STUDY ON OPERATION AND MAINTENANCE OF NATIONAL TUBES LTD.

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

Submitted By

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DAFFODIL INTERNATIONAL UNIVERSITY

January 2020

Certification

This is to certify that this field study report entitled study on **"OPERATION AND MAINTENANCE OF NATIONAL TUBES LTD."** is done by the following student under my direct supervision for the partial fulfillment of the requirements for the degree of B.Sc. in Electrical and Electronic Engineering. The presentation of the work was held on January 2020.

The matter embodied in this field study has not been submitted for the award of any other degree to any other university.

Signature of the candidates

…….

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DECLARATION

This field study submitted by **MD. Bayjid Hossain Khan, ID: 163-33-3701**, session: Fall-2016 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronics Engineering** on January 2020.

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Dedicated to
Our Parents and Allah

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LIST OF ABBREVIATIONS

Short Name	Full Name
AC	Alternating Current
DC	Direct Current
CT	Current transformers
OCB	Oil circuit breakers
HRC	High Rupturing Capacity
SF6	Sulphur hexafluoride circuit breakers
VCB	Vacuum Circuit Breaker
SLD	Single-line diagram
PLC	Programmable logic controller
ERPS	Enterprise Resource Planning
GMP	Good Manufacturing Practices
GSS	Grid Sub-Stations

ACKNOWLEDGEMENT

First of all, I like to give thanks to Allah. Then we would like to take this opportunity to express our appreciation and gratitude to our Internship Supervisor **Dr. Md. Samsul Alam, Professor and Dean of** Faculty **of Engineering** of the Daffodil International University

for being dedicated in supporting, motivating and guiding me through this Internship. This Internship can't be done without his useful advice and helps. Also thank you very much for giving us opportunity to choose this Internship.

We also want to convey our thankfulness to Dr. Md. Samsul Alam, Professor and Dean of Faculty of Engineering for his help, support and constant encouragement.

Apart from that, I would like to thank our entire friends for sharing knowledge; information and helping us in making this Internship successful.

To my beloved family, I want to give them my deepest love and gratitude for being very supportive and also for their inspiration and encouragement during my studies in this University.

ABSTEACT

The field study report titled "**Study On Operation and Maintenance of National Tubes Limited (NTL)** " covers the complete operation of IMW gas generator and 800KV and 600K V Diesel Generator. Electrical protection of different parts of electrical machines and apparatus used in National Tubes Limited (NTL), instrument Reaper. The main intention of this field study is to learn and get knowledge about various equipment and maintenance of an industrial. In this field study also improve my theoretical knowledge and practical field working experience with enough ideas and understanding of the performance of parameters. which gives me more information about each Operation, how Control Panel works, how to troubleshooting and Maintenance of machine, switchgear, controlling device, Transformer, Capacitor etc.

This industry has their single line diagram of power transmission and distribution which provided by DESCO in rate of two 33KV fee.

Chapter: 01

Introduction

1.1 Introduction:

National Tubes Limited (NTL) was founded in 1964 to provide service of benefit of the nation by producing high quality import-substitute gas/oil line pipes according to the specifications of American Petroleum Institute and water line pipes similar to British Standard.

It was State-owned and permitted under "Bangladesh Steel & Engineering Corporation" (BSEC) in 1972 and Considered as an enterprise of BSEC.

In 1980 Company name was changed to “National Tubes Limited” and in same year the second Manufacture mill (½”-4”) established into operation and in 1982 3rd Manufacture mill (4”-8”) established. It is one and only steel pipe manufacturer company which is belongs to Bangladesh government. the NTL was transformed into a public limited company by off-loading 49 percent shares to the public and 51 percent shares are taken by the government in 1989. NTL was permitted to usage API Monogram for producer of plain end line pipe PSL in 1992. NTL was listed to the best one of ten companies in 'stock market evaluated' In 2001. NTL was permitted to usage 'BSTI monogram ‘on GI, MS (A) pipes in 2002.

NTL was obtained (ISO 9001) Testification for quality administration system applies to the producer of line pipe and it also obtained API specification for quality administration system applies to the producer of Line Pipe in 2004. Now a imperial Board of Directors handle the company with an administration team of high quality professionals, engineers, technical and general staff.

1.2 Mission / Vision of (NTL):

MISSION

To contribute to the well being of the nation by producing high quality import-substitute Gas/Oil line pipes according to the specifications (Spec Q1 & 5L) of American Petroleum Institute (API) and Water line pipes (G.I.) according to British Standard (BS-1387 & BS-729) as an API Licensee and an ISO 9001 : 2015 certified company. We place Quality above all. We are firmly committed to all our stakeholders such as : our valued customers, our employees, our business associates, our fellow citizens and our valued shareholders.

VISION

Building a unique enterprise reflecting utmost integrity, transparency and accountability at all levels and marketing value added products manufactured under an uncompromising quality program devoted to continuous improvements for customer's satisfaction with modern technology, innovative vision and motivated workforce developed through strategic management of human resources training and achievement of maximum satisfaction by providing customers with products that meet according to their quality requirement.

1.3 Board of Directors:

NATIONAL TUBES LIMITED

Board of Directors

Engr. Md. Abul Khayer Sardar
Director, NTL Company Board &
Managing Director
National Tubes Ltd.

Md. Mazibur Rahman Khan
Director, NTL Company Board,
Director, ABL Company Board &
Share Investor

Md. Saiful Islam
Director, NTL Company Board,
Director, ABL Company Board &
Share Investor

Pirjada Torab Hossain
Indipendent Director
NTL Company Board

Umma Kulsum
Director, NTL Company Board and
Share Investor

Md. Abul Kalam Azad
Company Secretary

1.4 First time visit of NATIONAL TUBES LIMITED:

Who don't love natural working place. National tube limited have a natural green environment working place. In 17th September our First time visit of NATIONAL TUBES LIMITED. They welcome us with soft drinks and biscuit. they are friendly and helpful.

Started first day with visit the factory area, hearing its history and watch the tubes production system. Then we visited all the tubes production floor and maintenance room.

After visiting maintenance room and Before entering in the pipe manufacturing area, our honorable teacher gives us every information about factory safety rules.

1.5 Internship Outline:

This Internship organized as follows,

Chapter: 01 Introduction the internship.

Chapter: 02 Switchgear.

Chapter: 03 Fuse.

Chapter: 04 Protective Relay.

Chapter: 05 Protection of Alternators and Transformers.

Chapter: 06 Customer Sub-station of NTL.

Chapter: 07 Conclusion and references.

Chapter: 02

Switchgear

2.1 Introduction:

The modern civility needed a good demand of electrical energy for daily life style. Most of the energy is needed for make our modern life more easy such as lighting, heating, Home apparatus, manufacturer electrical appliance etc. The sharpness of Power supply in modern daily life has reached in high places for that it become more important and sensitive to protected the power system from the damage of any fault conditions which can be occurs in any time. for consideration this condition we have to use switch-gear to disconnect the fault system from generator, distribution lines and other component which also work in both conditions normal and fault. Mainly a switchgear design to switching and protecting any device if there is any fault or if needed. e.g. switches, fuses, circuit breakers, relays etc.

2.2 Switchgear:

The switchgear system is directly connected to the supply system. It is installed in both the high and low voltage side of the power transformer. It is used for de-energizing the equipment for testing and maintenance and for clearing the fault. During normal operation, switchgear Allows switch on or off generators, transmission lines, distributors and other electrical equipment. On the other hand, when a failure (e.g. short circuit) happens on any part of power system, a heavy current flows through the equipment, threatening damage to the equipment and interruption of service to the customers. But, the switchgear detects the fault and disconnects the unhealthy section from the system.

The automatic protective switchgear mainly made of the relay and circuit breaker. When the fault happens in any section of the system, the relay of that section comes into operation and close the trip circuit of the breaker which disconnects the faulty section. The active Department continues to deliver loads as usual, and thus there is no loss of equipment and no complete disruption to supply.

2.3 Types of Switchgear:

1. Low voltage (LV) Switchgear.
2. Medium voltage (MV) Switchgear.
3. High voltage (HV) Switchgear.

2.3.1. Low Voltage Switchgear:

Commonly electrical switchgear rated up to 1 KV is termed as low voltage switchgear. In the word LV Switchgear includes low voltage circuit breakers, switches, off load electrical isolators, HRC fuses, earth leakage circuit breaker, miniature circuit breakers (MCB) and molded case circuit breakers (MCCB) etc.

2.3.2 Medium Voltage Switchgear:

From 3 KV to 36 KV switchgear system is classified as medium voltage switchgear or MV switchgear. These switchgears are of many types. They may metal confined indoor type, metal confined outdoor type, outdoor type without metal enclosure, etc. The interruption medium of this switchgear is also oil, SF6 and vacuum. The main requirement of MV power network is to interrupt current during faulty condition irrespective of what type of CB is used in the MV switchgear system.

2.3.3 High Medium Voltage Switchgear:

The power system deals with voltage over 36KV, is referred as high voltage. As the voltage level is high the arc made during switching operation is also very high. So, have to take special care to during designing of high voltage switchgear. Therefore, high voltage circuit breaker should have special features for safe and reliable operation.

