Self-supporting; which might be of the following types (examples are shown in figure 5)

- Lattice steel towers.
- steel poles.
- Steel reinforced concrete poles.
- Wooden poles

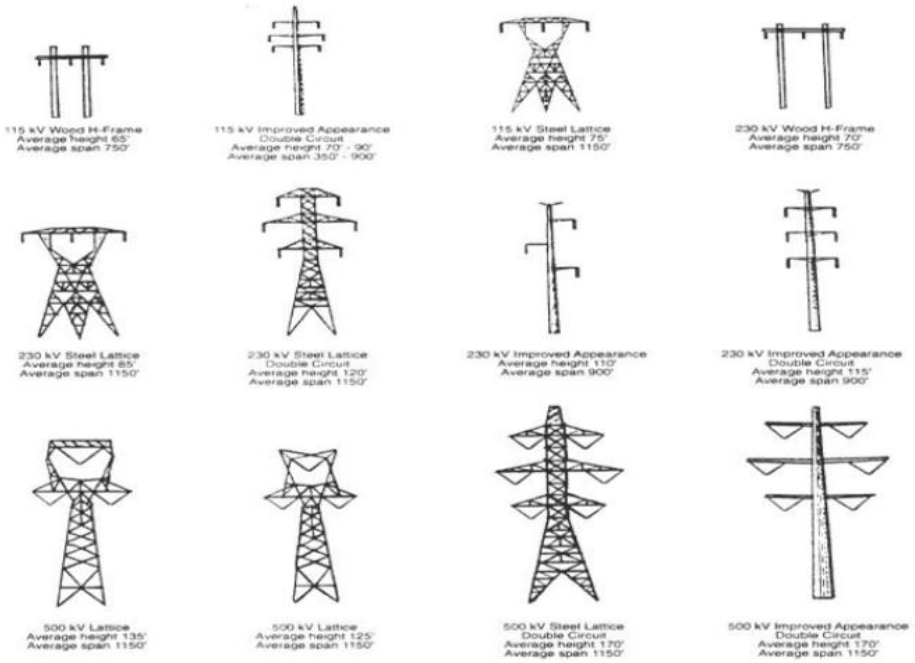

Fig:4.3 samples self supporting OHTL .

4.6 Guyed or non-self-supported: although those types of supports were introduced at the second quarter of the 20th century, but their use declined with time for the transmission purposes compared to the self-supporting ones. However, guyed supports can be in the H, V or Y shapes. Another use of the guyed supports is for fast transmission system restoration in case of transmission supports collapse or for transmission circuits diversion during projects or modification works and for this purpose, some special designed guyed supports called Emergency Restoration Systems (ERS) that can be assembled in short time in different configurations are used. Respectively a sample H-shape guyed power transmission support and an ERS support are shown in figure

Fig:4.4 Sample of Guyed OHTL support

Moreover, OHTL supports can be classified according to the mechanical support they are providing to the conductors into:

1. Angle supports: used when the line is changing its direction with deviation angles varies from 30 to 90 degrees in a standardized value (e.g. 30, 45, 60, etc.).

2. Suspension supports: used for sections were the line is running straight with some allowed deviation usually not to exceed 10 degrees.

3. Terminal supports: usually used at substation entry as they are designed to take full mechanical tension on one side and no tension (or slack) on the other side.

Furthermore, OHTL supports might be classified based on the number of circuits they are carrying (supporting); and so, it might be single circuit support, double circuits support or quadrable circuits support and in some rare cases, OHTL support is designed to carry one or more transmission circuits in the upper part of the support and a distribution circuit/circuits or insulated fiber communication cable in the lower part but this kind of supports utilization will be only possible with OHTL with short spans between supports.

4.7 General considerations for OHTL supports design

In this part, the basic steps for the design of an overhead line supports are determined in brief remembering that in the design process, and although it is to some how standardized process, the design is highly affected by the data and requirements provided by the utility itself which are to be as accurate as possible to reflect the local working conditions of the line to be met by the design.

