

A

TRAINING

REPORT ON

PURVANCHAL VIDYUT VITRAN NIGAM LIMITED



BRANCH OF

UTTAR PRADESH POWER CORPORATION LIMITED

132/33 KV Substation



UPPCL

Uttar Pradesh Power Corporation Limited

A

Training Report Submitted

In partial Fulfillment Of The Requirements

For The Award Of Degree Of

Bachelor of Technology

In

ELECTRICAL ENGINEERING

BY

ABHISHEK TRIPATHI



ACKNOWLEDGEMENT

Training has an important role in exposing the real life situation in an industry. It was a great experience for me to work on at **Subdivision of Electrical Division Distribution-1 of UTTAR PRADESH POWER CORPORATION LIMITED** through which I could learn how to work in a professional environment.

Now, I would like to thank the people who guided me and have been a constant source of inspiration throughout tenure of my summer training.

I am sincerely grateful to **MR. A.K.SINGH (EXECUTIVE ENGINEER)** and **MR. SUNILKUMAR (SUB DIVISION OFFICER)** at **132/33 kv substation, HALIYA MIRZAPUR** who rendered me his valuable assistance, constant encouragement and able guidance which made this training actually possible.

I wish my deep sense of gratitude to **MR. RAJENDRA PRASAD (JUNIORENGINEER)** whose affectionate guidance has enabled to complete this training successfully. I also wish my deep sense of gratitude to **MR. V.K.MAURYA (HOD:EEDEPARTMENT)** and other faculty members whose guidance and encouragement made my training successful.

ABHISHEK TRIPATHI

DISCRIPTION OF SUB-STATION

Type:-Outdoor Grid Sub-Station

Incoming Line Voltage:-132KV

Outgoing Feeder Voltage:- 33KV

Haliya sub-station receives power from **LALGANJ** Sub-station (UPPCL).

Haliya Substation Has 4 Feeder And 2 Transformers

- 1) Transformer 1st is 10 MVA has Two feeders:- 1st KOTAGHAT FEEDER and 2nd DAMALGANJ FEEDER
- 2) Transformer 2nd is 5 MVA has Two feeders:-1st HALIYA FEEDER and 2nd ADHAWA FEEDER

Definition of sub-station:

“A set of equipment reducing the high voltage of electrical power transmission to that suitable for supply to consumers”.

“The **electrical substation** can be defined as a network of electrical components comprising of power transformers, busbars, auxiliaries, and switchgear etc. The components are interconnected such that creating a sequence of a circuit capable to be switched OFF while running on normal operation through manual commands while in emergency situations it can be switched OFF automatically. The emergency situations may be an earthquake, floods, or short circuit etc.”



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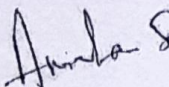

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. **Abhishek Tripathi** Student of **B. TECH** from '**BBD university Lucknow**' has successfully undergone Project Training at our "**Saubhagya - RE works at Basti Sant Kabir Nagar**" for the period of "**07.06.2019 to 20.07.2019**".

During this period of training he was exposed to all **Electrical and Civil works** and we found him sincere in his works.

This certificate has been issued on his request.

For, LARSEN & TOUBRO LIMITED

(Anirban Sen)

HR Manager

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INTRODUCTION

The present day electrical power system is ac. i.e. electric power is generated, transmitted, and distributed in the form of Alternating current. The electric power is produced at the power station, which are located at favourable places, generally quite away from the consumers. It is delivered to the consumer through a large network of transmission and distribution. At many places in the line of power system, it may be desirable and necessary to change some characteristic (e.g. Voltage, ac to dc, frequency p.f. etc.) of electric supply. This is accomplished by suitable apparatus called sub-station for example, generation voltage (11KV or 6.6KV) at the power station is stepped up to high voltage (Say 220KV to 132KV) for transmission of electric Power. Similarly near the consumer's localities, the voltage may have to be stepped down to utilization level. Suitable apparatus called sub-station again accomplishes this job.

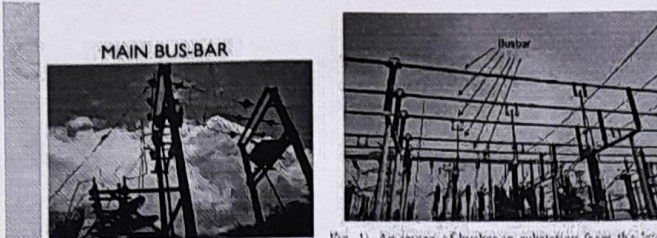
About the substation:-

The substation in Haliya is one of the important power grids in the state of UTTAR PRADESH. Cause it supplies the HALIYA & locality. The most important of any substation is the grounding (Earthing System) of the instruments, transformers etc. used in the substation for the safety of the operation personnel as well as for proper system operation and performance of the protective devices. An earthen system comprising of an earthing mat buried at a suitable depth below ground and supplemented with ground rods at suitable points is provided in the substations. These ground the extra high voltage to the ground. As it is dangerous to us to go near the instrument without proper earth. If the instruments are not ground properly, they may give a huge shock to anyone who would stay near it and also it is dangerous for the costly Instrument as they may be damaged by this high voltage.

