North South University

SUMMER 2021

EEE498R –Internship

Submitted to,

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Lecturer

Submitted by,

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Date of Submission:

3 October 2021

DECLARATION

I hereby declare that this internship report is the outcome of my own work. Many references are quoted to support my work. I also declare that the internship report, neither in whole nor in part has been previously submitted else for any degree.

1/10/2021

……………………………

Kazi Abdullah Al Hasan
Id: 1620190043
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CERTIFICATE

The internship carried out by **Kazi Abdullah Al Hasan** bearing student ID: 1620190043, in Tokai Power Product Limited from July 1, 2021 to September 30, 2021, is completed under my supervision. I believe this report, prepared with the findings of the internship work meets acceptable criteria for presentation and can be submitted for evaluation to the department of Electrical & Electronic Engineering in partial fulfillment of the requirement for the degree of Bachelor of Science (B.Sc.) in Electrical and Electronic Engineering.

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ACKNOWLEDGMENT

At first my gratefulness goes almighty Allah to give me strength and ability to complete the internship and this report.

My special thanks to Tokai Power product limited to allow me to work internship in their factory. In this Project, I got an opportunity for learning different engineering knowledge. I consider myself to become a part of it. I would like to add a few heartfelt words for all those who knowingly or unknowingly became a part of this of Internship project in numerous ways. I am also grateful to all of the respected Engineers, operators, and technicians that assisted me in the preparation of the report.

My supervisor, **Ahmed Fahmin**, Lecturer, Department of ECE, to whom I am extremely grateful for his unwavering support and guidance throughout my internship period.

Finally, I must acknowledge my parents' with due respect for their constant support, patience and believe in my ability to successful completion of the internship work and this report.

ABSTRACT

The primary goal of this traineeship is to familiarize myself with the industrial environment and to gain practical experience with electrical power transmission and distribution. As a final-year student, I will learn about the fundamental industrial operations of power transmission and distribution. In addition, students will learn about transformer maintenance, circuit breakers, transformer isolators, bus bars, protective relays, and the control room.

The capacity of a power generation system to quickly restore machine supply and revert to normal operation circumstances has a substantial impact on its reliability performance. This paper is intended to design and analyze of Power transformer, control system of a building.

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Chapter One
Introduction

1.1 Overview of the Organization

Founded in 1997, Tokai Power Products Ltd. (TPPL) has been playing a part in the steady growth of Bangladesh economy by contributing in various aspects of power generation, transmission and distribution.

The company envisions a prosperous Bangladesh and strives to complement the public and private sector initiatives by providing total power solutions to our valued customers. Maximizing customer value being prime focus, Tokai Power Products Ltd. has earned profound name and reputation in last two decades through their quality service delivery and customer centric approach. Run by vastly experienced veteran engineers, the company incorporates the effective balance of youth and experience; and operates uncompromisingly with ethical management practice along with its core engineering expertise.

Besides offering turnkey engineering solutions, TPPL applies appropriate technology and efficient process in their manufacturing and testing facilities which is well-equipped to produce and assemble power and distribution transformers, HT and LT switchgear panels, PFI and other equipment associated with electrical power transmission and distribution.

TPPL, with its highest order of manufacturing and administrative standard, has been certified as an ISO 9001:2008 company and we also give utmost importance to the health and safety of our prized employees. With quality, reliability and customer service at the heart of our values, Tokai Power Products Ltd. boasts a rich clientele featuring a host of giant conglomerates and power utilities steering the forward-moving Bangladesh.

1.2 Services provided by the organization

- Power station
- Industrial, commercial, residential electric connection installation
- Rewiring & upgrading electric works
- Energy meter, turnkey projects
- Sub-station work
- Electric lift

1.3 Workplace factory

Tokai Power Products Ltd. (TPPL) is primarily a manufacturing firm, in addition to the services they give. Power transformers, LT & HT switchgear panels, vacuum circuit breakers, PFI, and other electrical power transmission and distribution equipment are all manufactured by them. I was able to observe and learn how they manufacture and install all of the electrical equipment connections.

Figure 1: TPPL factory

Chapter Two
Transformer

A transformer is an electrical device that transfers electrical energy between two or more circuit through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a voltage in a second coil. Power can be transferred between the two coils through the magnetic field, without a metallic connection between the two circuits.

The Power transformer is one type of transformer that is used to transmit electrical energy in any component of the electronic or electrical circuit between the distribution primary circuits and the generator.

These transformers are utilized in distribution networks to interface step down and step up voltages.

- The range of large power transformers can be from 100MVA and beyond
- The range of medium power transformers can be from -100MVA
- The range of low power transformers can be from 500-7500kVA

2.1 Transformer structure and components

The structure of the power transformer is modeled with metal that is covered by sheets. It is fixed into either a shell type or core type. The structures of the transformer are wound and attached, employing conductors to produce three 1-phases or one 3-phase transformer.

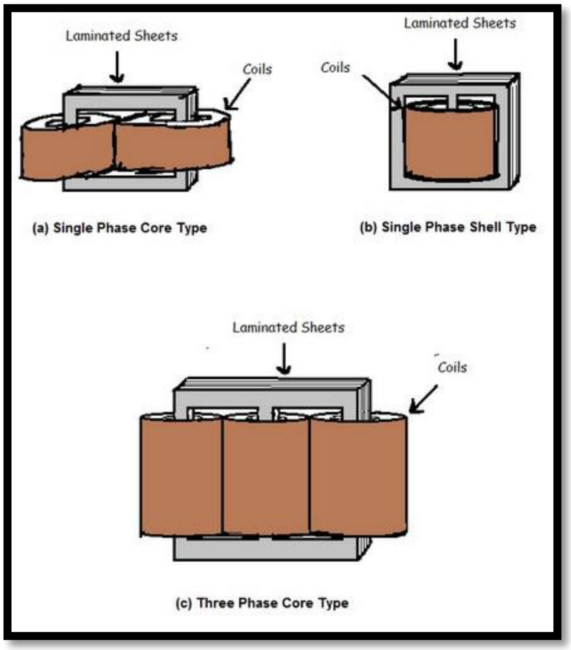

Figure 2: Different phase core type

2.1.1 Winding:

Transformer windings are a crucial aspect of the transformer construction, because they are the principal current-carrying conductors wound around the laminated sections of the core. In a single-phase two winding transformer, two windings would be present. The one which is connected to the voltage source and creates the magnetic flux called the primary winding, and the second winding called the secondary in which a voltage is induced as a result of mutual induction.