In Fault condition tripping and switching operation of high voltage circuit are very rear. Most of the time these circuit breakers remain, at ON condition, and may be worked after a long period of time. So CBs must be reliable enough to confirm safe operation, as when required.

2.4 Switchgear Equipment:

The most important equipment of switchgear given below,

1. Switches.
2. Fuses.
3. Relays.
4. Circuit breakers.

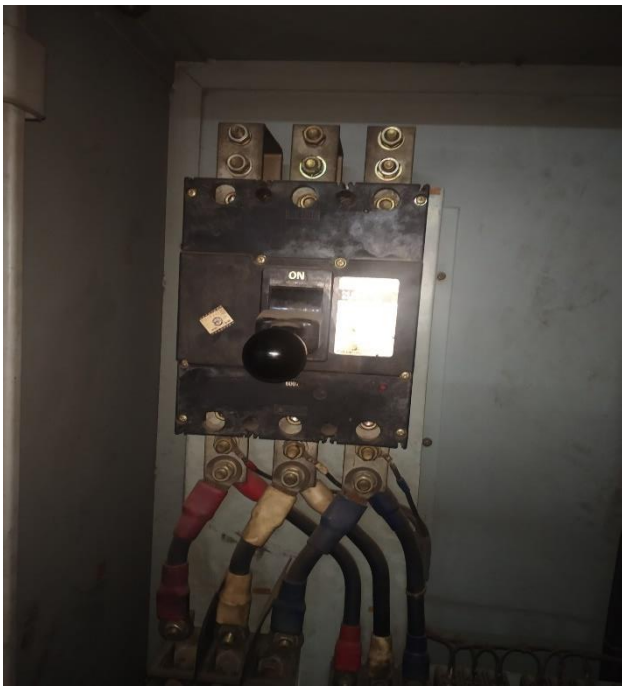


Fig 2.1: Switchgear

2.4.1 Switches:

In electrical engineering, a switch is an important Device that can "on" or "off" an electrical circuit, to off the current from one conductor to another. The mechanism of a switch removed or restored the conducting path in a circuit when it is operated. It can be operated manually, for example, a light switch or a keyboard button, may be operated by a moving object such as a door, or may be operated by any kind of sensing element for pressure, temperature or flow. A switch has to one or more sets of contacts, which may operate simultaneously, sequentially, or alternately.

Fig 2.2: Switches

2.4.2 Fuses:

In Engineering sector fuse is a cheap price and most used protection device. It is made of concise strip of metal. It melts when an unexpected current flow over the circuit and for this the circuit disconnect from system. Fuse is also a protection device which provide overcurrent protection. overcurrent can't be happening because a tiny metal wire or strip that melts when too much current flows in the system.

Fig 2.3: Fuses

2.4.3 Circuit Breakers:

Circuit Breakers are mechanical switching devices that can make, carry or break a circuit either manually or automatically under normal and abnormal circuit conditions. Under normal conditions, a circuit breaker can make, carry or break currents and under abnormal conditions, it can make or carry for a specific time and break the currents.

Fig 2.4: Circuit breakers

2.4.4 Relays:

Relays can be said one kind of switches, which protect the system by open and closes circuits electromechanically or electronically. normally a Relays operate an electrical circuit system by opening and closing from other circuit when any fault occurs.

Maximum time Relays used to switch low current system and also control the circuit system and it never take high amps form the system but it just consumes low amps for operates. But A relay can control high volts and amps because of that a relay can sense if there is any high amps' flow in the system, if there is a high amp then the relay will disconnect the system. For this great working and protection relay are greatly used for switching 'starting coils, heating elements, pilot lights and audible alarms' etc.

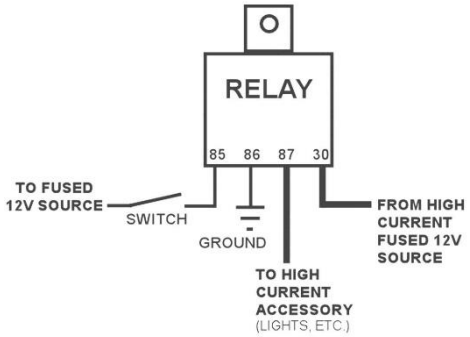


Fig 2.5: Relays

2.5 Bus-Bar Arrangements:

Normally a bus-bar system arranged with circuit breaker and isolator. If there is any fault occurs, by tripped off the faulty section of the bus-bar with the help of circuit breaker we can easily disconnect the circuit from fault system. To support its own weight A bus-bar must be enough inflexible and should be enough capable to face mechanical vibration and possibly earthquakes. It also faces the precipitation accumulated in Outdoor vent. When temperature changed or increase for resistance unit heating, it introduced thermal enlargement temperature, so it should be closed temperature variations in time, also must be considered magnetic forces changed or increase by high currents.

2.5.1 Single Bus-bar System:

This kind of classification of a system are very simple and facile. This system normally arranged with one bus-bar and switch. this bus-bar also connected with the substation materials such as transformer, generator, feeder etc.

The basic advantages of a single bus-bar system are,

1. It has low basic cost.
2. It demands low maintenance.
3. It is easy for operation.

The basic disadvantages of single bus bar system are,

1. it cannot be possible to clean, repaired or tested without de-energising the whole system.
2. If bus-bar is facing any fault itself then the power supply will have interrupted.
3. If Any fault on the system then it can be overloaded by all the generating capacity, which can be a dangerous fault current.

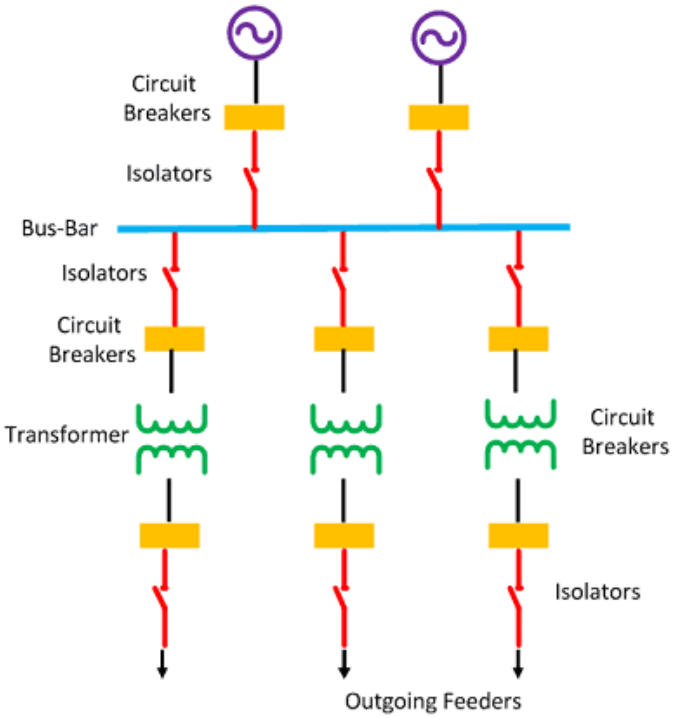


Fig 2.6: Single Bus-bar System

2.5.2 Single bus-bar system with Sectionalisation:

In this kind of bus-bar arrangement, most time the circuit breaker and isolating switches are used. The isolator cut off the faulty section of the bus-bar, therefore protects the system from complete shutdown. This kind of arrangement uses one addition circuit breaker that does not increase the cost of the system.

The advantages of Single bus-bar system with Sectionalisation are,

1. The faulty section is removed without affecting the continuity of the supply.
2. The maintenance of the individual section can be done without disturbing the system supply.
3. The system has a current limiting reactor which decreases the occurrence of the fault.

The disadvantages of Single bus-bar system with Sectionalisation are,

1. the system uses the additional circuit breaker and isolator which increases the cost of the system.