Equipments in a 132KV Sub-Station:-

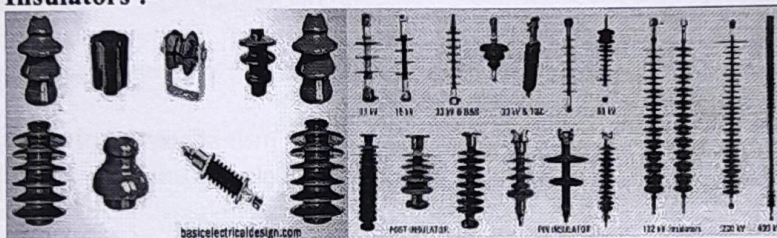
The equipment required for a transformer Sub-Station depends upon the type of Sub-Station, Service requirement and the degree of protection desired. 132KV EHV Sub-Station has the following major equipments:-

1) Bus bar :-



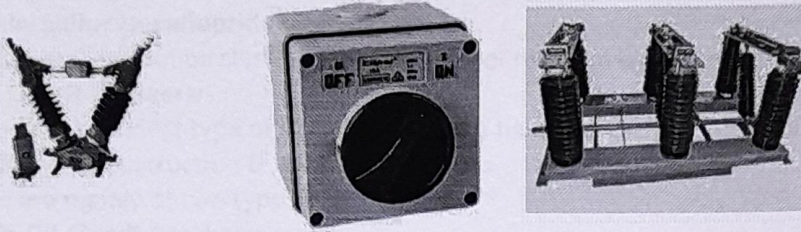
When a no. of lines operating at the same voltage have to be directly connected electrically, bus-bar are used, it is made up of copper or aluminium bars (generally of rectangular X-Section) and operate at constant voltage. The bus is a line in which the incoming feeders come into and get into the instruments for further step up or step down. The first bus is used for putting the incoming feeders in LA single line. There may be double line in the bus so that if any fault occurs in the one, the other can still have the current and the supply will not stop. The two lines in the bus are separated by a little distance by a Conductor having a connector between them. This is so that one can work at a time and the other works only if the first is having any fault.

2) Insulators :-



The insulator serves two purpose. They support the conductor (or bus bar) and confine the current to the conductor. The most commonly used material for the manufactures of insulators is porcelain. There are several type of insulator (i.e. pine type, suspension type etc.) and their use in Sub-Station will depend upon the service requirement. Post insulators are used for the bus bars. A post insulator consists of a porcelain body, cast iron cap, & flanged cast iron base. The whole cap is threaded so that bus bars can be directly bolted to the cap. When the line is subjected to a greater tension, strain insulators are used. When tension in line is exceedingly high, two or more strings are used in parallel.

3) Isolating Switches:-



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

The operating principle is manual plus one of the following:-

1.Electrical Motor Mechanism

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

3) Circuit breaker :-

A circuit breaker is a equipment, which can open or close a circuit under normal as well as fault condition. These circuit breaker breaks for a fault which can damage other instrument in the station. It is so designed that it can be operated manually (or by remote control) under normal conditions and automatically under fault condition. A circuit breaker consists of fixed & moving contacts, which are touching each other under normal condition i.e. when breaker is closed.

Whenever a fault occurs trip coil gets energized, the moving contacts are pulled by some mechanism & therefore the circuit is opened or circuit breaks. When circuit breaks an arc is stack between contacts, the production of arc not only interrupts the current but generates enormous amount of heat which may cause damage to the system or the breaker itself. Therefore the main problem in a circuit breaker is to extinguish the arc within the shortest possible time so that

the heat generated by it may not reach a dangerous value. The medium used for arc extinction is usually

Oil, Air, Sulfur Hexafluoride (SF₆) or vacuum.

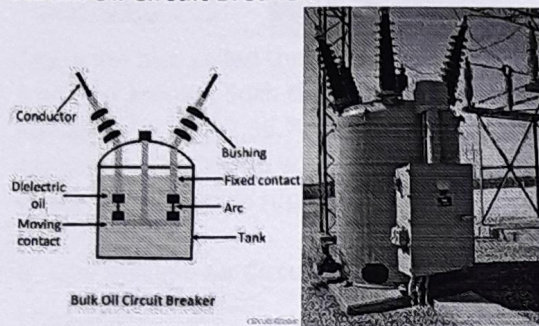
Circuit breakers can be classified on the basis of medium used for arc extinction:

4.Oil Circuit Breakers:-

These are the oldest type of circuit breakers & have the virtues of reliability, simplicity of construction & relative cheapness.

These are mainly of two types:

a.Bulk Oil Circuit Breakers:-



using large quantity of oil are also called the *dead tank type* because the tank is held at earth potential. Such circuit breakers may further be classified as:-

i.Plain Break Oil Circuit Breakers:-

are very simple in construction & widely used in low voltage dc & ac circuits. For use on higher voltages, they become unduly large in size & need huge of transformer oil. In addition, such breakers are not suitable for high-speed interruption; therefore, these cannot be used in auto-closing.

