

REPORT ON 10 DAYS INTERNSHIP IN MADHIRA SUB-STATION

Submitted in partial fulfilment of the requirements for the completion of

PROFESSIONAL TRAINING

By

Nithin Gade (Reg. No. 41140023)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

SCHOOL OF ELECTRICAL AND ELECTRONICS

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade “A++” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600119

OCTOBER 2023

**DEPARTMENT OF ELECTRICAL AND
ELECTRONICS ENGINEERING**

BONAFIDE CERTIFICATE

This is to certify that this Internship Report submitted for EPICS is the bonafide work of **Nithin Gade (41140023)** who carried out the **SUBSTATION** Internship during the period June 2023.



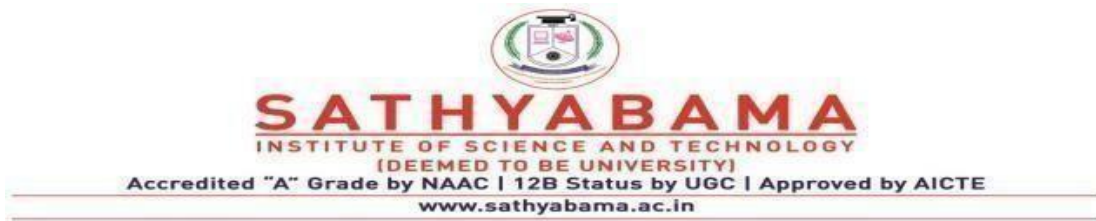
EXTERNAL GUIDE

Dr. C. Bhuvaneswari, M.E., (Ph.D.)



HEAD OF THE DEPARTMENT

Dr. S. Radhika, M.E., (Ph.D.)



ACKNOWLEDGEMENT

I am pleased to acknowledge My sincere thanks to the Board of Management of **SATHYABAMA** for their kind encouragement in doing this Internship project and for completing it successfully. We are grateful to them.

I convey our thanks to **Dr. N. M. Nandhita.**, Dean, School of Electrical and Electronics Engineering and **Dr. S. Radhika**, Head of the Department, Dept.of Electrical and Electronics Engineering for providing us necessary support and details at the right time during the progressive reviews.

We would like to express our sincere and deep sense of gratitude to our Report Guide **Dr. C . Bhuvaneswari** for her valuable guidance, suggestions and constant encouragement paved the way for the successful completion of our project work.

We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of **Electrical and Electronics Engineering** who were helpful in many ways for the completion

TABLE OF CONTENTS

CHAPTER No.	TITLE	PAGE No.
1	INTRODUCTION ABOUT THE COMPANY	1
1.1	Single line diagram	6
1.2	Bus Bar	7
1.3	Insulator	7
1.4	Isolating Switches	7
1.5	Circuit Breaker	8
1.6	Curent Transformer	9
1.7	Transformer	9
1.8	Lightning Arrestors	10
1.9	Power Transformer	11
1.10	Feeder	11
1.11	Capacitor Bank With Reactors	12
2	NATURE OF WORK DONE	15
3	CONCLUSION	16

CHAPTER 1

INTRODUCTION ABOUT THE COMPANY

The present day electrical power system is A.C. i.e. electric power is generated transmitted and distributed in the form of alternating current. It is delivered to the consumers through a large network of transmission and distribution. At many places in the line of the power system it may be desirable and necessary to change some characteristic of electric supply

This is accomplished by suitable apparatus call sub-station for example, generation voltage(11KV or 6.6KV) at the power station is stepped up to high voltage(say 132KV or 220KV) for transmission of electric power. The assembly of apparatus used for this purpose is the sub-station. Similarly near the consumers localities the voltage may have to stepped down to utilization level. This job is again accomplished by a suitable apparatus called “substation”

1.1 SINGLE LINE DIAGRAM

A single line diagram (SLD) of an electrical system is the line diagram of concerned

Electrical system which includes all the required electrical equipment connection sequence wise from the point of entrance of power up to the end of the scope of the mentioned work as in the case of 132KV substation, the SLD shall show lightening arrestors and circuit breakers, main power transformer, all protective devices/relays and other special equipment like CVT, GUARD RINGS, etc as per design criteria. And the symbols are shown below. There are several feeders enter into the substation and carrying out the power as these feeders enter the station they are to pass through various instruments.

1.2 Busbar :-

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.

1.2.1 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

1.2.1.1 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 high current 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.

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, Sulphur Hexafluoride (SF6) or vacuum.

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

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 faction 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 ampsto1amp. This is done because we have no instrument for measuring of such a large current. The main use of his transformer is-

(a)

Distance protection;

(b)

Backup

protection;

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

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 it 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 to protect the insulation of the system from the damaging effect of lightning. Metal Oxide varistor (MOVs) have been used for power system protection since the mid 70s. The typical lightning arrestor is also known as a surge arrestor. It 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 them from lightning i.e. from high voltage entering into them. 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.