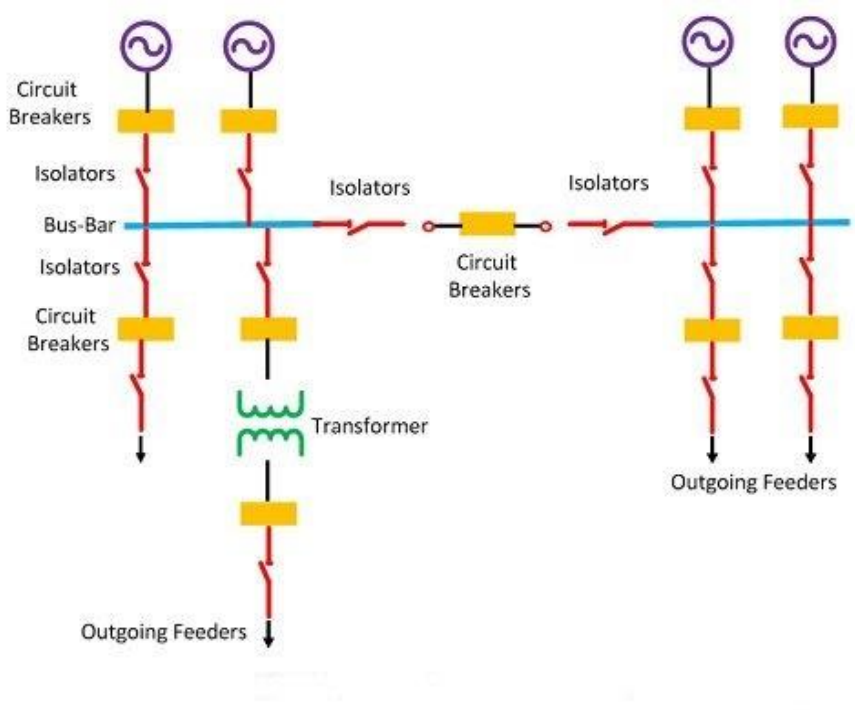


Fig 2.7: Single bus-bar system with Sectionalisation

2. 5.3 Duplicate Bus-bar system:

In a big station, it's very important to breakdowns and maintenance Have to intervene a little as doable with Relentlessness of electricity supply. For this purpose, duplicate bus-bar The system is deployed at the required stations. This kind of system arrange of two bus-bars, a ‘‘main bus-bar’’ and a ‘‘spare bus-bar". the generator and feeder each one can be attached to either bus-bar by the help of bus coupler which arranged with a circuit breaker and isolators. It shown in Figure Given below, service is interrupted when one bus switch to another. If want to change a circuit from one to another without any interruption of service, then there should be two circuit breakers per circuit. this kind of system arrangement are costly.

The basic advantages of duplicate bus-bar system are,

1. when main bus maintenance and repair, the supply don't get any effect as the entire load can be transferred to the spare bus.
2. When The feeder is testing, in this time circuit breakers can be connected to the another bus-bar, in this way the main bus-bar don't get any effect for power supply.
3. If the bus-bar get any fault, continuity power supply can be possible by transferring the system to the other bus-bar.

The basic disadvantages of duplicate bus-bar system are,

1. This kind of system arrange with two bus-bar and two circuit breakers are need and for that the system cost increases.
2. It also takes very high cost for maintenance.

For its higher cost, this kind of bus-bar system is rarely used in substations.

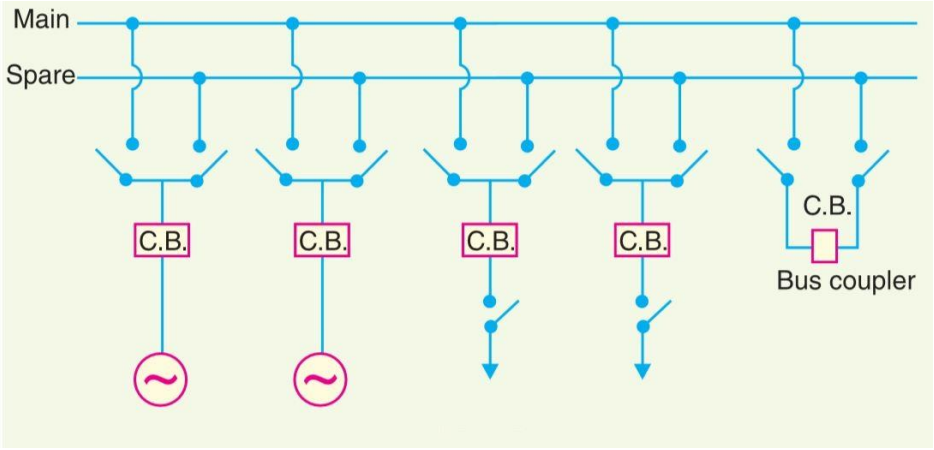


Fig 2.8: Duplicate bus-bar system

Chapter: 03

Fuses

3.1 Introduction:

It The circuit breaker Breaks circuit automatically when any short-circuit fault happen. Similarly, this circuit also brakes by a fuse in same faults, with lower efficiency and reliability. The Fuse was find out by "Thomas Alva Edison" in 1890, Fuse protect circuit from unexpected currents in low cost. Fuse is getting updates and improvements for the modern system day by day. In modern generation we have many kinds of fuse in the market, which can use for low to moderate voltage circuit where fault probability may not high or where circuit breaker used is not useful. In modern generation the power grid increasing fast, we have to improve our attention and knowledge of fuse and the applications which can help to increasing grid.

3.2 Fuses:

In Engineering sector fuse is a cheap price and most used protection device. It is made of concise strip of metal. It melts when an unexpected current flow over the circuit and for this the circuit disconnect from system. Fuse is also a protection device which provide overcurrent protection. overcurrent can't be happening because a tiny metal wire or strip that melts when too much current flows in the system.

3.3 Properties of Fuse Element:

The fuse element should have the following desirable characteristics,

1. Low melting point.
2. low ohmic loss
3. high conductivity (or low resistivity)
4. low cost and free from detraction

3.4 Symbols of fuse:

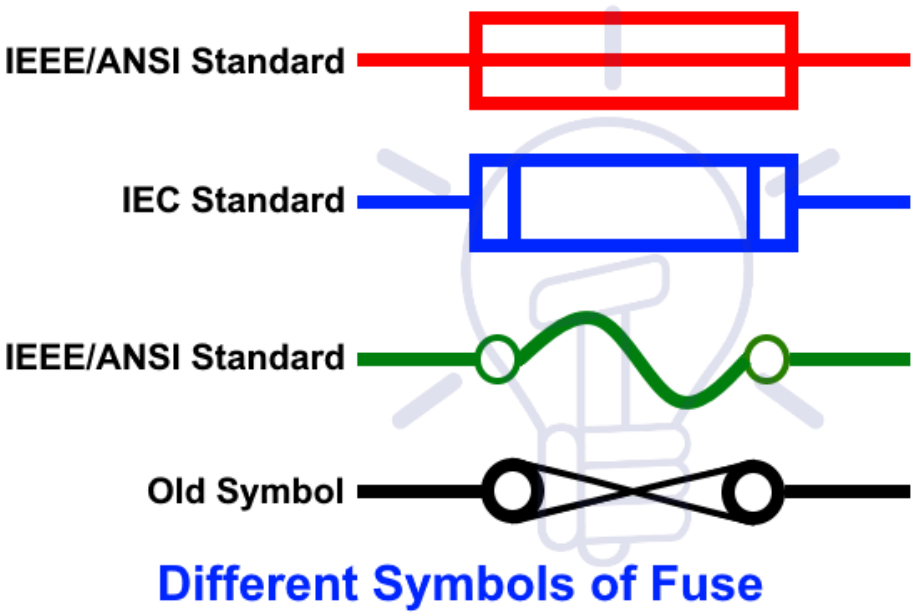


Fig 3.1: Different Symbols of Fuse

3.5 Types of fuse:

In this time Fuse is the easiest current protection device to protect against unwanted currents flow in the circuit. Normally fuse can divide into two part. they are

1. Low voltages fuses.
2. High voltage fuses.

3.6 Low voltages fuses:

For Low voltage fuses it can be divided into two parts. they are

1. semi-enclosed rewire able fuse.
2. H.R.C (high rupturing capacity cartridge fuse).

3.7 H.R.C (High-Rupturing capacity cartridge fuse):

H.R.C Type fuse tolerate some fault high current in the circuit for a time duration.in this time if the faults not remove form the circuit then it blows off or melts. HRC type fuse enclosure is made of chemical component or glass, this room arrange as that it can avoid the effect of atmosphere on the fuse material. The H.R.C have ceramic enclosure metal cap at both heads end, so that the fusible silver wire gets welded. There is a space in H.R.C enclosure, Around the fuse cable or fuse components, fully packed with a filling powder. H.R.C type of fuse is trusted and has inverse time characteristic, for that when a fault current is high then disconnected time is short and when a fault current is low, then disconnected time is long.

When any over current flows in the fuse component then high breaking capacity fuse the component is melted and vaporized. Such an amount of filling powder is that the chemical action among the silver vapors for that the filling powder make a high resistance substance that provide much help in quenching the arc.