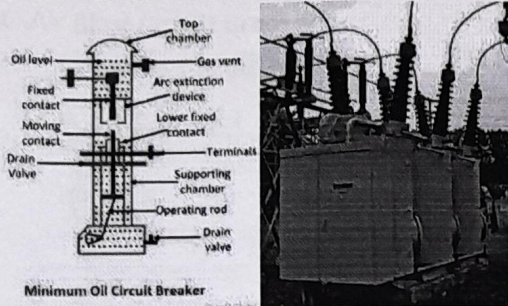
ii. Self Generated Pressure Oil Circuit Breakers:-

These are of three types viz. *Plain explosion pot* having limited breaking capacity, *cross jet explosion pot* suitable for interrupting heavy current high voltage (66kV) & *self compensated explosion pot* suitable for operation both at heavy currents as well as low currents. Plain explosion pot cannot be used either for very low currents because of increased arcing time or for very heavy currents because of risk of bursting of pot due to high pressure.

iii. Impulse Type Oil circuit Breakers:-

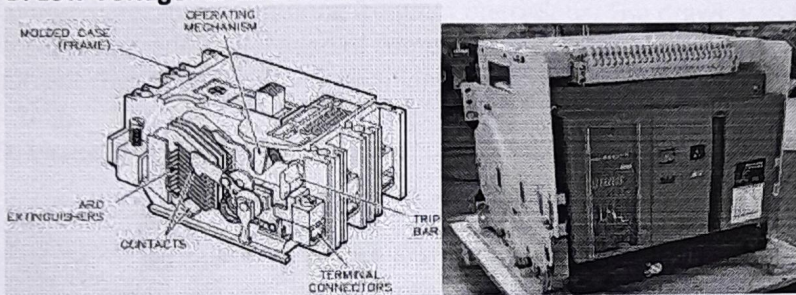
Have the main advantage, over other conventional design, of reduced requirement of oil (roughly one-fourth). The possibility of current chopping can also be avoided by using resistance switching.

B .Low oil or Minimum Oil Circuit Breakers:



These are also called the live tank circuit breakers because the oil tank is insulated from the ground. Such circuit breakers are now available for all type of voltages(3.6,7.2,12,36,72.5,145,245 & 420 kV) & for the highest breaking capacities. The MOCB with rated voltage of 12 kV has a single interrupter per phase without extra support insulator.

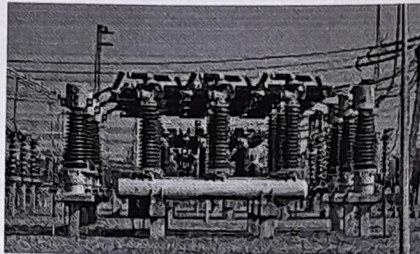
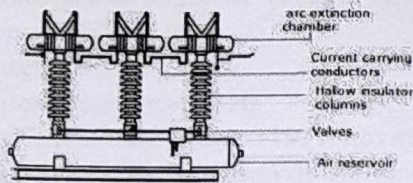
B. Low Voltage Air Circuit Breakers:-



These breakers are designed for use on dc circuits & low voltage ac circuits for the protection of general lighting & motor circuits. These breakers are usually provided with an over current tripping mechanism which may be of instantaneous or time delay type or combination of both. Trip devices may be set over a range from about 80 to 160 percent of rating. The breakers may also be provided with over tripping ranges & arrangements such as low voltage trip, shunt trip connected to ever voltage, reverse current or over current relays. Such breakers are of rating of two & including 6,000 A a.c& 12,000 A d.c, voltage ratings are 250 to 600 V a.c& 250 to 750 V d.c. Special breakers available up to 3,000 V for d.c services.

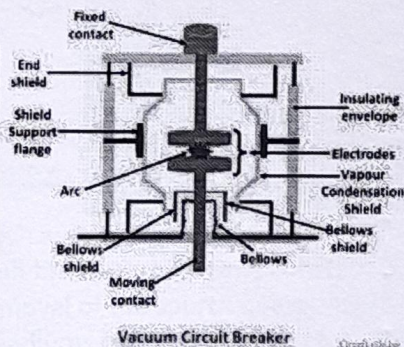
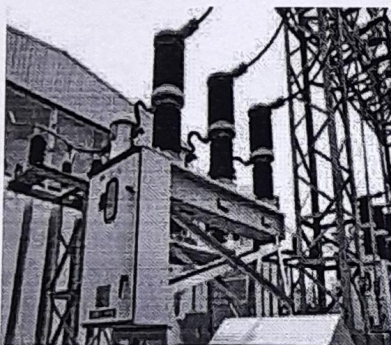
C. Air Blast Circuit Breakers:-

Air Blast Circuit Breaker



The air blast circuit breakers employs compressed air (at a pressure of 20 kg/cm) for arc extinction & are finding their best application in systems operating 132 kV & above (upto 400kV) with breaking capacity up to 7,500 MVA (during short circuit fault) & above although such breakers have also been designed to cover the voltage range of 6,600 Volts to 132,000 Volts. These breakers have the advantages of less burning of contacts because of less arc energy, little maintenance, facility of high speed reclosure no risk of explosion & fire hazard & suitability for duties requiring frequent operations. The drawbacks of such breakers are additional need of compressor plant for supplying compressed air, current chopping, sensitivity restriking voltage & air leakage at the pipe line fittings.

