**Internship**

Internship is a job training offered by an organization to give students exposure to the working environment & technologies. It is the most effective way for students to gain work experience before graduation. It presents a direct & practical experience to the students outside of the normal classroom setting. Here students sharpen their skills & gain practical proficiency.

The main purpose of internship program is to get the students exposed to the job market. It offers a chance to the stydents to relate their theoretical knowledge to the real world

PRINCIPAL
SHRIDEVI INSTITUTE OF
ENGINEERING AND TECHNOLOGY
TUMKUR - 572106.

| | |
|---|---|
| | **(h)** Seminar: Deliverable at the Institution under the supervision of a Faculty.<br>**(i)** Internship: Preferably at an industry/R and D organization/IT company/Government organization or elsewhere of significant repute for a specified period as mentioned in Scheme of Teaching and Examinations.<br>**(j)** Mandatory Courses (MC): These Courses are mandatory, without the benefit of a grade or credit, for students admitted to B.E./B.Tech. Programme. A pass in each mandatory Course is required to qualify for the award of degree. |
| **18OB3.2** | The minimum number of students registered to any Elective Course offered by the Departments shall be not less than ten.<br>However, the above condition shall not be applicable to Programmes having class strength of less than 10. In such cases, only one elective course shall be offered. |
| **18OB3.3** | A student shall exercise his option in respect of Elective Course/s and registered for the same at the beginning of the concerned semester. The student may be permitted to opt for a change of Elective Course/s within 15 days from the date of commencement of the semester as per the calendar of the University. |
| **18OB3.4** | **Course Registration:**<br>In order to maintain proper academic record of each student at the Institution, every student shall register for the Courses of a semester (Credits) under the supervision of a Faculty Advisor (also called Mentor, Counselor, etc.,) in each semester. |
| **18OB4.0** | **Internship/Professional Practice** |
| **18OB4.1** | Internship / Professional Practice<br>The Internship shall be completed during the period specified in the Scheme of Teaching and Examinations.<br>**1)** The internship shall preferably be at an industry/R and D organization/IT company/ Government organization of significant repute for a specified period as mentioned in Scheme of Teaching and Examinations.<br>**2)** The Department/college shall nominate staff member/s to facilitate, Guide and supervise students under internship.<br>**3)** The students shall report progress of the internship to the Guide in regular intervals and seek his/her advice. The Guide shall maintain the progress record of the candidates undergoing internship.<br>**4)** After the completion of Internship, students shall submit a report with completion certificate and attendance certificate to the Head of the Department with the approval of both internal and external Guides.<br>**5)** There shall be 40 marks for CIE and 60 marks for SEE. The minimum requirement of CIE marks shall be 50% of the maximum marks.<br>**6)** The internal Guide shall be the internal examiner for the SEE.<br>**7)** The external Guide for Internship shall be the external examiner for SEE. Examination for internship shall be conducted at the college and the date shall be fixed in consultation with the external Guide. The Examiners shall jointly award the SEE marks. [To be read along with 18OB8.9 (f)]<br>**8)** In case the external Guide expresses his inability to conduct the Examination, the Principal /Chief Superintendent of the Institute shall appoint a senior faculty of the Department to conduct the Examination along with the internal Guide.<br>**9)** Non-availability of Internal guide due to inevitable situations for the conduct of SEE, the Principal /Chief Superintendent of respective institute shall appoint a senior faculty of the Department to conduct the Examination.<br>**10)** The students are permitted to carry out the internship anywhere in India or abroad. The University will not provide any kind of financial assistance to any student for carrying out the Internship. |
| **18OB 5.0** | **Technical Seminar and Project** |
| **18OB 5.1** | **Technical Seminar:** Technical Seminar is one of the head of passing.<br>**(i)** Each candidate shall deliver Technical seminar as per the Scheme of Teaching and Examinations on the topic chosen from the relevant field.<br>**(ii)** The Head of the Department shall make arrangements for the conduct of seminars |