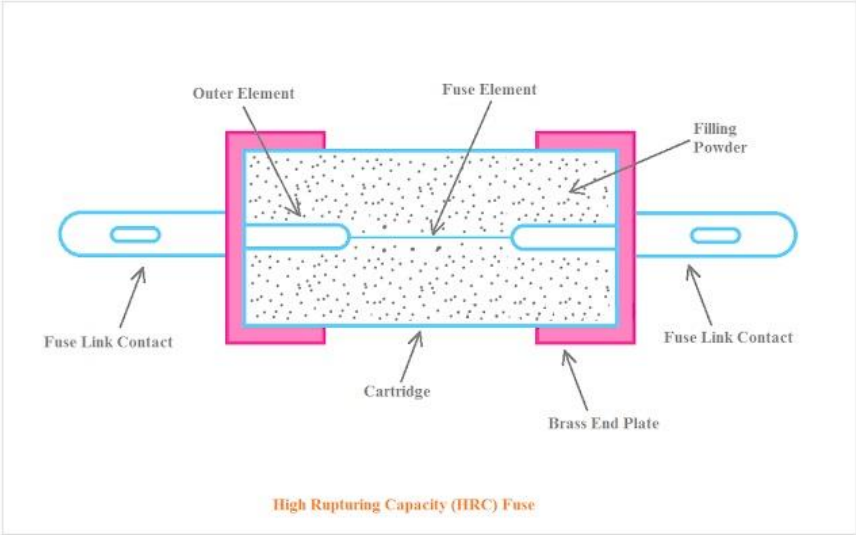


Fig 3.2: H.R.C (High-Rupturing capacity cartridge fuse)

3.8 High voltage fuses:

This kind of fuse can be classified into three types,

1. Cartridge type.
2. Liquid type.
3. Metal clad fuses.

3.9 Cartridge type fuses:

the cartridge type of fuses is also known as the "weak link" in a circuit. it construction is same as normal fuse, where a metal strip connected to both side metal. when a fault happens in the circuit or the circuit get overloaded then the metal strip or link blow up or quickly melts to off the circuit and cut off the power. Its protection or working period just one at a time, then it has to change or replace.

This High voltage cartridge fuses maximum time used in ('33 kV') with breaking ability of (‘8700 A') at that high voltage. The Rating of the command of ('200 A' at '6·6 kV') and ('11 kV' and '50 A') at ('33 kV') Also accessible.

Fig 3.3: Cartridge type fuses

Chapter: 04

Protective Relay

4.1 Introduction:

Generators, transformers, transmission and distribution circuits consisting in the power system, it's most important that in any time there a failure can be happening somewhere in the circuit system. If there Is a failure happens on any place in the circuit system, it has to operate quickly and detect and open from the circuit system from faults. There are two principal reasons for it. It has two main principles. First one is, when a fault not remove in time, it may off or disconnected service to the customers. Second one is, fast it remove the faulted material then the full system not get any damage.

4.2 Protective Relays:

Relays can be said one kind of switches, which protect the system by open and closes circuits electromechanically or electronically. normally a Relays operate an electrical circuit system by opening and closing from other circuit when any fault occurs.

Maximum time Relays used to switch low current system and also control the circuit system and it never take high amps form the system but it just consumes low amps for operates. But A relay can control high volts and amps because of that a relay can sense if there is any high amps' flow in the system, if there is a high amp then the relay will disconnect the system. For this great working and protection relay are greatly used for switching 'starting coils, heating elements, pilot lights and audible alarms' etc.

one relay circuit arrangement can be divided into 3 parts,

1. First part is the primary winding of a current transformer (C.T.) which is connected in series with the line to be protected.
2. Second part consists of secondary winding of C.T. and the relay operating coil.
3. Third part is the tripping circuit which may be either A.C. or D.C. It consists of a source of supply, the trip coil of the circuit breaker and the relay stationary contacts.

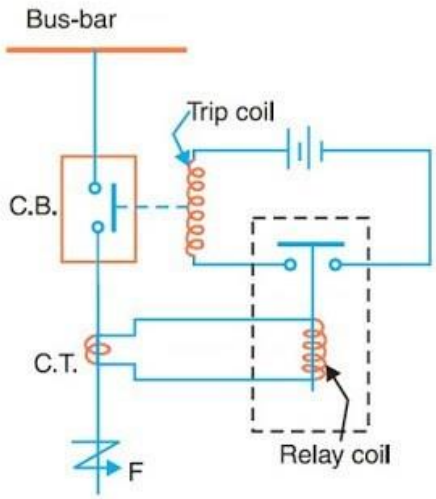


Fig 4.1: Protective relay circuit diagram

When a fault created in the transmission line on the part (F), in this condition the circuit flow a huge amount of current. That time a high current flow over on the relay coil, for that relay need to tip and open the faulty part from connection. relay sense and tip for command the circuit breaker to open the connection. This way relay provides the security of the circuit from harm.

4.3 Fundamental Requirements of Protective Relaying:

In order to work Properly a relay system must have some characteristics, some of the characteristics given below,

1. Selectivity.
2. Speed.
3. Sensitivity.
4. Reliability.
5. Simplicity.
6. Economy.

4.3.1 Selectivity:

The relay should be operated in simply those conditions that relays are permitted in the electrical power system. Some may be commonplace condition during fault for which some relays should not be operated or operated After a certain time delay Then protection relay must be Capable enough to select Suitable Condition for which it will be operated.

A good designed and capable relay system ought to be selective. the relay should be ready to sense that if there is a fault happens and also can sense the maximum fault and can control circuit breakers to open the circuit. The illustrated relating of power system shown in Figure given below. To this operation circuit breaker must be Located in each power system components to make this possible to disconnect Only faulty parts.

This system can be divided into the following protection zones:

1. Generators.
2. low-tension switchgear.
3. Transformers.
4. high-tension switchgear.
5. transmission lines.

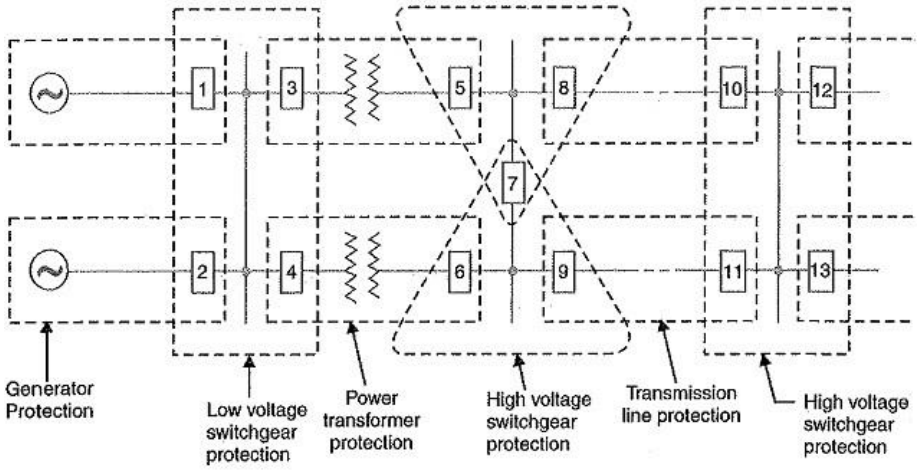


Fig 4.2: Different Protective Zone with Circuit Breakers

4.3.2 Speed:

The relay has to off the fault parts form the circuit with fast processing capability without that it can be a huge damage in line,

1. Any Electrical device get damage if relay carry fault currents for a long time.
2. If there is a failure on the system, then a huge voltage can be dropped if this kinds of faulty part not remove quickly it will harm all customer and generation plant.
3. A fast working relay can decrease the probability of fault in transmission line.

4.3.3 Sensitivity:

The Basic part of a relay that have ability to control and process with low amount of causative. The relay can complete his proses by giving volt-amperes to the coil. this power necessity is low demand to complete relay protection processes, which make relay more sensitive for operation. For that a 1 VA relay can be said sensitive than a 3 VA relay. so it have to considerable that a relay controlling system must be sensitive and it can be handle with low amount of input power.

4.3.4 Reliability:

the relay can work under a scheduled setting and this ability make a relay powerful. To make the relay even stronger, reliability is needed. without reliability this may cause a huge fault in the circuit.

4.3.5 Simplicity:

A relay control process must be easier, so that it maintained become easier. simplicity is closely connected to Reliability. so Its security design has to easier and for that reliability will greater.

4.3.6 Economy:

The most important part of a Device is providing protection with Economic aspects. sometimes protection and economically don't reliable, in this situation compromise with price and design its makes comfortable for use. normally a protective gear or equipment should not cost more than 5% of total cost, but in some purpose protection is more important than cost.in industrial or in generation power plant protection become important otherwise a fault can be damaged a machine, transformer, generator etc.

4.4 Basic Relays:

In modern power generation grid and transmission line may face any faults in any time. the relay is a device which can protect from huge damages. When a relay sense any fault in the circuit, to trip for disconnect the circuit from faulty circuit. circuit breakers are a common part of protection in power system where relay is the main part of a circuit breakers. Therefore, relay is the most usable and important part of power system.

Relay operated by two methods they are,

1. Electromagnetic attraction.
2. Electromagnetic induction.

4.5 Electromagnetic Attraction Relays:

In short word an Electromagnetic attraction relay works by attraction, also it can define as magnetic attraction. this kind of relay can be operated with D.C or A.C.

There are three kind of attraction relay they are,

1. Attracted armature type relay.
2. Solenoid type relay.
3. Balanced beam type relay.

4.5.1 Working Principle of Electromagnetic Attraction Relays:

As the working principle of a relay it arranges part which shown in the given below figures.

As their working principle an attraction relay can be divided in two parts they are,

1. low-voltage control circuit.
2. high-voltage operating circuit.

Normally a low tension circuit comprised with electromagnetic relay, switch and low power and the high tension circuit comprised with motor, electromagnetic relay and high power. Every electromagnetic relays are not predefined for controlling rules. it's just follow the principle of electromagnetic induction. if the power goes on the low voltage circuit, then coil get current and a magnetic field create there. when the magnetic field created armature force to start the motor. this particular way low voltage circuit works. if the off the low voltage circuit, current flow will stop through the coil and the blow coil also not getting any power for that the motor will stop.