D. Vacuum Circuit Breakers:-



The idea behind the vacuum circuit breakers is to eliminate the medium between the contacts-vacuum. The dielectric strength of vacuum is 1000 times more than that of any medium. In construction it is very simple circuit breaker in comparison to an air,

oil circuit breakers. These breakers are used for reactor switching transformer switching, capacitor bank switching where the voltages are high & the current to be interrupted is low.

Specification of 132 kV Vacuum Circuit Breaker:

Type=ELFSF2-1 (r)

Rated Voltage=145 kV

Rated Frequency=50 Hz

Rated Normal current=3150 Amps at 40°C

Rated Lightning Impulse Withstand Voltage=650 KV p

Rated Short Circuit Breaking Current=31.5 k Amps

Rated Short Time Withstand Current & Duration=31.3 k Amps for 3 sec

Line Charging Breaking Current=50 k Amps

First Pole To Clear Factor=1.5 Rated Gas Pressure SF₆/20°C

(abs) =7.0 bar

Closing & Opening Devices Supply Voltage=220 v (d.c)

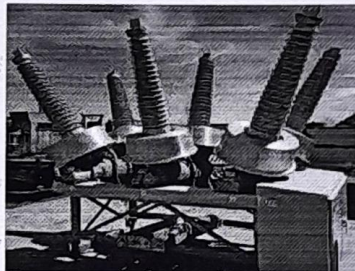
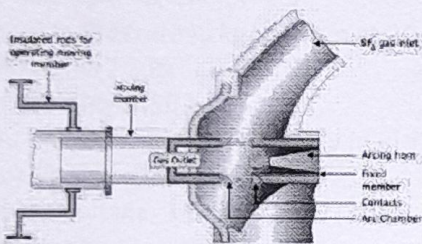
Auxiliary Supply Voltage=One Phase, 240v ac & Three Phase, 415v ac

Air Pressure=22 bar

Total Mass=1750 kg (approx)

Closing Time ≤ 130 m sec Maker= M/S ABB It is used for transformer-1

Sulphur Hex-fluoride Circuit Breakers:-



SF₆ gas has unique properties such as very high dielectric strength, non-reactive to the other components of circuit breakers, high time constant & fast recombination property after removal of the source energizing the spark, which proves it superior to the other mediums (such as oil or air) for use in circuit breakers. SF₆ circuit breakers have the advantages of very much reduced electrical clearances, performance independent of ambient conditions, noise less operation, reduce moisture problem, minimum current chopping, small arcing time, no reduction in dielectric strength of SF₆, low maintenance, reduced installation time & increased safety. Such as circuit breakers are used for rated voltages in the ranges of 3.6 to 760 kV. For the later operation a relay wt. is

used with a C.B. generally bulk oil C.B. are used for voltage up to 66 KV while for high voltage low oil & SF6 C.B. are used. For still higher voltage, air blast vacuum or SF6 cut breaker are used. The use of SF6 circuit breaker is mainly in the substations which are having high input kv input, say above **132kv** And more. The gas is put inside the circuit breaker by force ie under high pressure. When if the gas gets decreases there is a motor connected to the circuit breaker. The motor starts operating if the gas went lower than **20.8 bar**. There is a meter connected to the breaker so that it can be manually seen if the gas goes low. The circuit breaker uses the SF6 gas to reduce the torque produce in it due to any fault in the line. The circuit breaker has a direct link with the instruments in the station, when any fault occur alarm bell rings

Specification of 132kV SF6 Circuit Breaker:

Type=120-SFM-32B (3 Pole) STD.
Rated Voltage=145 kV
Rated Frequency=50 Hz
Rated Normal Current=1600 Amps
Rated Making Current=80 k Amps
Rated Short Circuit Breaking Current=31.5 k Amps
Rated Short Time Current=31.5 k Amps for 3 Sec
Rated Lightning Impulse Withstand Voltage=650 kv p
First Pole To Clear Factor=1.5
Rated Gas Pressure=6 kg/cm²-gm at 20°C tem
Gas Weight=7.5 kg
Total Weight=1450 kg
Rated Coil Voltage Closing=220 v (d.c) Tripping=230 v (d.c)
Motor Voltage=230 v (a.c)
Auxiliary Voltage=1 phase 230 v (a.c)
Rated Closing Time<130 m Sec
Rated Operating Time<130 m Sec
Maker=M/S CG I
This breaker is used in 132 kV, Mohaddipur Sub-Station 132 kV Transformer-II protection

5) Protective relay :-

A protective relay is a device that detects the fault and initiates the operation of the C.B. is to isolate the defective element from the rest of the system". The relay

detects the abnormal condition in the electrical circuit by constantly measuring the electrical quantities, which are different under normal and fault condition. The electrical quantities which may change under fault condition are voltage, current, frequency and phase angle. Having detected the fault, the relay operates to close the trip circuit of C.B. There are two principal reasons for this; Firstly if the fault is not cleared quickly, it may cause unnecessary interruption of service to the customer. Secondly, rapid disconnection of faulty apparatus limits the amount of damage to it & prevents the effects from speeding into the system. A protective relay is a device that detects the fault & initiates the operation of circuit breaker to isolate the defective element from the rest of the system. Most of the relays operate on the principle of electromagnetic attraction or electromagnetic induction. The following important types of relays are generally used in electrical distribution & transmission line:

1. Induction Type Over Current Relay
2. Induction Type Over Voltage Relay
3. Distance Relay
4. Differential Relay
5. Earth Fault Relay

1. Induction Type Over Current Relay:

This type of relay operates on the principle of electromagnetic induction. It initiates corrective measures when current in the circuit exceeds a predetermined value. The actuating source is a current in the circuit supplied to the relay by a current transformer. These relays are used on AC circuits only and can operate for fault flow in either direction. Under normal condition the resulting torque is greater than the driving torque produced by the relay coil current.

Hence the Aluminium disc remains stationary, but during fault current in the protective circuit exceeds the preset value. The driving torque becomes greater than the starting torque & the disc starts to rotate, hence moving contact bridges are fixed contact when the disc rotates to a preset value. Trip circuit operates the circuit breaker, which isolates the faulty section.

2. Induction Type Over Voltage Relay:

This type of relay operates on the principle of electromagnetic induction & initiates corrective measures when current in the circuit exceeds a predetermined value. Under normal condition the aluminium disc remains stationary. However if the voltage increases at any cost the disc starts to rotate,

hence moving contact bridges to the fixed contact when the disc rotates through a preset angle. Trip circuit operates the circuit breaker, which isolates the faulty section.

3. Distance Relay:

Under normal operating condition, the pull is due to the voltage element. Therefore the relay contacts remains open. However when a fault occurs in the protected zone the applied voltage to the relay decreases where the current increases. The ratio of voltage to current faults is below the predetermined value. Therefore, the pull of the current element will exceed that due to voltage element & this causes the beam to tilt in direction to close the trip circuit.

4. Differential Relay:

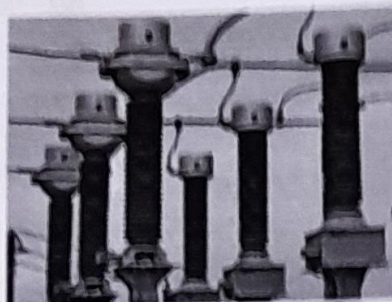
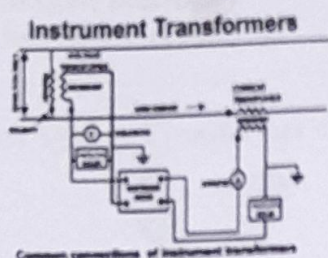
It compensates the phase difference between the power transformers primary & secondary. The C.T.s on the two sides are connected by pilot wires at both ends are same & no current flows through the relays. If a ground or phase-to-phase fault occurs, the currents in the C.T.s no longer will be the same & the differential current flowing through the relay circuit will clear the breaker on both sides of transformers. The protected zone is limited to the C.T.s on the low voltage side & C.T.s on the high voltage side of the transformer.

This scheme also provides protection for short circuits between turns of the same phase winding. During a short circuit, the turn ratio of power transformer is altered & cause unbalance in the system which cause the relay to operate. However, such sorts are better taken care by Buchholz relay.

5. Earth Fault Relay:

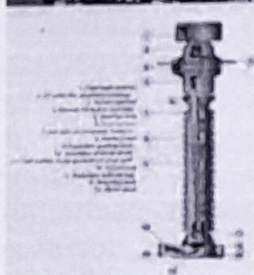
This scheme provides no protection against phase to phase faults unless & until they develop into earth faults. A relay is connected across transformer secondary. The protections against earth faults are limited to the region between the neutral & line current transformer. Under normal operating condition, no differential current flows through the relay. When earth fault occurs in the protected zone, the differential current flows through the operating coil of the relay. The relay then closes its contacts to disconnect the equipment from the system.

6) Instrument Transformers :-



The line in Sub-Station operate at high voltage and carry current of thousands of amperes. The measuring instrument and protective devices are designed for low voltage (generally 110V) and current (about 5A). Therefore, they will not work satisfactory if mounted directly on the power lines. This difficulty is overcome by installing instrument transformer on the power lines. There are two types of instrument transformer.

1) Current Transformer :-

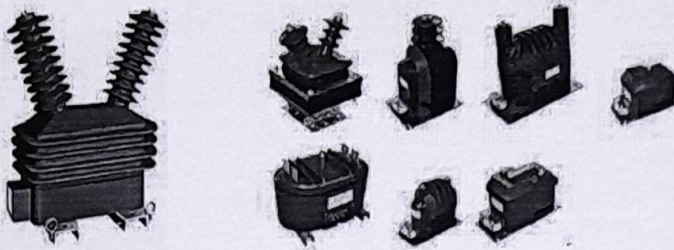


A current transformer is essentially a step-down transformer. It steps-down the current in a known ratio, the primary of this transformer consist of one or more turn of thick wire connected in series with the line. The secondary consist of thick wire connected in series with line having large number of turn of fine wire and provides for measuring instrument, and relay a current, which is a constant fraction of the current in the line. Current transformers are basically used to take the readings of the currents entering the substation. This transformer steps down the current from 800 amp to 1amp. This is done because we have no instrument for measuring of such a large current.