| | |
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| | (c) For Practical/ Mini-project/Internship/Project work– Phase 2 the maximum CIE marks shall be 40. To appear for the SEE, the minimum CIE marks to be secured shall be 50 % of the maximum marks i.e., 20 marks.<br>**(d)** For all other theory Courses of the Programme, the maximum CIE marks shall be 40. To appear for the SEE, the minimum CIE marks to be secured shall be 40 % of the maximum marks i.e., 16 marks.<br>**(f)** For Additional Mathematics I and II (to be completed by diploma lateral entry students) the maximum CIE marks shall be 40. To appear for the SEE, the minimum CIE marks to be secured shall be 40 % of the maximum marks i.e., 16 marks.<br>**(g)** For Engineering Graphics and Elements of Civil Engineering and Mechanics (of First Year Engineering and to be completed by B.Sc graduates under lateral entry) the maximum CIE marks shall be 40. To appear for the SEE, the minimum CIE marks to be secured shall be respectively 50 % and 40 % of the maximum marks i.e., 20 and 16 marks. |
| **18OB8.2** | **Continuous Internal Evaluation Procedure:** [To be read along with 18 OB 8.1and 8.3]<br>**(a) Theory Courses:**<br>**(i)** CIE Marks in each theory Course [including 'Technical English I and II', 'Constitution of India, Professional Ethics and, Cyber Law', 'Environmental Studies', 'Additional Mathematics I and II'], shall be the sum of marks prescribed for tests and assignments. Marks prescribed for tests shall be 30 and that for assignments 10.<br>**(ii)** The CIE marks awarded for tests in the theory Courses shall be based on three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.<br>**(iii)** The remaining 10 marks shall be awarded based on the evaluation of assignments/unit tests/written quizzes that support to cover both lower and higher order thinking skills as per Revised Bloom's Taxonomy.<br>**(iv)** Final CIE marks awarded shall be the sum of 18OB8.2 (a) (ii) and (iii) for a maximum of 40 marks.<br>**(v)** The candidates shall write the tests, assignments/unit-tests /written quizzes in Blue Books which shall be preserved by the Principal/ Head of the Department for at least six months after the announcement of University results and shall be made available for verification at the direction of the Registrar (Evaluation).<br>**(b) Engineering Graphics/ Drawing/Field work Courses:**<br>The CIE marks awarded for I year Engineering Graphics Course shall be based on<br>**(i)** Classwork for 24 marks (sketching and Computer Aided Engineering Drawing).<br>**(ii)** Two Tests conducted in the same pattern as that of SEE for 16 marks (The marks secured can be taken as best of the two tests).<br>**(iii)** Final CIE marks awarded for Engineering Graphics shall be the sum of 18OB8.2 (b) (i) and (ii) for a maximum of 40 marks.<br>**(iv)** The CIE marks awarded for higher semester Drawings/ Design Drawings offered by various branches shall be based on the evaluation of the sheets and one test in the ratio 60:40.<br>**(v)** The CIE marks awarded for field work (like Surveying Practice) shall be based on the evaluation of the associated field work and one test in the ratio 60:40.<br>**(c) Practical Courses:**<br>The CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and one practical test in the ratio 60:40.<br>**(d) Internship:**<br>The CIE marks awarded for internship shall be based on the evaluation of Internship Report, Presentation skill and Question and Answer session in the ratio 50:25:25.<br>**(e) Technical Seminar:**<br>The CIE marks awarded for Technical Seminar shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.<br>**(f) Mini – Project:** |

REGISTRAR
Visvesvaraya Technological University
BELAGAVI - 590 018.