If the secondary output voltage is less than that of the primary input voltage the transformer is known as a “Step-down Transformer”. If the secondary output voltage is greater than the primary input voltage it is called a “Step-up Transformer.

Laminated sheets are assembled in a series manner and to form the laminated core. The thickness of the core is kept 0.55 mm. Laminated and well insulated iron cores are used for the completion of the magnetic circuit and to reduce iron and eddy current losses.

In figure (2), the primary winding is 33KV and secondary winding is 11KV. In this case it is step-down transformer and that is why primary winding is Δ (delta) connected and secondary winding is Y (wye) connected. The ac source is known as primary winding. The load which is taken from the source is called secondary winding. The transformer consists of soft iron core or the silicon steel core. Also two windings attached to it, they are primary winding and the secondary winding. The windings are insulated from one another. The conducting material (a conductor is a material which contains movable electric charges) used for the windings, depends upon the application. But in all cases, each turns must be electrically insulated from each other to ensure that the current travels throughout every turn.

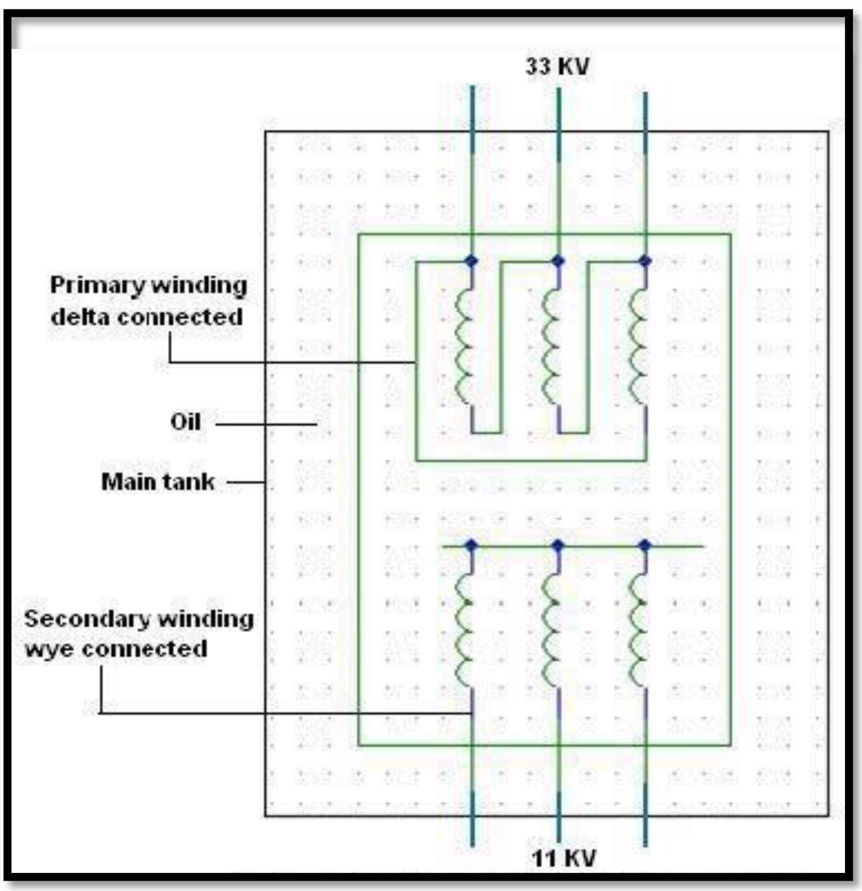

Figure 3: Winding connection

2.1.2 Insulations

Insulations are used between high voltage and low voltage windings to prevent the short circuits.

Insulated sheets - Primary (low voltage) winding - Low voltage insulated sheets – Secondary (high voltage) winding – high voltage insulated sheets.

The primary and secondary windings are placed for the transformation of power. These maybe wound in cylindrical or sandwich types.

Insulation is the most important part of transformers. Insulation failures can cause the most severe damage to transformers. Insulation is required between the windings and the core, between windings, between each turn of the winding and between all current-carrying parts and the tank. The insulators should have high dielectric strength, good mechanical properties and high-temperature withstand ability. Synthetic materials, paper, cotton etc are used as insulation in transformers.

Figure 4: Insulations on winding

2.1.3 Main Tank

Main tank is such type of protective element for the primary winding and secondary winding. It protects all the windings and cores from the atmospheric effect. The three-phase windings are inserted inside the main tank. The end edge of the primary winding is connected from one side of the main tank. And the starting edge of the secondary winding is connected from opposite site of the main tank. Main tank is filled up with oil. And oil is used to provide insulation between the main tank and the windings.