POWER TRANSFORMER

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 25MVA

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 in gross 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 in gross 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 stores hed. 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 in gress into oil. The transformers are received on site with loose accessories hence the materials should be checked as per bills of materials.

FEEDER

In the context of electrical power distribution, a "feeder" refers to a conductor or a group of conductors that carry electrical energy from a substation or a distribution point to consumers. Feeders play a crucial role in the distribution of electricity from the higher-voltage transmission system to lower-voltage distribution networks and ultimately to homes, businesses, and industrial facilities. Here are some key points about feeders:

Purpose: Feeders are an essential part of the electrical grid. Their purpose is to transport electricity efficiently from the substation to various points in a distribution network, where it can be further distributed to end-users.

Voltage Levels: Feeders typically operate at medium voltage levels, which can vary depending on the specific distribution system and regional standards. Common feeder voltage levels include 11kV, 22kV, and 33kV.

Distribution Network: Feeders are part of the distribution network, which comes after the high-voltage transmission network. Distribution networks are responsible for delivering electricity to homes, businesses, and other consumers.

Types of Feeders: There are different types of feeders, including radial feeders and ring feeders. Radial feeders have a single source (substation) and distribute power in a one-way flow to consumers. Ring feeders have multiple sources and can provide redundancy and reliability in case of a fault

CAPACITOR BANK WITH REACTORS

Capacitor banks with reactors are commonly used in 132/33kV substations and other electrical distribution systems to improve power factor and voltage regulation. Here's an overview of the purpose and benefits of using capacitor banks with reactors in such substations:

Capacitor Banks:

Power Factor Correction: Capacitor banks are installed in substations to correct the power factor of the system. Power factor is a measure of how effectively electrical power is converted into useful work output. A low power factor indicates that a significant portion of the electrical power is being wasted, which can result in higher losses and reduced efficiency. Capacitor banks help improve the power factor by supplying reactive power to offset the lagging reactive power (inductive load) in the system. This improves the overall efficiency of the electrical distribution system.

Voltage Support: Capacitor banks can also provide voltage support by injecting reactive power into the system when needed. This helps maintain voltage levels within acceptable limits, especially during periods of high demand or when there are voltage drops in the system.

Reduction in Line Losses: Improved power factor through the use of capacitor banks can lead to reduced line losses, resulting in cost savings and increased energy efficiency.

. Reactors:

Voltage Regulation: Reactors, specifically shunt reactors, are used to control voltage levels in the substation and distribution network. They absorb excess reactive power when the voltage is too high, thus preventing overvoltage conditions. This is particularly important in areas with varying load profiles and intermittent power generation.