The main use of this transformer is-

- (a) distance protection;
- (b) backup protection;

2) Voltage Transformer or Potential Transformer :-



It is essentially a step – down transformer and step down the voltage in known ratio. The primary of these transformer consist of a large number of turn of fine wire connected across the line. The secondary winding consist of a few turns, provides for measuring instruments, and relay a voltage that is known fraction of the line voltage. In Mohaddipur Substation.

Specification of 132 kV P.T.:

Line voltage=132 kV

VA/Phase=750

Phase=1

Class=B

Frequency=50 Hz*

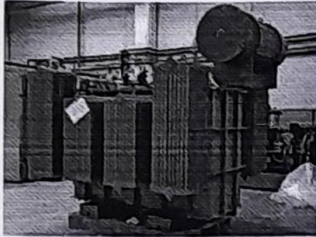
Neutrally Earthed Voltage=

Primary-73200V

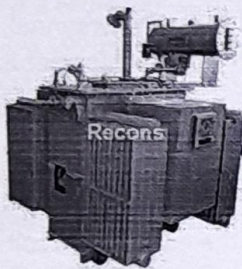
Secondary-63.5V

It may be of various shape i.e. core, shell. It is made of cold-rolled-grain-oriented Silicon-steel of varnish insulation on the lamination. The core is laminated to reduce the core loss. The laminations are made in steps & try to give circular cross section. Bolts & nuts secure the lamination. The core is placed at the bottom of the tank. The tanks are constructed from sheet steel

10MVA Transformer:-

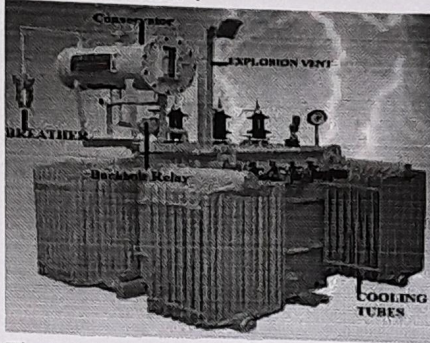


5MVA Transformer:-



For small tank & boiler sheet for large tank.. There are thermometer pockets, radiator tubes for increasing cooling surfaces. A 3-phase transformer has six separate windings, three primary & three secondary wound iron cores. name led copper with insulation is used for winding. Insulated papers are used for interlayer insulation. Paper in the form of tape may be utilized for tapping winding leads and other parts. Pressboards are used for insulation between windings & core. Pressboards are also used to separate HV windings from LV windings inputs nearer the core.

9) Transformer :-



There are two transformers in the incoming feeders so that the three lines are step down at the same time. In case of a 220KV or more Auto transformers are used. While in case of lower KV line such as less than 132KV line double winding transformers are used of lower KV line such as less than 132KV line double winding transformers are used Transformer is static equipment, which converts electrical energy from one voltage to another. As the system voltage goes up, the techniques to be used for the Design, Construction, Installation, Operation and Maintenance also become more and more critical. If proper care is exercised in the installation, maintenance and condition monitoring of the transformer, it can give the user trouble free service throughout the expected life of equipment which of the order of 25-35 years. Hence, it is very essential that the personnel associated with the installation, operation or maintenance of the transformer is through with the Instructions provided by the manufacture.

Basic Principle:

The transformer is based on two principles; firstly, that an electric current can produce a magnetic field (electromagnetism) and secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). Charging the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil. The two circuits are electrically isolated but magnetically linked through a low reluctance path. If one coil is connected to a.c supply, an a.c is setup in both of these circuits. This helps to transfer the voltage from one side to another. We have observed five at KLSD along with two station transformers. Out of these five, two are 132/33kV in y-d mode & others are 33/11 kV in d-Y mode.

Accessories of transformers:

Core & Winding:

Conservator:

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

Breather:

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

Diverter tank:

It is a drum like structure mounted on a transformer wall & filled with transformer oil & connected to conservator. It reduces arcing during tap changing operation.

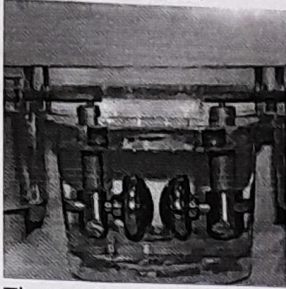
Radiator:

It is of small thickness & large diameter plates & used for heat dissipation during operation. Large diameter means large surface area & better cooling.

Temperature Indicator:

There are two temperature indicators on the transformer tank one for oil temperature measurement & another for core temperature measurement. In 31.5 MVA Transformers when oil temperature reaches 65°C cooling fans start automatically but when the oil temperature rises at 75°C or winding temperature rises at 85°C the alarm circuit will be closed. Further increase in oil or winding temp the circuit will trip automatically.

Transformer Oil:



The tank is filled with transformer oil; & sealed. It is a mineral oil obtained by refining crude petroleum.

It serves the following purposes:-

1. Provides additional insulation

II. Carries away the heat generated in the core & oils Good transformer oil should have:-

High dielectric strength.