| | |
|---|---|
| | The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.<br>**(g) Main Project Work:**<br>**(i)** Project Work Phase – 1<br>The CIE marks awarded for project work phase -1 shall be based on the evaluation of project work phase -1 Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.<br>**(ii)** Project Work Phase - 2<br>The CIE marks awarded for project work phase -2 shall be based on the evaluation of project work phase -2 Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Project report shall be the same for all the batch mates. |
| | **(h) Vyavaharika Kannada (Balake Kannada)/Aadalitha Kannada** (Samskruthika **Kannada)**<br>**(i)** CIE Marks in Vyavaharika Kannada (Balake Kannada)/Aadalitha Kannada (Samskruthika Kannada) shall be the sum of marks prescribed for tests and assignments. Marks prescribed for tests shall be 75 and that for the assignments shall be 25.<br>**(ii)**The CIE marks awarded for the tests shall be based on three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 25 marks and the final CIE marks shall be the sum of the marks of all the three tests.<br>**(iii)** The remaining 25 marks shall be awarded based on the evaluation of assignments/oral discussions/ quizzes that supports communication skills.<br>**(iv)** Final marks awarded shall be the sum of 18OB8.2 (h) (ii) and (iii) for a maximum of 100 marks.<br>**(v)** Students shall write the tests in Blue Books and complete the exercises/activates/ questions given in the University Kannada textbook. These shall be preserved by the Principal/ Head of the Department for at least six months after the announcement of University results and shall be made available for verification at the direction of the Registrar (Evaluation). |
| **18OB8.3** | **(a)** The CIE marks in the case of Internship/Technical Seminar/Mini-Project and Project Work Phase 1 and 2 shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.<br>**(b)** A committee constituted by the Head of the Department of Humanities and Social Science shall inspect and authenticate the award the CIE marks for the Course Vyavaharika Kannada (Balake Kannada)/Aadalitha Kannada (Samskruthika Kannada). The committee shall consist of two senior faculty members of the Department and the senior most acting as the Chairperson. |
| **18OB8.4** | **(i)** Students satisfying the attendance requirement but failing to secure the minimum percentage of CIE marks, in any Course/s, shall not be eligible for the SEE conducted by the University and they shall be considered as fail in that Course /those Courses. However, they can appear for University examinations conducted in other Courses of the same semester and backlog Course/s if any.<br>**(ii)** Students who have satisfied the attendance requirement but not the CIE requirements shall be permitted to register afresh and appear for SEE after satisfying the CIE requirements in the same Course/s (with or without satisfying the attendance requirement) when offered during subsequent semester/s.<br>**(iii)** Each appearance to SEE to complete a course shall be treated as an attempt. |
| **18OB8.5** | CIE marks of those students, who come under 18OB8.4, shall also be sent to the Registrar (Evaluation) along with other course CIE Marks. |

**SHRIDEVI INSTITUTE OF ENGINEERING & TECHNOLOGY, TUMKUR -06**

**DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING**

2021 - 22

**8th Semester Internship Details**

| Sl No | USN | Name of the Student | Internship Topics |
|---|---|---|---|
| 1 | 1SV17EE006 | Netravathi S.M | Study of protections systems of 220KV substation |
| 2 | 1SV17EE012 | Supriya. A | Testing of transformer |
| 3 | 1SV18EE002 | Amoghavarsha M | Substation and its maintenance |
| 4 | 1SV18EE003 | Gavisiddapp A | Energy meter |
| 5 | 1SV18EE004 | Mohammed Fakruddin | Study of protection system of 220KV substation |
| 6 | 1SV18EE005 | Mohammed Luqmaan | SCADA |
| 7 | 1SV18EE006 | Nethrananda K N | Basic types of meters and metering |
| 8 | 1SV18EE007 | Preetham M | Manufacturing and testing of current and potential transformer |
| 9 | 1SV18EE008 | Rakesh S | Study of $SF_6$ circuit breaker |
| 10 | 1SV18EE009 | S Don Benin Joses | Static relay. |
| 11 | 1SV18EE011 | Shobhashree S | Study of protection system of 220KV substation |
| 12 | 1SV18EE012 | Subin S John | Substation and its maintenance |
| 13 | 1SV19EE400 | Meghana. T. C | Energy meter |
| 14 | 1SV19EE401 | Ravi Babu. M | Study of protection system of 220KV substation |
| 15 | 1SV19EE402 | Rudresh. B. J | Embedded systems and IoT |
| 16 | 1SV19EE403 | Sharath. H. M | Aurdino Programming |
| 17 | 1SV19EE404 | Tejamrutha Binndu N. Y | Study of metering equipments in 220KV substation |
| 18 | 1SV19EE405 | Vijaya. M. S | Study of transformer indicator at 220KV substation |

G. H. Rao

**HoD**

**EEE Dept**

Head of the Department
Electrical & Electronics Engineering
Shridevi Institute of Engineering & Technology
TUMKUR-572106.