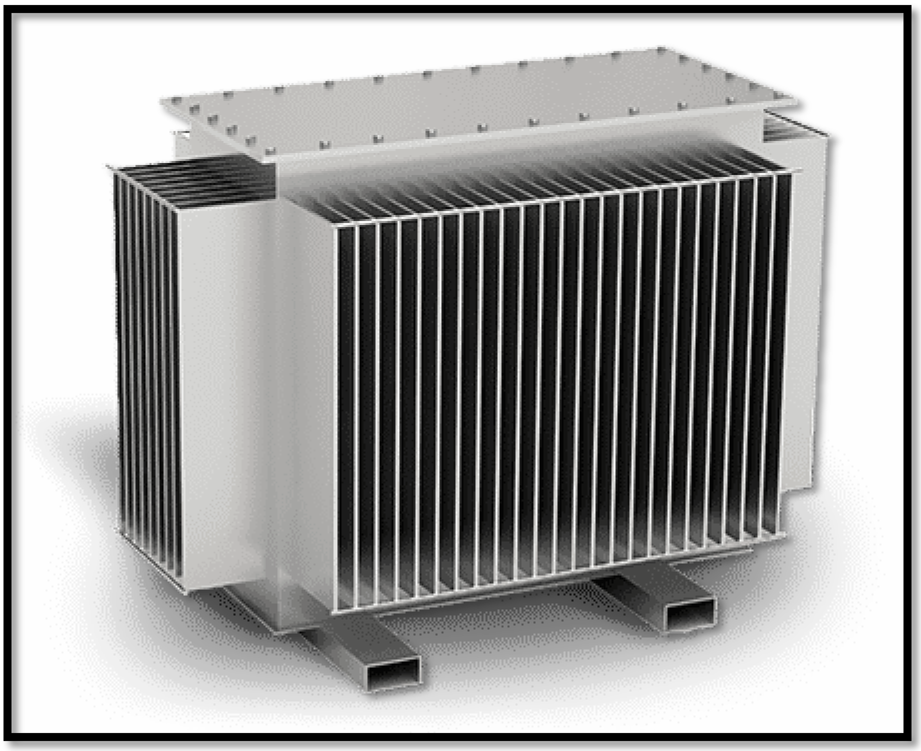

Figure 5: Main Tank

2.1.4 Transformer Oil

Transformer oil is used to provide insulation between the transformer main tank and the windings (both primary windings and secondary windings) and for keeping cool the transformer. The oil used should not have a flash point less than 160° C. The transformer oil also provides high dielectric strength to the coils and core which are submerged. This allow transformer to be more compact and cost efficient.

Figure 6: Reserved transformer oil

2.1.5 The Conservator

It's a drum, which is used as oil storage tank and it is mounted on the top of the transformer. During the expansion of oil due to internal fault of transformer or when load increases, windings (both primary and secondary winding) produce more heat. As a results oil volume can expand. And expansion of oil volume can enter from main to conservator tank via buchholz relay. Actually the tank is designed as an expansion reservoir which allows the expansion of the oil during operation.

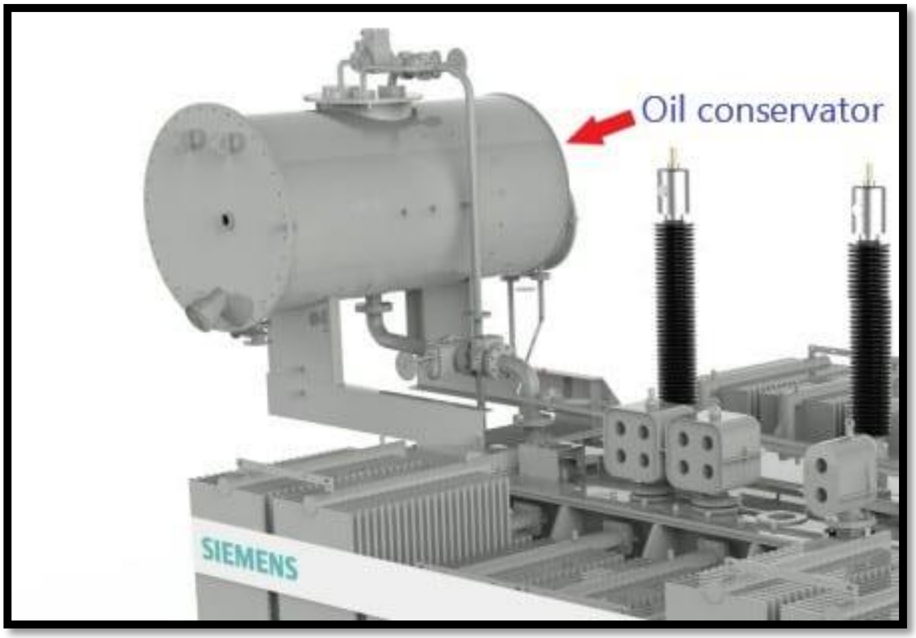

Figure 7: Conservator

2.1.6 Winding Temperature and Oil Temperature Indicator

Winding temperature indicator (meter) indicates the appropriate temperature of winding (The normal position of winding temperature is 75 degree centigrade). Oil temperature indicator (meter) indicates the appropriate temperature of oil (The normal position of oil temperature is 65 degree centigrade).

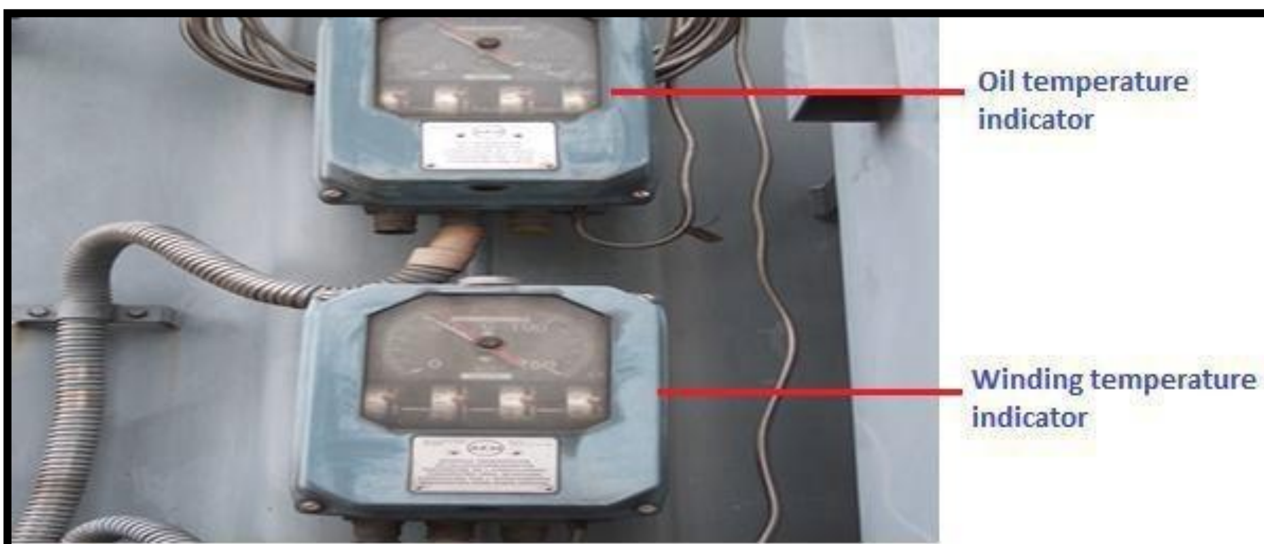

Figure 8: Oil Temperature and winding temperature indicator

2.1.7 Breathing System

A breather is used to prevent the transformer oil from the atmospheric pressure. Transformer breathing system is controlled by silica gel. It is used to absorb moisture. During the injection of oil into transformer tank some air can enter or exit in the conservator tank depending on expansion and extraction of the oil of main tank and silica gel is used to absorb the moisture from that air.