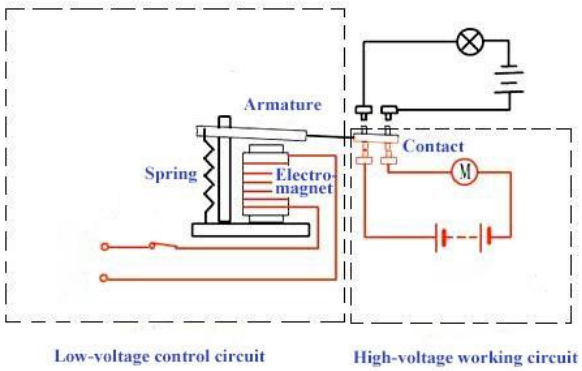


Fig 4.3: Electromagnetic Relay

Normally speaking, this kind of relay only use Electromagnet to “on” and “off” the circuit system, in other word it can be said control the circuit. if the both ends pass voltage to the coil, current will flow and make magnetic field which force armature to attract the movable contact. in the same way when the both ends don't pass voltage to the coil, current will not flow and magnetic field not force armature to attract the movable contact, and the armature back his normal position. actually when we give power to coil it will state that "ON”, and when we off the power from the coil it state that "OFF’.

4.6 Electromagnetic Induction relays:

This type relays mostly use for ac component, because it protection system is suitable for ac component. also for its behavior or protection system this kind of relay not use DC component.

4.7 Induction Disc Relay:

that kinds of relay made of metal disc which allow rotate at the mid of two electromagnets. This kind of relay operate by eddy some current to increase the dose when the electromagnet is created.

By the structure it can be divided into two parts they are,

1. Shaded pole
2. watt-hour meter

4.7.1 Shaded Pole:

Normally a shaded pole made as like it can inspire it by passing current through a single coil, where a magnetic form has a gap of air. This gap created some flux with help of current. which is divided in two parts. outside can be called “shading ring” and it is made of copper, and that component face some air in each pole which placed beside air gap.

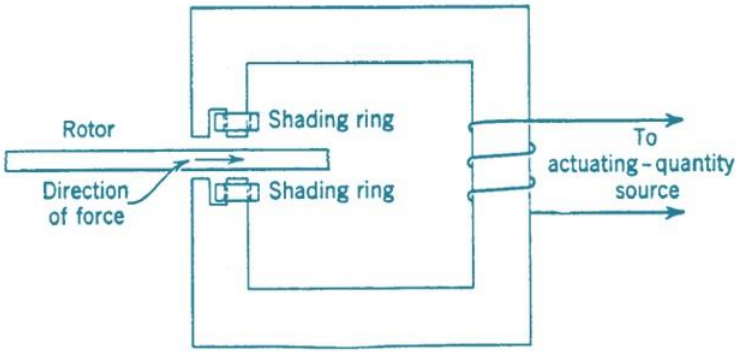


Fig 4.4: Shaded pole

4.7.2 Watt-Hour Meter Structure:

This meter design as like it can hold two separate coils on two separate magnetic part. Basic and main work is generating two needed fluxes to functioning a rotor. and it also seems like a disc.

Chapter: 05

Protection of Alternators and Transformers

5.1 Introduction:

The Modern electrical power transmission process has different material such as alternators, transformers, station bus-bars, transmission lines, and other materials. It is important to protect material from a faults which can be occur any time. protective relays are helpful employed to Identify the improper behavior of any circuit element and initiate corrective measures. As a matter of convenience, this part discusses with the protection of alternators and transformers. The very serious faults on alternators which demand quick attention is the stator winding faults. The Big fault on transformers fall out due to short-circuits in the transformers or their connections. primary system used for defenses against This fault is the differential relay design because the differential nature of amount makes this system Too much sensitive than several protective systems.

5.2 Protection of Alternators and Transformers:

The modern electrical power generating station is a big part of modern society. when power generate it need to transmission and distribution. basically power transmitted by transformer, so it need to be protect otherwise power plant will get some fault.

5.3 Faults of Alternators and Transformers:

There are some most fault that may occur in Alternators and Transformers, they are,

1. Failure of Prime-Mover.
2. Failure of field.
3. Over current.
4. Over Speed.
5. Overvoltage.
6. Unbalanced loading.
7. Stator winding fault.

5.3.1 Failure of Prime-Mover:

when a fault occurs and in a result there seems a failure in prime-mover then alternator take current because of that in this time alternator runs like as synchronous motor. This condition can have remembered as “inverted running “. in other case if steam supply gets stop it can be cause for inverted running, this may occur for turbo-alternator sets. When the steam has restored for supply, without making any problem in the system, alternator will start doing his duty. If steam problem stays long time, the machine should be safely removed by control room, for this process auto protection system in not needed. when same problem happens hydro generator, this problem can easily remove by mechanical components on the water wheel. if water flow become unexpected for output, generator will automatic disconnected by alternator. when same problem happens in Diesel engine generator, in this time it’s take a huge power from supply. so this is important part to provide protection against this fault. this problem can easily maintain by reverse power relays, which have time delay component. if the fault not remove in time the reverse power relays will disconnect the system. this protection complete just tripping the system by reverse power relays.

5.3.2 Failure of field:

when a field failure happens, it may the cause of a damage of the generator. A big generator generally takes power to excitation from other supply or a DC generator. if the supply failure for any reason it may the cause of failure of filed. in this condition generator runs faster than synchronous speed and draw current from system. it can't create a major fault quickly, but overheating and overloading may create a long time problem in generator. so if there is an any failure in the field, generator should be protected quickly. whenever, field failure occurs the generator must be disconnecting or protected quickly.

5.3.3 Over Current:

It mainly happens when the insulation winding is partially breakdown or when the supply system is overload. For following reason an alternators and transformers protection must be needed,

1. in modern technology is designed or planned an alternators as much reliable that only if a major overload, overheat occurs for overcurrent alternators will disconnected or it can be manually disconnected.
2. Main problem is when we use a protection for overcurrent it may create problem for the alternators which in power plan bus and interface in power supply.

5.3.4 Over Speed:

The over speed mainly happens when there is a loss on the alternator. for that in modern technology protection system made as that can protect against unwanted fault or loss by tripping the prime mover.

5.3.5 Over Voltage:

the modern alternators are design and planted as that can defend against any overvoltage fault. if there is any overvoltage and speed increase in prime mover of any recent losses, it has to protected quickly. this kind problem generally not happens steam-turbine, because of speed is very sensitive issue. every time control system continues check its speed. for that any protection needed here.

when same problem happens hydro generators, where speed is very sensitive issue but control system is not check speed sensitive. when the speed is increase by recent loss, it must be checked. otherwise overvoltage will reach a un tolerated value which may cause of over stress the stator windings and breakdown may occurs. to avoid this kind of situation over-voltage protection used in hydro generators. where an overvoltage relay is used for protection.

5.3.6 Unbalanced loading:

If the Unbalanced loading may occur when different current flow in line. This kind of faults may occur in two ways, first one is line to earth and second one is line to line. most time line to earth fault ocurs.in this time unbalance current may be creating in the line, and it is so bad for circuit and equipment.

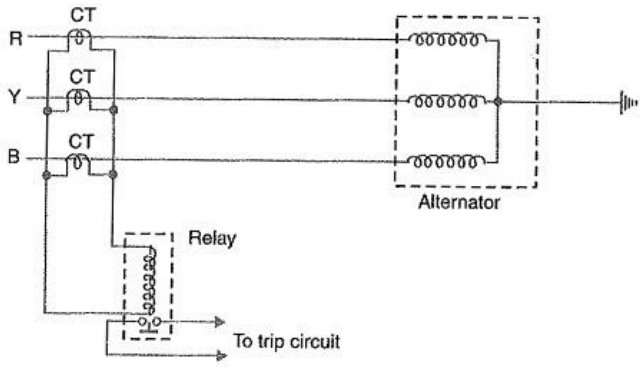


Fig 5.1: Unbalanced loading

There is a figure given, which is arranged to protect against unbalanced loading. in this figure three transmission line are arranged like as one part is connected to secondary

in parallel and other three with CT. also a relay connected to the C.T Secondary. if the system is in normal condition, the currents flow in the phases is equal to zero. for that secondary said currents flow is also zero and there will be no extra current flow in the relay coil. if the system is in abnormal condition, the currents flow in the phases is not equal to zero. for that secondary said currents flow is also not zero and there will be an extra current flow in the relay coil. that means there is a fault in the system and relay will trip and circuit breaker will have disconnected the circuit.

5.3.7 Stator winding faults:

This kind of faults happen when there an insulation problem occurs. it can be a damage or burn by heat or internal fault. it also be named as stator winding faults. this kind of faults is more dangerous than other faults and it will be the reason of damage in costly equipment. so it is more important to protect all equipment immediately. some common faults are given below,

1. fault between phase and ground.
2. fault between phases.
3. inter-turn fault (involving turns of the same phase winding).