Anyhow, before starting the design of the line supports, the following details shall be provided:

1. The line electrical requirements such as:

- The minimum clearances between conductors, and between conductor and the support itself.
- Number, type and location of ground wire/wires with respect to the outermost conductor.
- The minimum required mid-span clearance of the lowest conductor above ground level or to other conductors at intersection with other lines conductors.
- Minimum Insulator required creep age path and hence the minimum length of the insulator assembly.
- Electrical loading requirements (this will determine the number of conductors per phase and number of circuits per support.
- Short circuits, Etc.

1. The line minimum mechanical strengths requirements and required safety factors.

2. Environmental & and climatic conditions including the proposed preliminary routes/ terrains.

Based on the above details, the supports design process is conducted to provide supports that accomplish the above requirements as below:

a) Selection of the basic supports configuration and minimum height to meet electrical design requirements. The supports minimum height is governed by:

- The minimum permissible ground clearance.
- The maximum sag.
- Phase conductors vertical spacing.
- Ground wire to top conductor vertical clearance.

b) Determination of the mechanical strength of the selected support configuration: the selected support configuration shall be designed mechanically to withstand the sum of the mechanical loads resulting from electrical requirements, climatic effects, terrain and the added safety factor. It is always to bear in mind during support design that the design the design is meet the loading requirements within the economic requirements of the utility.

The mechanical loads to be determined for the purpose of OHTL support design are:

I. Wind Loads: this step includes the determination of wind loads affecting both, the support and conductors.

II. Conductors load: this step includes the calculation of mechanical loads resulting from conductor's tensions (the maximum working tension and Every day stress), short Circuit conditions, ice accumulation in cold weather countries.

III. Induced vibration effects.

IV. Finalize the design based on combined Loads: this is necessary to achieve a reasonable design that matches the requirements without being oversized and achieved by the assumption that not all of the factors aforementioned will be at highest together.

V. Applying the safety factor.

VI. Design verification through prototyping and type testing of the supports.

4.8What is Underground Electric Transmission?

The **electric power transmission** can be done using a method like undergrounding as an alternative to overhead power transmission. These cables have low visibility and not affected by bad -weather. But, the cost of these cables is high and laying process is time-consuming

instead of overhead building. The finding of faults in **underground transmission lines** takes much time for repairing as well as locating. In urban areas, this type of transmission is enclosed with shielded with dielectric liquid and a metal pipe that is either fixed or spread through pumps.

If an electric-fault breaks the underground pipe & generates a dielectric liquid into the nearby mud, then the liquid nitrogen trucks are assembled to fix the damaged part of the pipe location. This kind of transmission cable can extend the fixed period as well as the cost of repair. The stats of the pipe and soil are monitored frequently throughout the period of repair.

Advantages of Underground Cables

There are several advantages that are associated with the laying of specific types of cables under the ground for purposes of transmitting electricity.

The following is a brief outline of these advantages.

1. Compared to overhead cables, underground cables are much safer. This is because underground electrical cables are not exposed to the many dangers that ead power cables are exposed to.
2. It is cheaper to maintain underground cables over the course of time as compared to overhead ones. In practice, the cost of installing underground cables far exceeds what is associated with the installation of overhead ones. But once the underground cables have been installed, it is highly unlikely that will have to be repaired every now and then as it is the case with overhead electrical cable types.
3. Underground transmission of electricity is associated with reliability. This is because instances of constant disruption in the supply of power as a result of storms or faults that are associated with overhead transmission lines are not common when power transmission lines are laid underground.

The **disadvantages** of underground transmission lines include the following.