Figure 9: Transformer breather

2.1.8 Buchholz relay

Buchholz relay is a protective element of transformer. It is installed at the middle position of the transformer tank and the conservator tank. It's a gas actuated relay installed in oil immersed transformers for protection against all kinds of faults. Buchholz relay detects the incipient faults at a stage much earlier than is possible with other forms of protection.

When gas is produced in the main tank due to a minor fault, oil volume expands and can enter to conservator tank via Buchholz relay. If oil's motion is very rapid, then at 1st, it gives the signal to the control room. If the fault is very big then it trips the transformer.

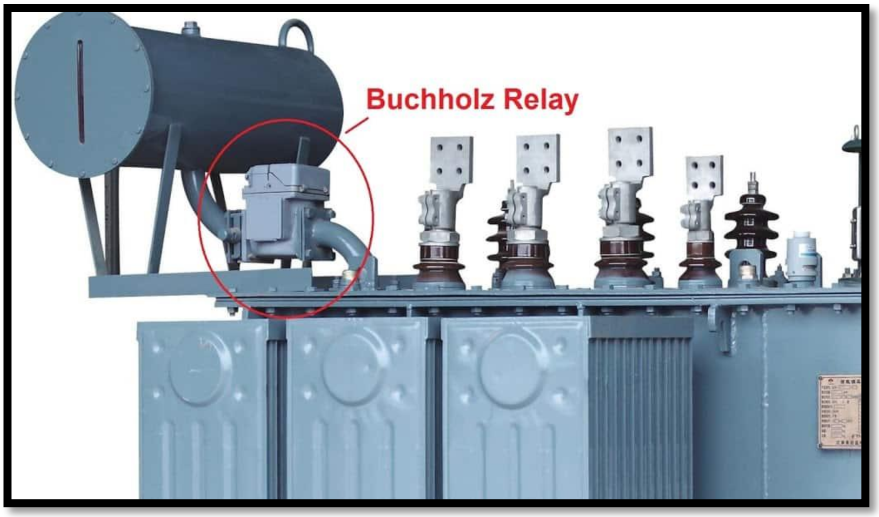

Figure 10: Buchholz Relay

2.1.9 Bushings (high voltage, low voltage)

The bushings provide proper insulation between live conductor and earthed tank. In majority of the transformers, HV and LV line terminals are taken out from tank through bushings. Bushings are very important and costly accessories of a transformer. Transformer bushing provides a very effective insulation between line conductor and tank.

Figure 11 : HV and LV Bushings.

2.1.10 Explosion vent

An explosion vent acts as an emergency exit for oil and air gases inside a transformer. It is a metallic pipe with a diaphragm at one end, held slightly above the conservator tank. Faults occurring under oil elevate the pressure inside the tank to dangerous levels. Under such circumstances, the diaphragm ruptures at a relatively low pressure to release the forces from within the transformer to the atmosphere.

2.1.11 Diaphragm

It is used to discharge excess pressure in the atmosphere when excess pressure is developed inside the transformer during loading.

2.1.12. Radiator & Fan

These are used for transformer cooling purpose. The power lost in the transformer is dissipated in the form of heat. Dry transformer is mostly natural air cooled. But when it comes to oil immersed transformers, a variety of cooling methods are followed. Depending on the kVA rating, power losses and level of cooling requirements, radiators and cooling fans are mounted on the transformer tank. The heat generated in the core and winding is passed to the surrounding transformer oil. This heat is dissipated at the radiator. In larger transformer forced cooling is achieved with the help of cooling fans fitted to the radiators.

Figure 12: Radiator of transformer

2.1.13 Temperature gauge

It's a thermometer which is mounted on the transformer to measure its temperature.

2.1.14 Drain valve

It is used to drain oil from the transformer. The freezing point should not be higher than 15° C and viscosity should be 30° C and 15° C.

Chapter Three
Switchgear

Electricity in daily life to mankind is the most important blessings to mankind but, once it comes to electricity supply, it needs to be done securely. Thus, to maintain the security level of electrical distribution, it is very hard to employ safety devices. There are different types of devices that help in protecting electrical devices as well as its connections in different areas like industrial, residential, etc. To overcome this, a switchgear device is used because of its different features and functions.

Switchgear consists of a variety of switches, circuit breakers, fuses, and other components that are used in an electric power system to manage, regulate, and turn circuits on and off. Switchgear protects and isolates electrical equipment from the power source by managing the circuit, allowing for testing, maintenance, and fault correction.

Switchgears are used in generation, transmission and distribution systems. These are necessary at every switching point in the power system because there are several power systems because there are several voltage levels and fault levels which has to be controlled and protected by accessible switching devices and for isolation.

Switchgear is directly connected to the power supply system and can be categorized based on the voltage level.

- Low voltage switchgear (LV).
- Medium voltage switchgear (MV).
- High voltage switchgear (HV).

3.1 Low voltage switchgear (LV)

The power system which deals up to 1KV is called as LV or low voltage switchgear. This kind of equipment mainly includes switches, LV circuit breakers, HRC fuses, earth leakage (EL) circuit breakers; offload electrical isolators, MCBs (miniature circuit breakers) and MCCBs (molded case circuit breakers), etc.

Figure 13: LV switchgear

3.2 Medium voltage switchgear (MV)

The power system which deals up to 36 kV is called MV or medium voltage switchgear. These are available in different types like without metal enclosure outdoor type, metal-enclosed indoor & outdoor type, etc. This kind of equipment includes substation devices like minimum oil CBs, bulk oil CBs, SF6 gas-insulated, air magnetic, gas-insulated, vacuum, etc.

The disruption medium of this type of switchgear can be vacuum, SF & oil. The main condition of this type of power network is to break off current throughout faulty conditions in this system. This is capable of ON/OFF operation, interruption of short circuit current, capacitive current switching, inductive current switching and used in some special applications.

Figure 14: MV switchgear

3.3 High voltage switchgear (HV)

The power system which deals above 36KV is called HV or high voltage switchgear. When the level of voltage increases then the arcing will be generated as the switching operation is extremely high. As a result, during the designing of this equipment, special care has to be taken. The main component of this equipment is the High Voltage (HV) circuit breaker.