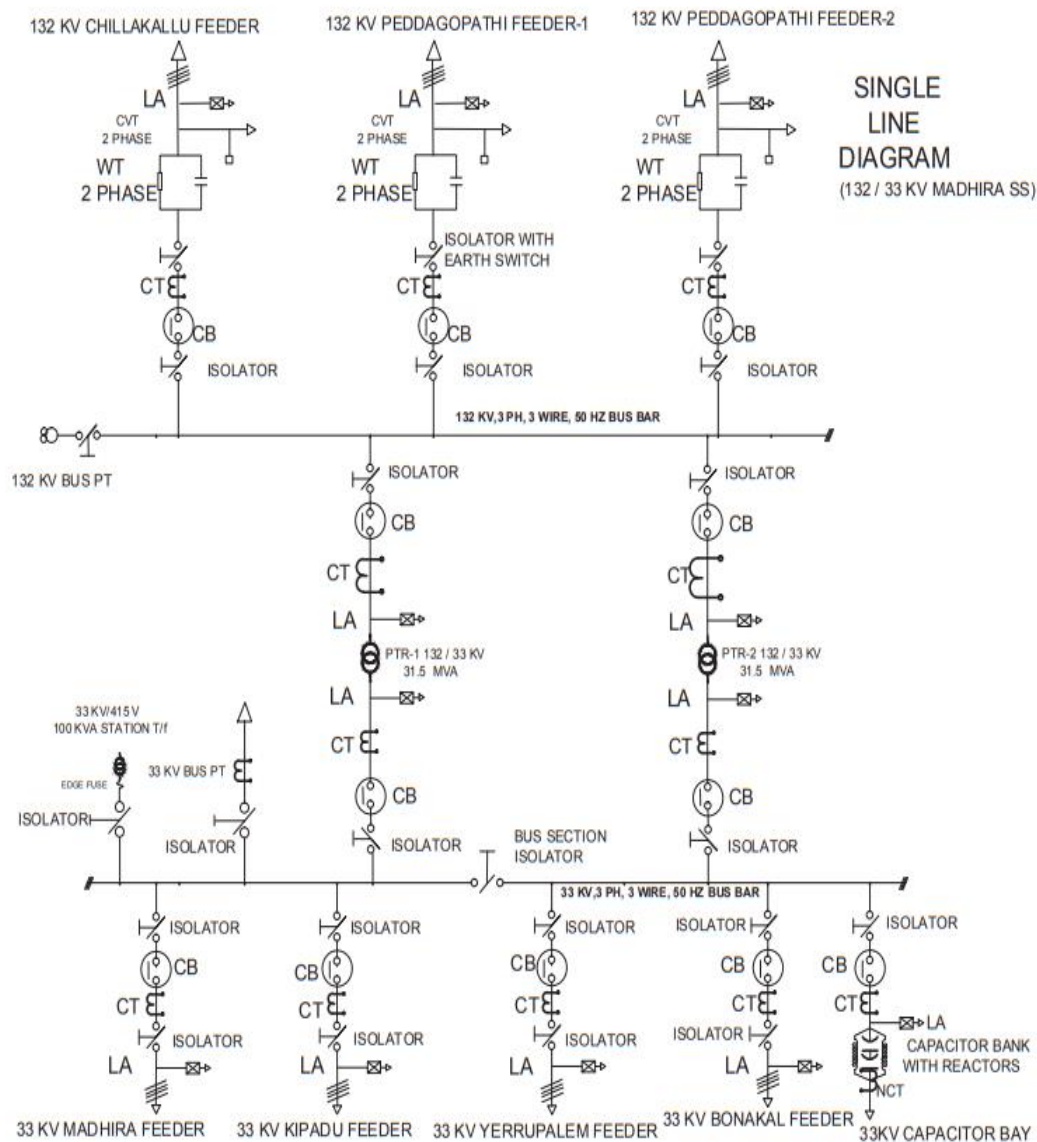
Limiting Inrush Currents: Reactors are also used to limit inrush currents during the energization of transformers and capacitor banks. Inrush currents can be extremely high when transformers are switched on, potentially causing equipment damage or tripping protective relays. Reactors help mitigate these high inrush currents.

Combined Use:

The combined use of capacitor banks and reactors in substations allows for better control of reactive power and voltage levels. This is especially important in 132/33kV substations where voltage regulation and power factor correction are crucial for maintaining the reliability and efficiency of the electrical distribution system.

It's important to note that the selection, sizing, and configuration of capacitor banks and reactors in a substation depend on various factors, including the specific requirements of the distribution network, load characteristics, and the local operating conditions. Proper design and coordination of these components are essential to

ensure optimal performance and reliability in the substation. Additionally, safety measures and protective devices are put in place to prevent overvoltage or overcurrent conditions in the event of capacitor bank or reactor failure



CHAPTER 2

NATURE OF WORK DONE

Substations are critical components of electrical power systems, and they play a pivotal role in the generation, transmission, and distribution of electricity. The nature of work done in a substation is diverse and encompasses a wide range of activities. Here are the primary tasks and responsibilities associated with substations

Voltage Transformation:* Substations are responsible for stepping up or stepping down the voltage of electricity as it moves through the power grid. This transformation is essential to efficiently transmit electricity over long distances and to distribute it at the appropriate voltage levels to consumers.

Switching and Control:* Substations have switches, circuit breakers, and isolators that allow operators to control the flow of electricity and isolate specific sections of the grid when necessary for maintenance or fault isolation.

Protection and Relaying:* Substations are equipped with protective relays that monitor the electrical parameters and respond to abnormal conditions, such as overcurrents or voltage surges. These relays trigger circuit breakers to isolate faults and prevent damage to equipment.

Monitoring and Control: Many modern substations are equipped with Supervisory Control and Data Acquisition (SCADA) systems that enable remote monitoring and control of various components within the substation. Operators can monitor parameters like voltage, current, and temperature and make adjustments to ensure grid stability.

Maintenance and Inspection:* Regular maintenance activities are essential to ensure the reliable operation of substation equipment. This includes inspections, cleaning, lubrication, and the replacement of worn-out components.

Equipment Testing:* Substations often conduct various tests on equipment to verify their performance and safety. This includes insulation resistance tests, oil testing for transformers, and circuit breaker testing.

Conclusion: A substation is a crucial component of an electrical power system, serving as an intermediary between the high-voltage transmission network and the lower-voltage distribution network. In conclusion, substation plays a vital role in ensuring the reliable and efficient delivery of electrical energy to consumers. Here are some key points to summarize the importance of substations:

In conclusion, substations are the backbone of the electrical power system, enabling the efficient and reliable supply of electricity to meet the needs of society. Their continued development and integration with emerging technologies are essential for a sustainable and resilient energy future.