- Undergrounding cables are very expensive.
- The repairing of these cables as well as finding faults can take many days.
- The locations of underground cables are not always noticeable, which can lead to damage the cables.
- Operation of these cables are very difficult due to the high reactive power of these cables generates high charging currents.
- Underground cables will damage the movement of soil

Installation

The installation process of underground electrical cables requires digging whereas, in overhead lines, it is located on poles. Due to some utility service lines, this may be complicated by another type of value services like pipelines of gas, oil, and sewer lines. Other problems may occur due to loose soil, rocks and water on roads will more expensive to fit.

Dissipation of Heat

Dissipation of heat in underground power transmission cable is partial with insulation layers as well as protection like sheaths & armoring. Therefore, most of the heat is maintained near the cable.

Conductors Size

Compared to overhead cables, underground cables have a huge conductor with the same quantity of electrical power. As underground electrical power transmission cables have an artificial cooling system.

Carrying Ability of Voltage

The underground electric power transmission cables are limited by the costly construction and dissipation of heat. Due to these reasons, an underground cable transmits up to 33-kilovolts.

Fault Recognition & Repair

It is complicated to recognize the faults in underground electric power transmission. Because it takes a lot of time to find as well as repair the underground cables.

Security of Public

The underground electric power transmission cables are very safe to the environment, public, animals, etc. These cables are not impacted and affected by the conditions as well as trees, accidents, animals, storms, physical interference, the wind that may direct to damage the poles, cables, etc.

Lightning Expulsion Effect

The underground electric power transmission cables are not affected by the lightning expulsion.

Voltage drop & Interference

The underground electric power transmission cables have less voltage drop due to the truth that these cables are much larger in diameter than overhead cables for the same power delivery.

These cables don’t interfere with close proximity communication lines TV, radio, corona discharge.

Life Span

The lifespan of underground electric power transmission cables has low compared to overhead cables.

Ecological Impact

The underground electric power transmission cables more benefits of health, ecological due to noise reduction and superior plants management. Additionally, these cables have low loss of transmission, reduced harm, and accidents.

Use of Land

The underground electric power transmission cable uses better land without the view of cables as well as poles, which leads to improving the values of the property.

CHAPTER 5

Distribution of Substation

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

5.1.1 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.

5.2 Main Element of Overhead Line

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

5.2.1 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.

5.2.2 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.

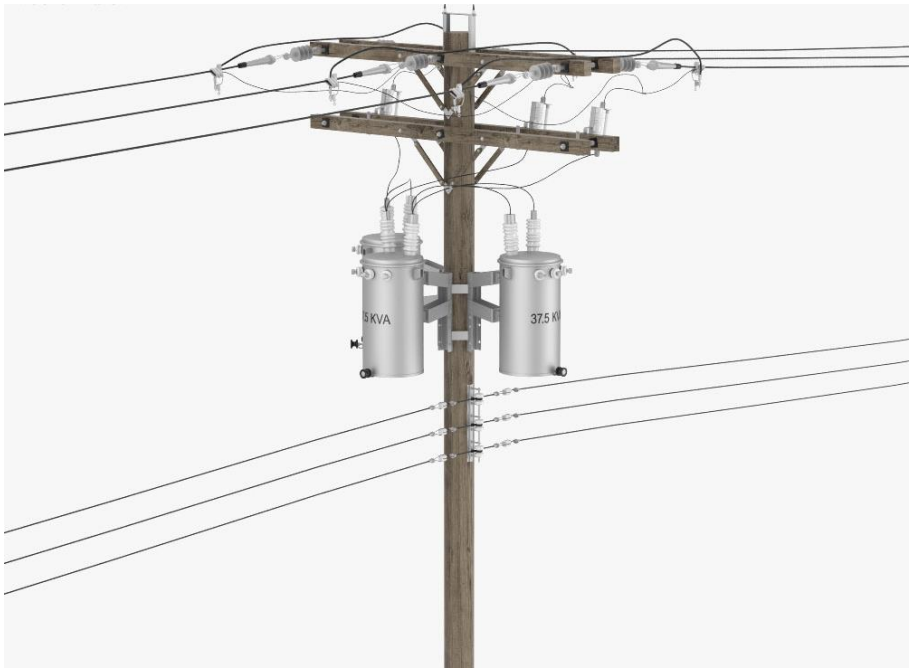

Fig 5.2: Electric Pole

5.2.3 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

5.2.4 Insulators

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.