Figure 15: HV switchgear

3.4 Works of switchgear

- It protects the equipment from short-circuits & fault currents.
- This device gives isolation to the circuits from power supplies.
- It increases the availability of the system by allowing more than one source to feed a load.
- It can open & close the electrical circuits under the conditions of normal & abnormal.
- In normal conditions, it can operate manually so it ensures the safety of the operator & also proper electrical energy utilization.
- In abnormal conditions, it operates mechanically. Once a fault happens this device detects the fault & detaches the damaged part in the power system. So it protects the power system from damage.

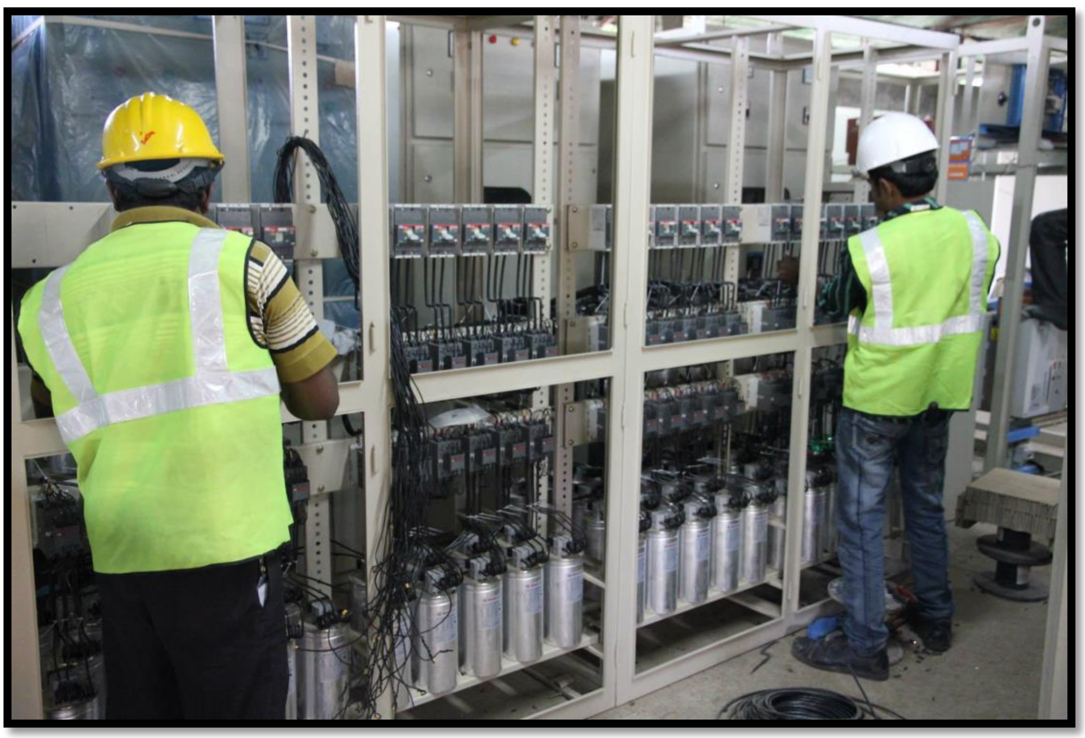

Figure 16: Connecting the circuits of switchgear at TPPL

Chapter Four
Circuit Breaker

The circuit breaker is the major component of switchgear; it is a combination of equipment within the switchgear enclosure that interrupts high voltage currents.

A circuit breaker is a switching device which can open and close a circuit in a small fraction of second under normal as well as during fault condition. Basically, it is automatically operated by electrical switch which is designed to protect an electrical circuit form damage caused by overload or short circuit and its basic function is to detect a fault condition.

I'm going to discuss the circuit breakers that I observed being manufactured at Tokai Power Product Limited.

4.1 Miniature Circuit Breaker (MCB)

When a circuit is connected to an MCB, and access current flow through the MCB which surpasses the specified value, it opens the circuit.

Automatically switches off electrical circuit during any abnormal condition. It’s an electromechanical device which guards the electrical wires and electrical load from overcurrent to avoid any kind of fire.

Single, double, triple, and four pole versions are available, as well as a neutral pole if required. Normal current rating is from 0.5-63A. Means it can detect a circuit with 63A. It can’t go beyond that.

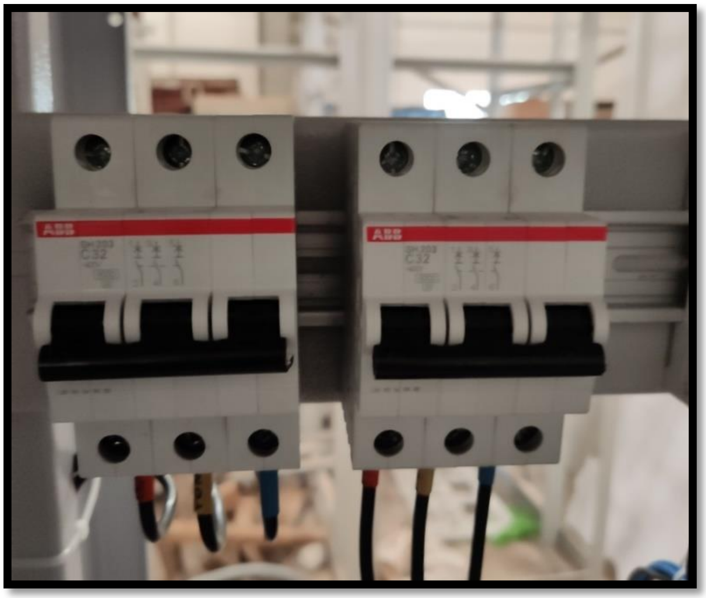

Figure 17: Miniature Circuit Breaker

In commercial applications, 20V branching circuits are protected by single-pole breaker circuits.
And, 240V branching circuits are protected by double-pole breaker circuits.
They are used for overload (thermal) and short circuit (magnetic).
When a MCB has C16 written on it, means it is a class C with an overload current of 16A.
In my picture MCB has C32, which means it's a class C with an overload current of 32A.