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA, BELGAVI - 590014

AN INTERNSHIP REPORT ON

## "LIGHTNING ARRESTERS"

BACHELOR OF ENGINEERING

IN

**ELECTRICAL & ELECTRONICS ENGINEERING**

Submitted by

**MEGHANA G S (1SV18EE401)**

***Under the guidance of***

**Mrs. SHWETA.T.M** M. Tech, MISTE

Asst Profesor

Dept. Of E&EE, SIET- TUMKUR

SHRIDEVI

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An ISO 9001:2015 Certified Institution

**Department of Electrical & Electronics Engineering**

**SHRIDEVI INSTITUTE OF ENGINEERING AND TECHNOLOGY**

(An ISO 9001 – 2008 certified Institution)

**SIRA ROAD, TUMKUR-572106**

**2021-22**

SHRIDEVI INSTITUTE OF ENGINEERING AND TECHNOLOGY
TUMKURU-572106

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SHRIDEVI
EDUCATION

# CERTIFICATE

This is to certify that the internship carried out in "SANTHEMAVATHUR 66/11 KV SUBSTATION KUNIGAL, TUMKUR DISTRICT", Tumkur by **MEGHANA G S[1SV17EE401]** basified student of **Shridevi Institute of Engineering and Technology** in partial fulfilment for the award of degree **Bachelor of Engineering** in **Electrical & Electronics** of the **Visvesvaraya Technological University,** during the year **2021-2022.** It is certified that any corrections/suggestions indicated in the Internal Assessment, have been incorporated in the report. The internship has been approved, as it satisfies the academic requirements in respect of internship prescribed for the said degree.

| | | |
|---|---|---|
| Shwetha T.M. | G. H. Ravi Kumar | Narendra Vishwanath |
| **Mrs. Shwetha. T.M** | **Mr. G. H. Ravi Kumar** | **Dr. NarendraVishwanath** |
| Asst Professor | H.O.D. | M.E, Ph.D., |
| Dept. of E&EE | Dept. of E&EE | Principal, SIET |

**External Viva**

| **Name of the Examiners:** | **Signature with date** |
|---|---|
| 1. Tanuja K.S | Tanuja K.S 25/7/22 |
| 2. Chabai | Chabai 25/7/22 |

# KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

Office of the
Assistant Engineer (Ele)
66/11kV Sub-Station
KPTCL, Santhemavathuru

## TO WHOMSOEVER IT MAY CONCERN

This is to certify that, **Ms. MEGHANA G S** bearing **USN: 1SV18EE401** studying B.E (E&E) from **SHRIDEVI INSTITUTE OF ENGINEERING AND TECHNOLOGY** has visited 66/11Kv Santhemavathuru Sub-Station from **15/09/2021** to **15/10/2021.**

During the visit to the above sub-station, equipment details, practical aspects of "operation & maintenance of sub-station" was briefed the sub-station Engineers.

DATE: 16/10/2021
PLACE: Santhemavathuru

ಸಹಾಯಕ ಇಂಜಿನಿಯರ್ (ವಿ)
66/11 ಕೆ.ವಿ. ವಿದ್ಯುತ್ ಉಪಕೇಂದ್ರ
ಸಂತೆಮಾವತ್ತೂರು

# ACKNOWLDGEMENT

"Experience is the best teacher", but an experience is fulfilled only when there is hard work, good support and co-operation. It is always wise to appreciate such people who have helped me to complete this internship seminar successfully.

I take it as a privilege to express through this page of the report a few words of cordial gratitude and respect to all those who guided and inspired me at every step towards the completion of this seminar.

I am thankful to **DR.NARENDRA VISHWANATH** Principal, Shridevi institute of Engineering and Technology Tumakuru for his support and co-operation during the course of this seminar work.