5.2.5 Types of Insulator

The most commonly used insulators are given below

- Pin type insulators
- Suspension type insulators
- Strain insulators
- Shackle insulator

Fig 5.3: Pin type insulator

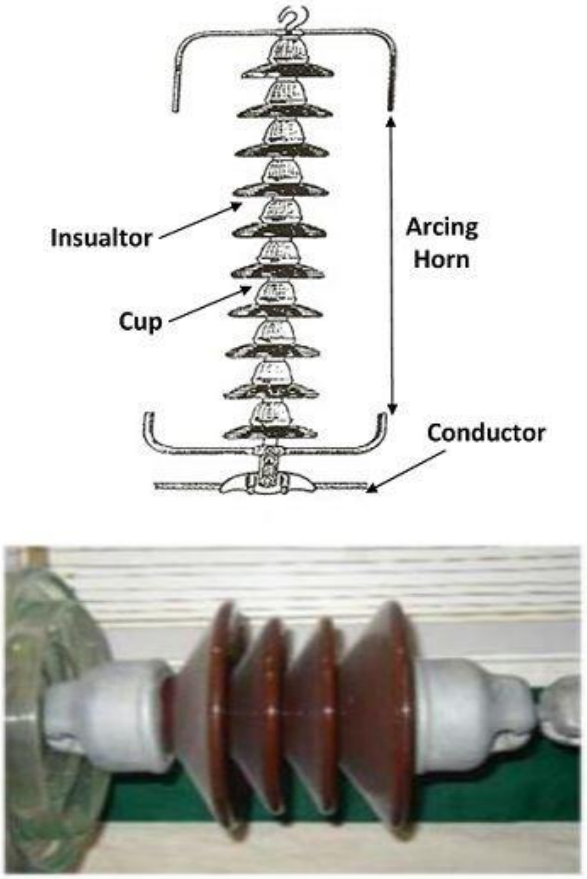

Fig 5.4: Suspension type insulator

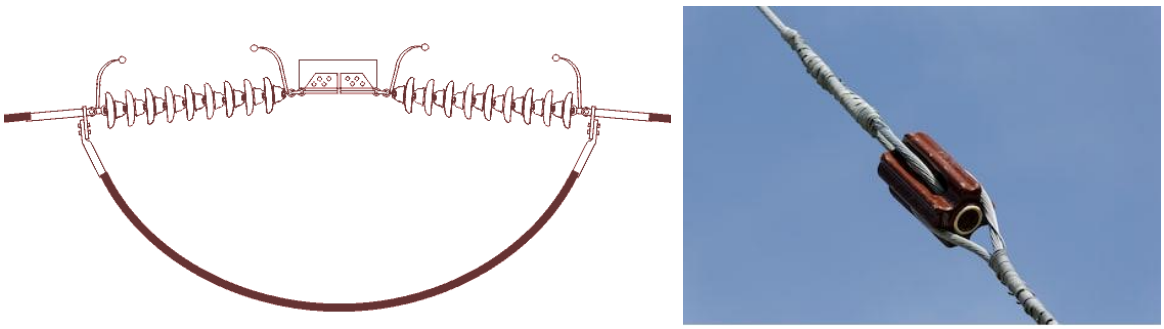

Fig 5.5: Strain Insulator.

Fig 5.6: Shackle Insulator

5.3 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.

5.4 Feeder

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

Figure 5.7: Feeding system of transformer in sub-station

CHAPTER 6

Protection of Substation

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 recloses 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.

6.1 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.

6.2 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.

6.3 Lightening Arrester Protection

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.

6.4 Fire 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 provider of water.

6.5 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.

6.6 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.

6.7 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.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 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.

7.2 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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