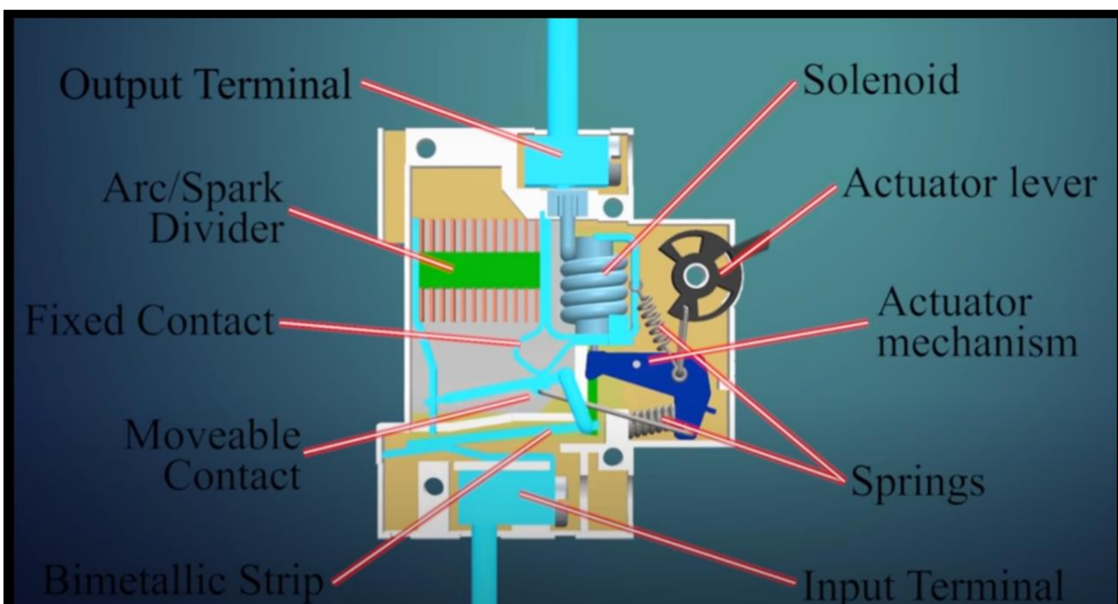

Figure 18: Inside MCB

4.1.1 MCB components

1. Input terminal

2. Bimetallic strip (copper & steel): Metal expands at different rates when heated. As a result, when they are joined together and heated, the metal strip bends because one metal expand more than the other metal. In MCB, the heat can be provided by flowing current.

3. Movable contact: It is moved by the mechanism to turn on or off by the MCB.

4. Fixed contact: The other part of the contact is fixed. From the fixed contact current flows in the solenoid coil.

5. Solenoid coil: This solenoid coil is used to create a magnetic field that will push the plunger with a pin as required.

6. Output terminal: It goes to the appliance.

7. Arc/Spark divider: It extinguishes the spark generated while separating the contacts.

4.1.2 Overload situation

When the MCB is on, the current flows through the bimetallic strip, and thus the strip starts bending. When the current increases strips bends more. The strip then pulls the plastic part and this moves the mechanism, then the spring help to break the circuit, so the time to break remains small, and the MCB strips.

As the circuit breaks, the current through the bimetallic strips stops and thus it regains its shape. At the same time a spark can be generated between the contacts. This spark can damage the components and thus it needs to extinguish as soon as possible. This spark travels towards the spark divider with the help of guides. The shape of the guide is designed as such that the spark travels to the spark divider. The spark divider also helps to dissipate the heat produced by the spark.

4.1.3 Short-circuit situation

A large amount of current goes through the MCB in a short circuit. As the current flows through the solenoid it creates a strong magnetic field. This magnetic field pushes the pin placed in the solenoid. The pin moves the mechanism, separating the contacts, thus the MCB trips and the current flow stops. A spark is also generated and it is dissipated the spark divider.

Bimetallic strip is for overload, but for short circuit the solenoid is working to trip the MCB. Because time is very important and bimetallic strip needs time to heat up and bend. A short circuit needs to stop as soon as possible; hence we have the solenoid to trip the MCB instantly.

4.1.4 Advantages of MCB

- Cheap
- Low breaking capacity
- Max rated current 125A.
- Interrupting current rating 10KA.
- Mainly used in domestic.

4.2 Molded Case Circuit Breaker (MCCB)

The traditional molded-case circuit breaker uses electromechanical (thermal magnetic) trip units that may be fixed or interchangeable. An MCCB provides protection by combining a temperature sensitive device with a current sensitive electromagnetic device. Both these devices act mechanically on the trip mechanism.

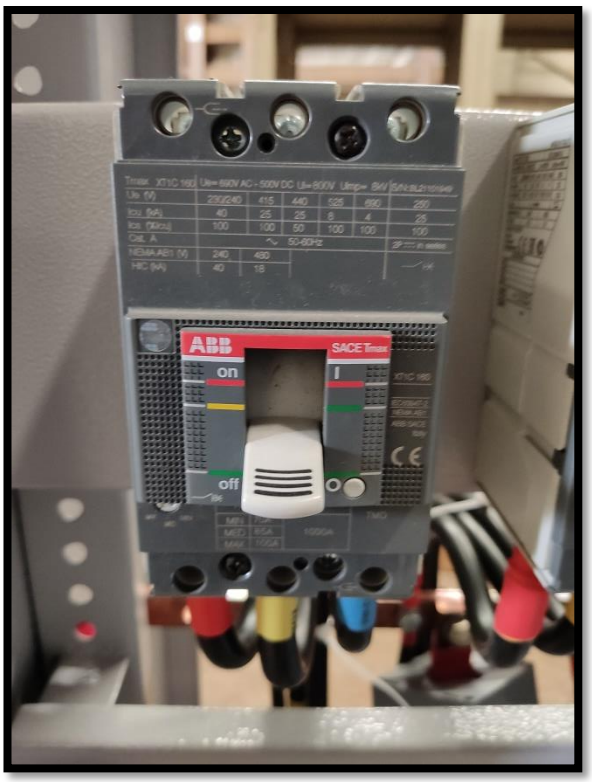

Figure 19: MCCB

4.2.1 Construction of MCCB

1. **Arc chute**: It is a stack of mutually insulated parallel metal plates that used to divide the arc being developed in the molded case circuit breaker. Arc chute material is made up of steel and glass fiber material.

2. **Moving Contact**: An electrolyzed brass material is used as a moving contact. The material of construction of the moving contact should be high arc resistance, corrosion resistance, low resistivity etc. The material of construction decides the life span of the MCCB.

3. **Operating mechanism**: It deals with the contact opening and closing process. The speed of the operating mechanism does not depend on how fast the handle is moved. It is called a quick make and quick break. It will be associated with the relay operating mechanism.