I would like to convey heart full thanks to **Mrs. SHWETA. T. M.** **M.Tech, MISTE,** Asst. proff., Dept of EEE, Shridevi institute of engineering and Technology, for guiding me at each step and providing valuable information which helped me to complete this report. I also thank all the faculty and staff of the department of Electrical and Electronics Engineering for their support and encouragement.

Last but not the least my heart full thanks to parents, family members and friends who encouraged and give moral support throughout the course of study

Meghana

.....

**Signature of Student**

**MEGHANA.G.S**

**(1SV18EE401)**

# UNDERTAKING

**I, MEGHANA G S (1SV18EE401),** student of VIII semester, **BACHELOR OF ENGINEERING IN ELECTRICAL AND ELECTRONICS, SHRIDEVI INSTITUTE OF ENGINEERING AND TECHNOLOGY**, Tumkur , hereby declare that ,this internship work carried out in "SANTHEMAVATHUR 66/11 KV SUBSTATION KUNIGAL, TUMKUR DISTRICT", is an original and bonafide work carried out in partial fulfillment of requirements for the award OF **BACHELOR OF ENGINEERING DEGREE BY THE VISVESVARAYA TECHNOLOGICAL UNIVERSITY,BELAGAVI-590018** during the academic year 2021-2022.

I also declare that to the best of our knowledge and belief, the work reported here in does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion by any students.

Date:
Place: Tumkur

**MEGHANA G S**
**(1SV18EE401)**

# CONTENTS

# LIST OF FIGURES

CHAPTER 1

# ABOUT THE ORGANIZATION
# KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

**Karnataka Power Transmission Corporation Limited**, also known as **KPTCL**, is the sole electricity transmission and distribution company in state of Karnataka Its origin was in Karnataka Electricity Board. This electricity transmission and distribution entity was corporatized to provide efficient and reliable electric power supply to the people of Karnataka state.

## 1.1 Introduction

- Karnataka Power Transmission Corporation Limited is a registered company under the Companies Act, 1956 was incorporated on 28-7-1999 and is a company wholly owned by the Government of Karnataka with an authorized share capital of Rs.2182.32 crores. KPTCL was formed on 1-8-1999 by carving out the Transmission and Distribution functions of Karnataka Electricity Board.
- Karnataka Power Transmission Corporation Limited is mainly vested with the functions of Transmission of power in the entire State of Karnataka and also Construction of Stations & Transmission Lines and maintenance of 400/220/110/66 KV Sub-Stations. Many new lines and Sub-Stations were added & existing stations were modified in the transmission network. It operates under a license issued by Karnataka Electricity Regulatory Commission.
- The various wings of KPTCL is as follows:
  - Corporate Office at Kaveri Bhavan, Bangalore.
  - Six Transmission zones, each zone is headed by a Chief Engineer.
  - State Load Dispatch Centre
  - SCADA(Supervisory Control and Data Acquisition)

- KPTCL has 5 No. of 400 KV Station, 101 No. of 220 KV Station, 413 No. of 110 KV Station and 637 No. of 66 KV Station. The Total Transmission Line in CKMs is 36124 as on31.03.2018.
- The annual turnover of the Organization was nearly Rs.3380 crores during the year2016-17.

## 1.2 History

- The erstwhile Mysore State had the enviable and glorious position of establishing the first major hydro-electric generating station at Shivasamudram as early as 1902 for commercial operation. The art at that time was still in its infancy, even in the advanced countries. The longest transmission line, at the highest voltage in the world, was constructed to meet the power needs of mining operations at Kolar Gold Fields.
- The generating capacity of the Shivasamudram Power House gradually increased to 42 MW in stages. To meet the increasing demand for power, the Shimsha Generating Station, with an installed capacity of 17.2 M. W, was commissioned in the year 1938. The power demand was ever on the increase, for industries and rural electrification, and additions to generating became imperative. The1ststageof 48 MW and 2nd stage of 72 MW of the Mahatma Gandhi Hydro-Electric Station were commissioned during 1948 and 1952, respectively.
- Subsequently, the Bhadra Project, with an installed capacity of 33.2 MW, and the Thungabhadra Left Bank Power House, with an installed capacity of 27 MW at Munirabad were commissioned during 1964 and 1965,respectively.
- The State of Karnataka, with availability of cheap electric power, and other infrastructure facilities, was conducive for increased tempo of industrial activity. It became necessary therefore, to augment power generating capacity by harnessing the entire potential of the Sharavathi Valley. The first unit of 89.1 MW was commissioned in 1964 and completed in1977. The demand for power saw a phenomenal increase in the mid sixties and onwards with the setting up of many public sector and private industries in the State. As power generation in the Sta to its vagaries, the State Government set up a coal based power plant at Raichur. The present installed capacity of the power plant at Raichur is 1260 MWs.