Low viscosity to provide good heat transformation.

High flash/fire point

Free from inorganic acid, alkali & corrosive Sulfur

Free from sludging under normal operating condition. It is Important to check the oil in regular intervals.

Specification of 132/33 kV Transformer:

In Mohaddipur substation two 132/33 kV power transformers are used for 33 KV Supply.

MVA=31.5kV (no load)

Frequency=50Hz

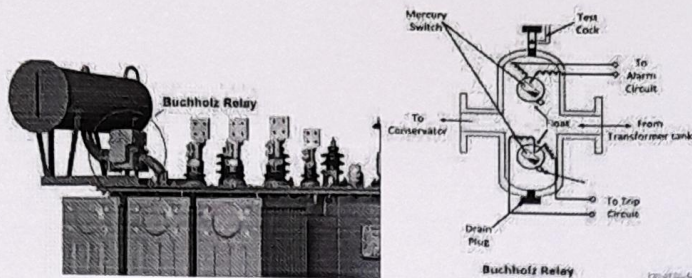
Vector symbol=y-D1

kV(no load) HV 132 kV, LV 33kV

Amps HV 138 A , LV 552A 17

Bushing:

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

Buchholz relay:

It is a gas actuated relay installed in oil immersed transformers for protection against all kinds of faults. Any fault produces heat & forces the evolution of gas. It mainly consists of two float switches placed in the connecting pipe between the main tank & conservator. Under normal condition they main tank and *Buchholz* relay is completely filled up with oil & the conservator tank is about half full. When the fault occurs, produces gas & collect in the container so the oil level gradually falls & closing the alarm circuit. If no attention is paid to it, the gas collection will be more & closes another circuit which will cut out the transformer from the line.

Explosion Vent/ Pressure Release Vent:

When the gas pressure on the container is heavy, explosion vent is released. Alarm circuit & trip circuit will close by *Buchholz* Relay, before opening the explosion vent it is used now adays.

Tap Changing:

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

Types of lightning arrestors:-

There are several types of lightning arrestors in use, differs only in their constructional detail but they are electrically identical & operate on the same principle.

They are-

- a. Rod gap arrestor
- b. Horn gap arrestor
- c. Valve type arrestor

a. Rod type arrestor:

It consists of two rods which are bent in right angles with a gap in between them. One rod is connected to the line circuit & the other one is connected to the earth. They are usually connected across the string of insulators & bushings of various transformers. The rod gap should be set to breakdown at about 20% below the impulse spark over voltage of insulation at the point where it is installed. To protect the insulator it should be one 3rd of the rod gap. Under the normal condition the gap remains non conductive. On the occurrence of high voltage surge on the line, the gap sparks over & the surge current is connected to earth.

b. Horn gap arrestor:

It consists of two horn shaped metals rods separated by a small air gap. The horns are so constructed that distance between them gradually increase towards the top. The horns are mounted on the porcelain insulators. One end of the horn is connected to the line & other end is efficiently grounded. Under normal condition the gap is non conductive. On the occurrence of high voltage, spark takes place across the gap & the arc to travel up the gap. At some position of arc, the distance may be for the voltage to maintain the arc. Consequently, the arc is extinguished, & the excess charge on the line is thus conducted to ground through arrestor.

c. Valve type arrestors:

It consists of a no. of flat disc of a porous material stacked one above the other & separated by a thin mica rings. porous material is made of specially prepared clay with a small add mixture of powdered conducting substance. The discs are arranged in such a way that the normal voltage may not cause the discharge to

Phase HV 3, LV 3
Mass of Oil=2360kg
Total Mass= 12140kg
Volume of oil= 2650Liter
Core & Winding Weight= 5950kg
Guaranteed Max. Temp. Rise in Oil=45°C,
Winding=55°C

11) Protection Against Lightning:

Transients or Surges on the power system may originate from switching or other causes, but the most important & dangerous surges are those which caused by lightning. The lightning surges may cause serious damage to the expensive equipments or strokes on transmission lines that reach the equipments travelling as a wave. Thus it is necessary to provide a protection against lightning surges, They are:-

1. Earth Screen.
2. Overhead Ground Wire.
3. Lightning Arrestor.

1. Earth Screen:

The power stations & the substations are generally have much expensive equipments. These stations can be protected from direct lightning strikes by providing earthing screens. It consists of a network of Copper conductors mounted all over the electrical equipments in the substation or Power station. The screen is properly connected to earth on at least two points through low impedance. On the occurrence of direct stroke on the station the screen provides a low resistance path by which lightning surges are connected to the ground. In this way station equipments are protected against lightning.

2. Overhead Ground Wires:

The most effective method of providing protection against direct lightning strokes is by the use of overhead ground wires. The ground wires are placed over line conductors at such position that practically all lightning strokes are intercepted by them.

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

At +ve plate:- $\text{PbSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O} = \text{PbSO}_4 + 2\text{H}_2\text{O}$, At -ve plate:-

$\text{PbSO}_4 + \text{H}_2 = \text{Pb} + \text{H}_2\text{SO}_4$

Color of the plate at the end of the charge becomes:- Positive plate:- Dark Brown

Negative plate:- Slate Gray The batteries are connected to the circuit breaker for tripping the circuit breaker. Here trip is used through type relays.