5.4 protection of transformers:

Transformers is made for transmitted energy. it is design or build, with a surround area and oil. for that any fault occurs in the transformer is rare. but if the rare fault may occur it is dangerous and have to disconnect the transformer from the system. for that a good automatic protection must be required to protect against any faults. there are many kinds of transformers used in power system and they need different protection against different faults.

5.5 transformer Fault:

there is no fixed fault which can only be happen in transformer. there are many kinds of faults occurs but mostly common faults given below,

1. Open circuits.
2. Overheating.
3. Winding short-circuits e.g. earth-faults,
4. Phase-to-phase faults and inter-turn faults.

5.6 Protection systems for transformer:

The transformer can be protect by many way, but mostly use though device which can sense automatic like relay. This kind of protection automatic sense and can compare the normal and abnormal condition. for protected the transformer, mostly used protection device and system name given below,

1. Buchholz (Gas) relay.
2. Earth-fault relays.
3. Overcurrent relays.
4. Differential system**.**

5.7 Buchholz (Gas) relay:

The Buchholz is build or design with mechanical fault detector. if there is a fault then the oil will heat up and the circuit will close.it is placed in transformer main tank for that it gets pressure when the fault occurs.it can sense faults quickly and can operate so fast. It works quickly, if there change in transformer windings. if there is any tap changed then Buchholz relay sense the change by comparing its own oil.

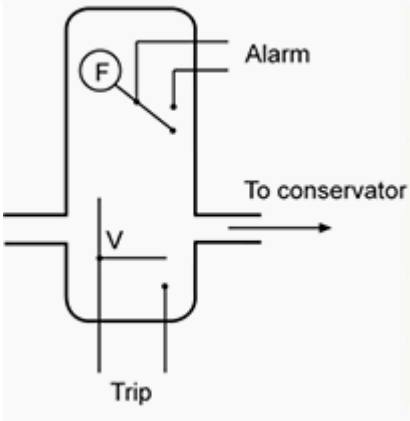


Fig 5.2: Buchholz (gas) relay (A)

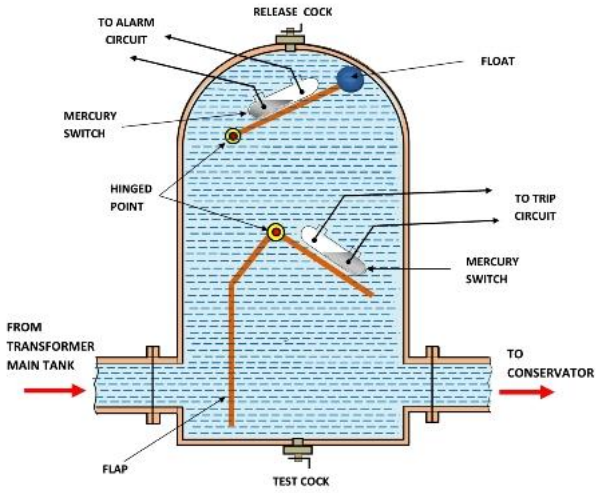


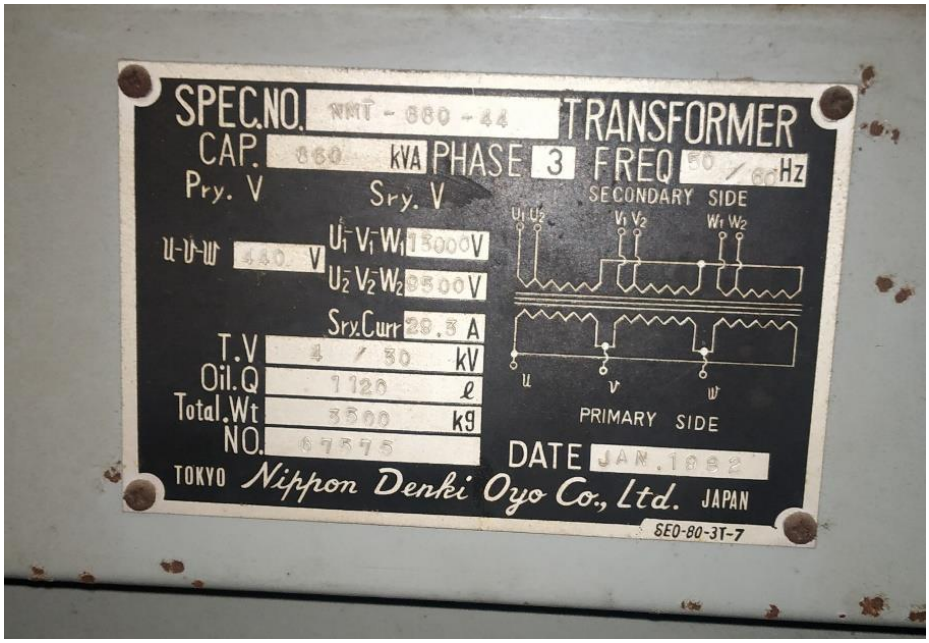
Fig 5.2: Buchholz (gas) relay (B)

Working principle of an of Buchholz relay given below,

1. when a faults occurs in transformer or for other reason, in that time oil is get heat. when oil heats up it increase with 70% of hydrogen gas for its characteristic. this hydrogen gas goes to conservator and the upper chamber where mercury switch is placed. when this gas crosses the limit then it pusher the float and the alarm circuit get on.
2. If any huge fault occurs which result is a big damage. in this time a huge amount of gas creates on the main tank. the oil flow from the main tank to Buchholz relay for that flap close the connection of mercury switch. This process completes the trip circuit to open the circuit breaker controlling the transformer. in this way a Buchholz relay completed this operation to trip the circuit breakers and open the circuit. this protection is more easy and reliable for transformer.

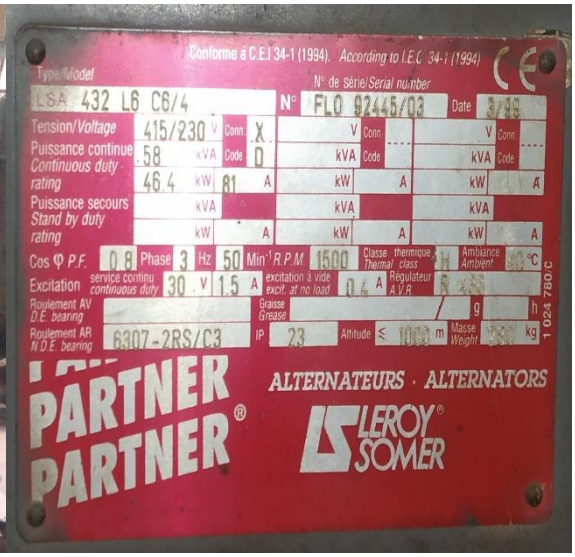
5.8 Transformer Data Use National Tubes LTD:

Description	Value
Company Name	Nitron denlei oyo co. ltd tokoyo,japan
Capacity (KVA)	660 KVA
Phase	3
Frequency (HZ)	50/60
Primary Side Voltage (V)	440
Secondary Side Voltage (KV)	13 & 9.5
Secondary Side Current (A)	29.3
T.v (KV)	4/30
Oil Quantity (L)	1120
Total Weight (KG)	3500