4. **Base cover**: A closed assembly of glass-fiber reinforced thermoset polymer material primarily used as a base cover of the molded case circuit breaker. It gives better mechanical strength. All the parts of the MCCB will be mounting inside of these covers.

5. **Terminal Connector**: The terminal connector is a bolt assembly, made up of steel material. It is used to connect the external circuit with the MCCB.

6. **Overload trip/ bimetallic contact:** The bimetallic contact is a temperature-sensitive component made of steel and copper material. In series with the line current, a bimetallic contact is built. As a result, the breaker's full line current will always travel via the bimetallic contact. It is used to trip the breaker in the event of an overload.

7. **Handle knob**: It is used to close or open the contact manually. Also, you cannot force to stop the breaker tripping by holding knob at the top side. It is called a free trip. Handle knob indicates the breaker status, whether it is in ON position or OFF position. If the handle is in the upward direction, it is called ON position, if it is in the downward position, the same called off position. If it is tripped, then the handle would be in the center position.

8. **Manual trip button**: A red color button that is associated with the operating mechanism is called a manual trip button. It is mainly used to trip the breaker manually for testing purposes.

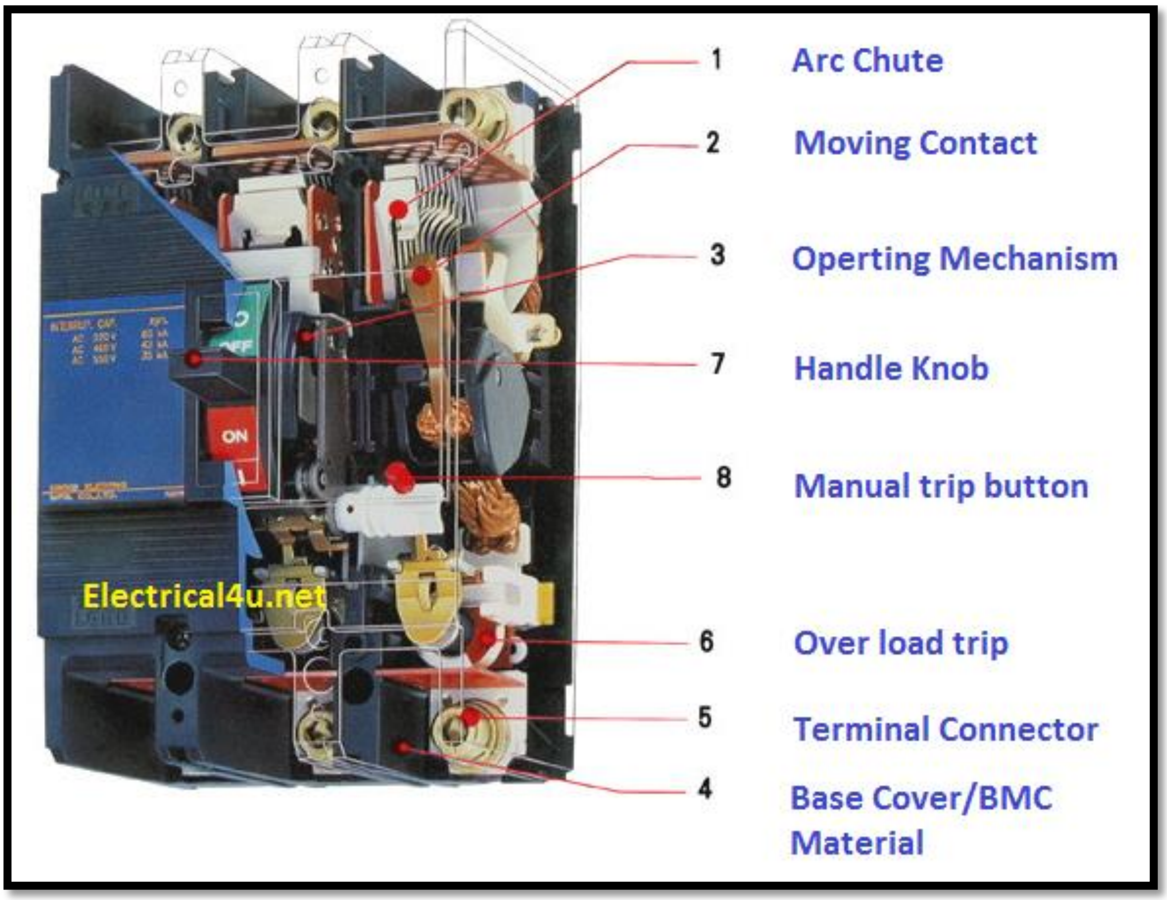

Figure 20: Construction of MCCB

4.2.2 Overload Protection

Overload protection is provided by the MCCB via the temperature sensitive component. This component is essentially a bimetallic contact: a contact which consists of two metals that expand at different rates when exposed to high temperature. During the normal operating conditions, the bimetallic contact will allow the electric current to flow through the MCCB. When the current exceeds the trip value, the bimetallic contact will start to heat and bend away due to the different thermal rate of heat expansion within the contact. Eventually, the contact will bend to the point of physically pushing the trip bar and unlatching the contacts, causing the circuit to be interrupted.

The thermal protection of the MCCB will typically have a time delay to allow a short duration of overcurrent which is commonly seen in some device operations, such as inrush currents seen when starting motors. This time delay allows the circuit to continue to operate in these circumstances without tripping the MCCB.

4.2.3 Electrical Fault Protection against short circuit currents

MCCBs provide an instantaneous response to a short circuit fault, based on the principle of electromagnetism. The MCCB contains a solenoid coil which generates a small electromagnetic field when current passes through the MCCB. During normal operation, the electromagnetic field generated by the solenoid coil is negligible. However, when a short circuit fault occurs in the circuit, a large current begins to flow through the solenoid and, as a result, a strong electromagnetic field is established which attracts the trip bar and opens the contacts.

4.2.4 Electrical Switch for disconnection

In addition to tripping mechanisms, MCCBs can also be used as manual disconnection switches in case of emergency or maintenance operations. An arc can be created when the contact opens. To combat this, MCCBs have internal arc dissipation mechanisms to quench the arc.

4.2.5 Advantages of MCCB

- High security
- Both low and high breaking capacity.
- Max rated current 1600A.
- Interrupting current ranges around 10KA-85KA.
- Mainly uses in industrial.