Specification of The Battery Charger:

Model=BC Rating=229 V, 24+24 AAC input=415 V \pm 10%, 30 Amps, 50Hz,
3 Phase DC output=24.7 volt, 24 A

13) Capacitor bank attached to the bus:-

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

14) Wave trap :-

Wave trap is an instrument using for tripping of the wave. The function of this trap is that it traps the unwanted waves. Its function is of trapping wave. Its shape is like a drum. It is connected to the main incoming feeder so that it can trap the waves which may be dangerous to the instruments here in the substation. Low pass filter when power frequency currents are passed to switch yard and high frequency signals are blocked. Line Isolator with E.B.To isolate the line from Sub Station and earth, it under shut down.

15) THE FIRE PROTECTION:-

The fire protection device should be kept in store yard for safety of equipments during storage. It can be useful in the time of danger. This includes fire extinguishers, constant supply of water etc.

the ground through the ground wire, so it protects the line from harmful effects of lightning.

3. Lightning Arrestors:

Firstly, we can see lightning arrestors. These lightning arrestors can resist or ground the lightning, if falls on the incoming feeders. The lightning arrestors can work in an angle of 30 degrees around them. They are mostly used for protection of the instruments used in the substation. As the cost of the instruments in the substation are very high to protect them from high voltage lightning these arrestors are used.

It is a device used in Electrical Power systems the insulation of the system from the damaging effect of lightning. Metal Oxide varistor (MOVs) have been used for power system protection the mid 70s.

The typical lightning arrestor is also known surge arrestor has a high voltage terminal and a ground terminal. When a lightning surge or switching surge travels down the power system to the arrestor, the current from the surge is diverted around the protected insulation in most cases to earth. Lightning arrestors with earth switch are used after the current transformers to protect it from lightning i.e. from high voltage entering into it. This lightning arrestor has an earth switch that can directly earth the lightning. The arrestor works at 30° to 45° angle of the lightning making a cone. The earth switch can be operated manually, by pulling the switch towards the ground. This also helps in breaking the line entering the station. By doing so maintenance repair of any instrument could be performed.

Switches, density monitor, Air Piping, control cables, wiring materials, SF6 gas pipes; SF6 cylinder should be stored in store shed.

VI. Power transformers:

The main Tank -The transformer is transported on trailer to substation site and as far as possible directly unloaded on the plinth. Transformer tanks up to 25 MVA capacity are generally oil filled, and those of higher capacity are transported with N2 gas filled in them +ve pressure of N2 is maintained in transformer tank to avoid the ingress of moisture. This pressure should be maintained during storage; if necessary by filling N2 Bushings -generally transported in wooden cases in horizontal position and should be stored in that position. There being more of Fragile material, care should be taken while handling them.

These should be stored with ends duly blanked with gaskets and end plates to avoid ingress of moisture, dust, and any foreign materials inside. The care should be taken to protect the fins of radiators while unloading and storage to avoid further oil leakages. The radiators should be stored on raised ground keeping the fins intact. Oil Piping. The Oil piping should also be blanked at the ends with gasket and blanking plates to avoid ingress of moisture, dust, and foreign All other accessories like temperature meters, oil flow indicators, PRVs, Buchholz relay; oil surge relays;

Gas kit O ' rings etc. should be properly packed and stored indoor in store shed. Oil is received in sealed oil barrels . The oil barrels should be stored in horizontal position with the lids on either side in horizontal position to maintain oil pressure on them from inside and subsequently avoiding moisture and water ingress into oil. The transformers are received on site with loose accessories hence the materials should be checked as per bills of materials.

VII. CONTROL AND RELAY PARTS:

These are used to control the operations of breakers, isolates, through protective relays installed on these panels various protection schemes for transformers, lines etc, are provided on these panels.

occur. The mica rings provide insulations during normal operation. At time of over voltage, the glow discharge occurs in the capillaries of the material & the voltage drops to about 350 volts per unit.

Specification of Lightning Arrestors In 132 kv System:

Style= SMX

Type= ZOBIVER

Rated Voltage=102 k v (r.m.s)

Long duration Discharge=3

Frequency= 50Hz

Pressure Relief Current (r.m.s) = 40 KA

Normal Discharge Current= 10 KA

12) Storage Battery-

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

a. Primary cell

b. Secondary or storage cell Secondary cells are of two types:-

a. Lead Acid cell

b. Alkaline cell

Working Principle:

When the + ve plate of Lead per Oxide & - ve plates of spongy lead are immersed in dilute H_2SO_4 & connected together by means of external circuit, current flows round the circuit. The cell works until the per Oxide is used up & under this condition the cell is said to be discharging. The cell under fully discharged condition: Positive Plate= PbO_2

Negative plate= Pb

Electrolyte=dil. H_2SO_4 (sp. Gravity=1.25)

During discharge: The chemical action can be represented by the following chemical equation. At + ve condition : - $PbO_2 + H_2 + H_2SO_4$

= $PbSO_4 + 2H_2O$, At - ve condition:- $Pb + SO_4 = PbSO_4$ 21

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