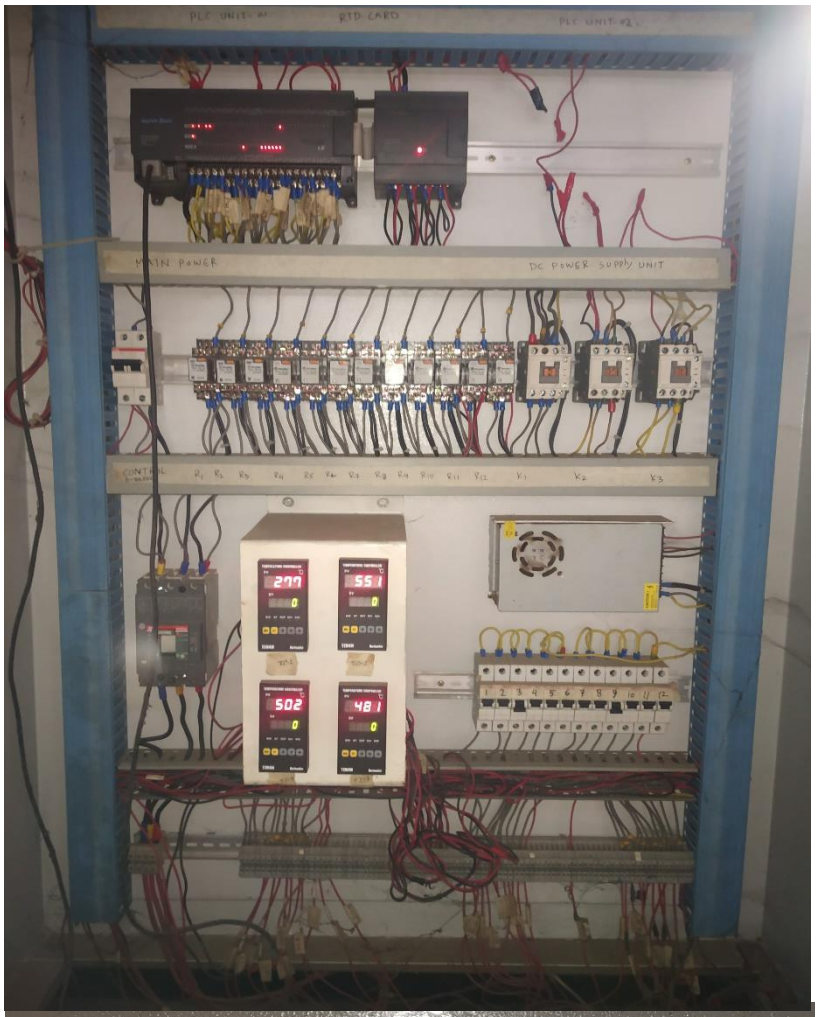


5.9 Generator Data Use National Tubes Ltd:

Description	Value
Company Name	Partner
Voltage (V)	415/230
Puissance Continue (KVA)	58
Continuous Duty Rating (KW)	46.4
Cos ω P.F	0.8
Phase	3
Frequency (HZ)	50
R.P,M	1500
Ambiance Ambient	40 ◦c
Regulator A.V.R	R 438
Mass Weight (KG)	280



5.10 Annealing Furnace of National Tubes Ltd:



Chapter: 06

Customer Sub-station of NTL

6.1 Introduction:

In modern power generation substation play a very important part. where energy is distributed, transmitted and controlling. it also converts energy from DC-AC or AC-DC by transformer. in simple word substation is the most important part to provide service, protection and maintenance.

6.2 Sub-station:

In modern power generation substation play a very important part. so a substation should have some important point that given below,

1. it should be placed in exact area. where it can be located in middle of load.
2. As a main part of power supply, it should be reliable and that can be maintenance, repair and carry can be easy.
3. It has to comfortable to control.
4. It should be reliable capital cost.

Fig 6.1: Sub-Station

6.3 Classification of Sub-Stations:

The modern substations can be classified in two part,

1. service requirement and
2. constructional features.

By working type substation can be divided into several parts, they are,

1. Transformer sub-stations
2. Switching sub-stations
3. Power factor correction sub-stations
4. Frequency changer sub-stations
5. Converting sub-stations
6. Industrial sub-stations

6.4 Industrial sub-stations:

This kind of substation give Power supply to a business client. This case industrial company require need a high capacity and controlling substation. Normally this substation should have capability to carry "1-35 KV' Or more. In NTL (National Tubes Limited) they use medium voltage substation. they consume amount of 33kv from Desco.

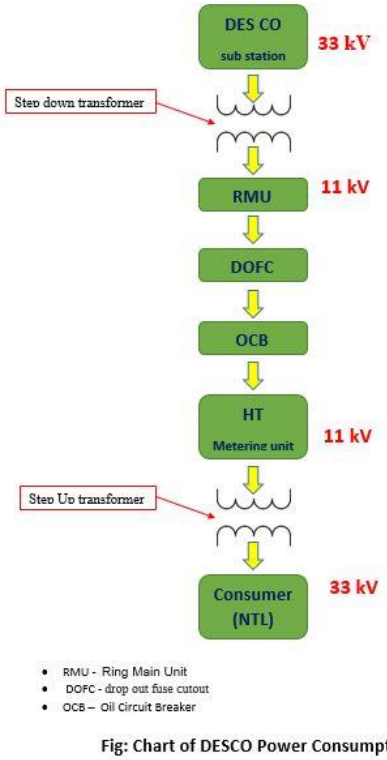


Fig 6.2: Chart of power consumption

6.4.1 Medium Voltage Sub-station:

The power transformation is within the range of 30 MVA for 33/11 kV distribution. Air insulated Switchgear Substation has mounted isolators, Auxiliary Transformer and PT on gantry structure with CT, VCB erected on foundation. Gas insulated Switchgears are kept indoors with isolators PT, VCB and CT stored inside panels while transformers are kept outside.

6.5 Sub-station equipment used:

This equipment is mostly used in Sub-station,

1. Transformer.
2. Circuit Breaker.
3. Lightning arrester.
4. Air Break (AB) switches / Isolator.
5. Insulator.
6. Bus-bar.
7. Capacitor Bank.
8. Earthing.
9. Fencing.
10. Distribution panel board.

6.5.1 Transformer:

Transformers is made for transmitted energy. it is design or build, with a surround area and oil. for that any fault occurs in the transformer is rare. but if the rare fault may occur it is dangerous and have to disconnect the transformer from the system. for that a good automatic protection must be required to protect against any faults. there are many kinds of transformers used in power system and they need different protection against different faults. The distribution transformers were find out in 1882.

By considering Transformers construction, it can be divided into two parts,

1. Core type.
2. Shell type.

6.5.1.1 Core type:

Normally A core type transformer made with rectangular shape and coils are circular or rectangular. Core Type mostly used in high voltage for reducing iron loss to normal. and this type have high insulation. so it is reliable for HV.

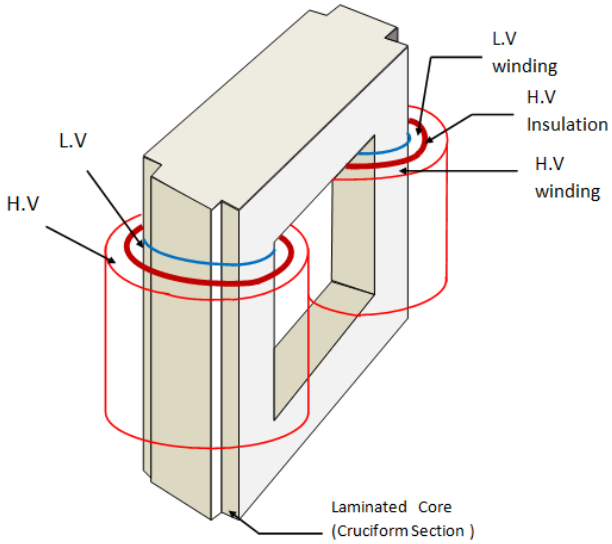


Fig 6.3: Core Type Transformer

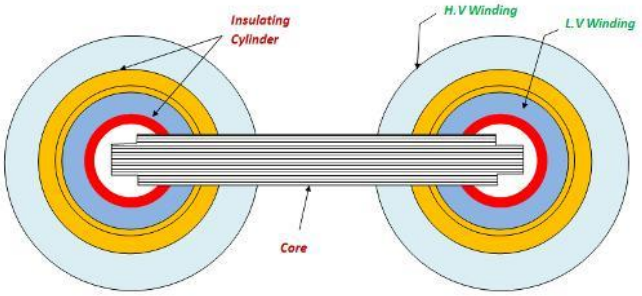


Fig 6.4: Core Type Transformer Top view

6.5.1.2 Shell type:

Normally A shell type transformer low voltage. shell type benefit is that suitable with low voltage when copper need more then iron core so it is best choice. This type has good insulation that's why you can easily put winding anywhere that comfortable.

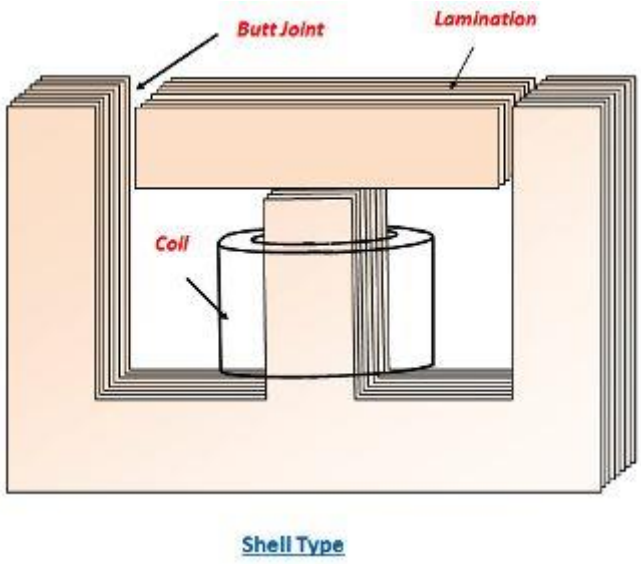


Fig 6.5: Shell Type Transformer

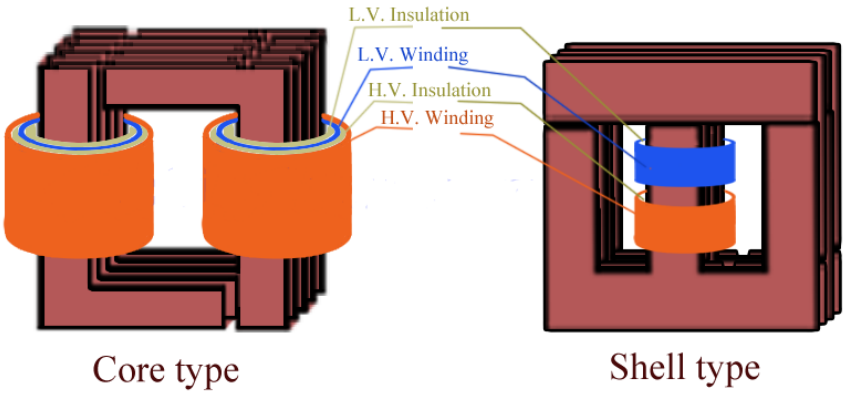


Fig 6.6: Core Type & Shell Type Transformer

6.5.2-Circuit Breaker:

In a circuit breaker relay is the most important part. because it is controlling the full operation of a circuit breaker. Relays can be said one kind of switches, which protect the system by open and closes circuits electromechanically or electronically. normally a Relays operate an electrical circuit system by opening and closing from other circuit when any fault occurs.