4.3 Vacuum Circuit Breaker (VCB)

A vacuum circuit breaker is such kind of circuit breaker where the arc quenching takes place in vacuum.

The operation of opening and closing of current carrying contacts and associated arc interruption take place in a vacuum chamber in the breaker which is called vacuum interrupter.

- Suitable for mainly medium voltage application.
- Vacuum technology for higher voltage has been developed, however it is not commercially viable.

Figure 21: VCB

4.3.1 The construction of VCB

Construction VCB is mainly divided into three parts:

- Fixed contacts
- Moving contact
- Arc shield which is placed inside the arc interrupting chamber.

The outer envelope of vacuum circuit breaker is made up of glass because the glass envelope helps in the examination of the breaker from outside after the operation. If the glass becomes milky from its original finish of silvery mirror, then it indicates that the breaker is losing vacuum.

The fixed and moving contacts of the breaker are placed inside the arc shield. The pressure in a vacuum interrupter at the time of sealing off is kept at about 10^{-6} torr. The moving contacts of the circuit breaker are move through a distance of 5 to 10 mm depending upon the operating voltage.

The metallic bellows made of stainless steel is used to move the moving contacts. The design of the metallic bellows is very important because the life of the vacuum circuit breaker depends on the ability of the component to perform repeated operations satisfactorily.

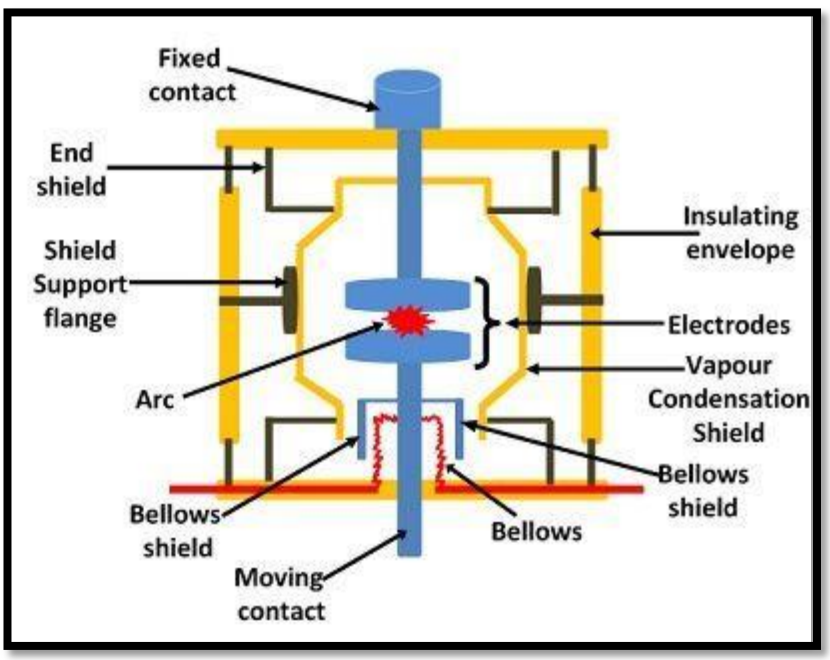

Figure 22: construction of VCB

4.3.2 Working Vacuum Circuit Breaker

When the fault occurs in the system, the contacts of the breaker are moved apart and hence the arc is developed between them. When the current carrying contacts are pulled apart, the temperature of their connecting parts is very high due to which ionization occurs. Due to the ionization, the contact space is filled with vapor of positive ions which is discharged from the contact material.

The density of vapor depends on the current in the arcing. Due to the decreasing mode of current wave their rate of release of vapor fall and after the current zero, the medium regains its dielectric strength provided vapor density around the contacts reduced. Hence, the arc does not restrike again because the metal vapor is quickly removed from the contact zone.

4.3.3 Advantages of Vacuum Circuit Breaker or VCB

- Service life of vacuum circuit breaker is much longer than other types of circuit breakers.
- Vacuum circuit breaker does not require any additional filling of oil or gas. They do not need periodic refilling.
- There is no chance of fire hazard like oil circuit breaker. It is much environment friendly than SF_6 Circuit breaker.
- Replacement of vacuum interrupter (VI) is much convenient.
- After proper contact separation, rapid recovery of high dielectric strength on current interruptions occurs with only a half cycle or less arcing.
- Breaker unit is compact and self-contained. It can be installed in any required orientation.

Chapter Five
Internship Summary

4.1 Experience

Overall, I had a good internship experience. Experience has taught me more than I could have expected throughout my internship. I had no idea where my career was headed when I started this, and I was unsure of what I could do and what I was truly good at.

My internship has helped me have a better understanding of my skill set and where I might go in my career, but most significantly, it has shown me that I am not alone. This job has taught me that nearly everyone is in a position similar to mine.

Despite the challenging environment at Experience, it has taught me how to conduct you in the workplace. Working at the workplace and getting used to everything has definitely prepared me for whatever position I put myself in next. Simply observing daily happenings has taught me more about collaboration and how people can work together to accomplish goals.

4.2 Limitations of work

Hardware development cannot be achieved all the time because there is always a mechanical system functioning, and only a few times has there been a problem if inappropriate work has been done unexpectedly.

We can't collect some internal data due of their internal & external systems, such as if they publish the data for everyone, then the government rules will be broken, which is why every firm or organization have some regulations, else it won't be possible to run effectively.

We are unable to properly and effectively watch some equipment in a restricted area since a sub-station is a very dangerous and restricted place for high voltage electricity, which is extremely harmful for inexperienced people and the general public.

Figure 23: Testing the power transformer with high voltage.

4.3 Conclusion

I can say that completing an assignment at the facility has taught me a lot of things that we used to just learn from books. So, before entering the real world, I required this hands-on experience to expand my understanding of power engineering.

There are a lot of things I didn't know until I went through this practical part at the end of my graduation. Among other things, I learned about control panel batteries, jacket water circuits, alternator winding temperatures, alternator bearing temperatures, and so on. Seeing the numbers on VCB's screen taught me how to measure them. Here, the values of the voltage, current and temperature frequently change. So we have to note down the numbers or values after every one hour. This numbers show us that whether the machines are working well or not.

If the government provides and should be required to provide substation training in order to build knowledge and practical skills with high performance, an engineering student will learn more than just theory.

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