Maximum time Relays used to switch low current system and also control the circuit system and it never take high amps form the system but it just consumes low amps for operates. But A relay can control high volts and amps because of that a relay can sense if there is any high amps' flow in the system, if there is a high amp then the relay will disconnect the system. For this great working and protection relay is greatly used for switching 'starting coils, heating elements, pilot lights and audible alarms' etc.

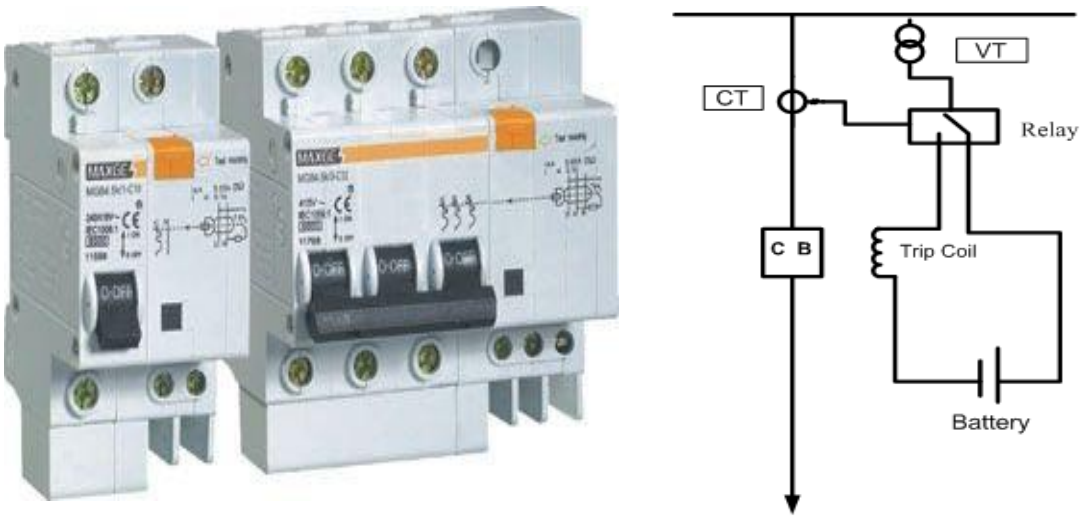


Fig 6.7: Circuit Breaker

6.5.3 Lightning arrester:

A Lightning arrester main duty is provided safety from lightning. in modern power plant related every equipment need Lightning arrester. when a lightning occurs it need to be pleased to earth, otherwise it may the cause for a huge damage. Lightning arrester working principle is simple. when a lightning occurs near of any transmission pole or substation or any electrical equipment, lightning arrester place is to art. a lightning contains huge high voltage so if can damage any consumer device, transformer or may be the cause of death. so lightning arrester is an important protection of electrical power system.

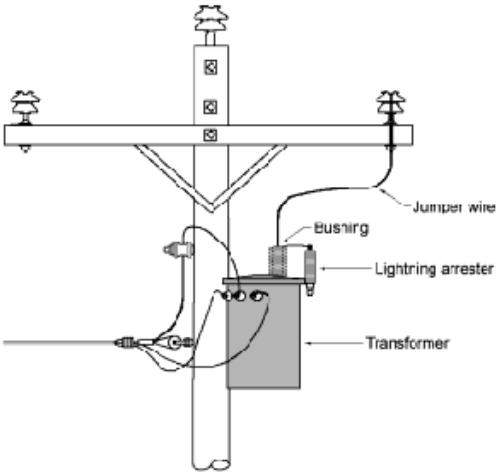


Fig 6.8: Lightning Arrester

6.5.4 Air Break (AB) switches / Isolator:

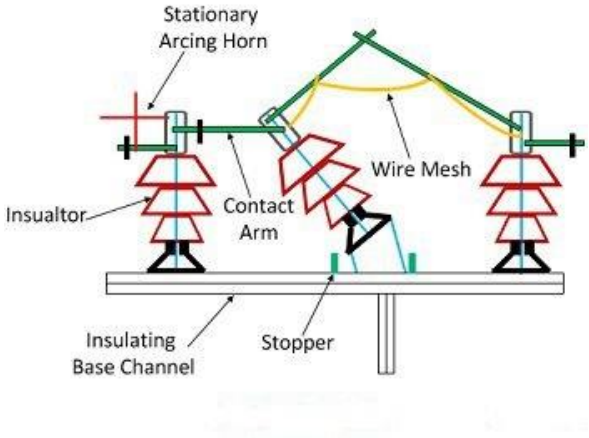


Fig 6.9: Air Break (AB) switches / Isolator

6.5.5 Insulator:

insulator used to provide protected the pole. a little amount of current can flow from that. it also increases the strength of the transmission cable.

Fig 6.10: Insulator

6.5.6 Bus-bar:

Normally a bus-bar system arranged with circuit breaker and isolator. If there is any fault occurs, by tripped off the faulty section of the bus-bar with the help of circuit breaker we can easily disconnect the circuit from fault system. To support its own weight A bus-bar must be enough inflexible and should be enough capable to face mechanical vibration and possibly earthquakes. It also faces the precipitation accumulated in Outdoor vent. When temperature changed or increase for resistance unit heating, it introduced thermal enlargement temperature, so it should be closed temperature variations in time, also must be considered magnetic forces changed or increase by high currents.

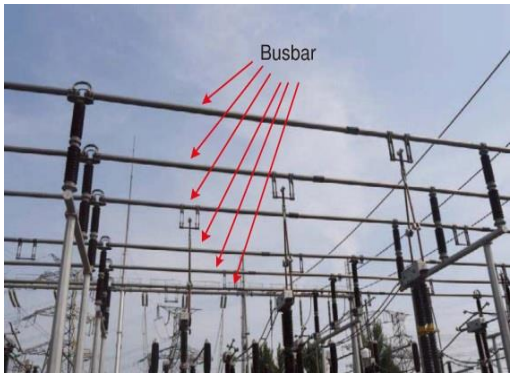


Fig 6.11: Bus-Bar

6.5.7 Capacitor Bank:

A capacitor Bank is a group of several capacitors of the same rating that are connected in series or parallel with each other to store electrical energy.

Fig 6.12: Capacitor Bank

6.5.8 Earthing:

In modern generation system Earthing is a common fact. if there is any fault occur or any machine short circuit then Earthing help to ground that un expected current.

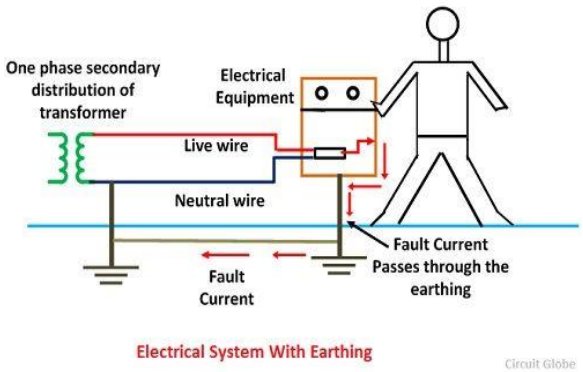


Fig 6.13: Earthing

Types of Electrical Earthing:

By the characteristic earthling can be divided into two types,

1. Neutral earthling.
2. Equipment Earthing.

6.5.9 Distribution Panel Board:

Fig 6.14: Distribution Panel Board

Chapter: 07

Conclusion and References

7.1 Conclusion:

National Tubes Limited (NTL) is one of the best government tube manufacturer Industry. Considering the current Digital ongoing platform, it is very much important to takes place. In this regard the govt. there is lot of work to rising the Industry sector in government sector going more. My experience with National Tubes Limited (NTL) for a short time. this internship not only increased my knowledge, gives me more professional expressing. For giving me this opportunity to complete my industrial attachment in their industry. I'm also grateful to all the engineers and employees of National Tubes Limited (NTL). for their heartiest support and co- operation.

This report contains the power generation system, electrical protection of different parts of electrical machines and apparatus used in National Tubes Limited (NTL). During three months of my practicum session, I have learned practical knowledge about how to generate power, how to supply power for internal use, what was the purpose of transformer, how to improve power and so on. I am also elucidated the various ways of protecting electric machines against various electrical faults.

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