- To augment the energy resources of the State, the Kalinadi Project with an installed capacity of 810MW at Nagjhari Power House and 100 MW at Supa Dam Power House, with an energy potential of 4,112 Mkwh, were setup.
- The transmission and distribution system in the State was under the control of the Government of Karnataka (then Mysore) till the year 1957. In the year 1957, Karnataka Electricity Board was formed and the private distribution companies were amalgamated with Karnataka Electricity Board.
- Till the year 1986, KEB was a profit making organization. However, in the subsequent years, like other State Electricity Boards in the country, KEB also started incurring losses, mainly due to the increase in agricultural consumption and due to the implementation of the economic policies of the Government, the performance of the power sector was affected.
- To improve the performance of the power sector and in tune with the reforms initiated by Government of India, the Government of Karnataka came out with a general policy proposing fundamental and radical reforms in the power sector. Accordingly a bill, namely Karnataka Electricity Reforms Act was passed by the Karnataka Legislature. The Reform bill has mandated major restructuring of the Karnataka Electricity Board and its Corporatization. As part of Corporatization, the Karnataka Electricity Board ceased to exist and the Karnataka Power Transmission Corporation Limited to look after Transmission and Distribution in the State and VVNL (Visweshwaraiah Vidyuth Nigama Limited) to look after the generating stations under the control of erstwhile Karnataka Electricity Board were constituted from 01.08.99.

## 1.3 -Overview

- Government vide order No. 69 BSR 2001 Bangalore, dated 15/02/2002 has unbundled KPTCL and formed four distribution companies
- Consequent to this the function of distribution of power has been totally separated from KPTCL. KPTCL is now vested with the responsibility of transmitting power all over the State and construction and maintenance of Stations and lines of 66KV and above.

| Zone Name | Description |
|---|---|
| MESCOM | Mangalore Electricity Supply Company |
| BESCOM | Bangalore Electricity Supply Company |
| HESCOM | Hubli Electricity Supply Company |
| GESCOM | Gulbarga Electricity Supply Company |
| CESCOM | Chamundeshwari Electricity Supply Corporation |

**Table-1 Zones of distribution**

- The four newly formed independent distribution companies, which were registered on 30/04/2002, are Bangalore Electricity Supply Company, Mangalore Electricity Supply Company, Hubli Electricity Supply Company and Gulbarga Electricity Supply Company. They have started functioning w.e.f.. 01/06/2002. These companies are in charge of distribution of power within their jurisdiction.
- The Fifth Distribution Company Chamundeshwari Electricity Supply Corporation limited is a company incorporated under the company act 1956 and is a successor entity to Karnataka Power Transmission Corporation Limited (KPTCL) and MESCOM in respect of Distribution and retail supply of Electric power for five districts. Its operation started from 01.04.2005 as per the GOK order E.N.08P.N.R 2005/262.
- CKL was incorporated on 20th August, 2007 under the Companies Act, 1956 and commenced its business operations with effect from 16th October, 2007. PCKL is responsible for capacity addition and procuring power on behalf of the ESCOMs from various sources including purchase of power through Energy Exchange,
- Banking (SWAP) as well bilateral transactions. PCKL also coordinates with other States and Central Government agencies on power related issues.
- KPTCL buys power from power generating companies like Karnataka Power Corporation Limited (KPCL) and other IPPs (Independent Power Producers) like GMR, Jindal, Lanco (UPCL) etc., and sell them to their respective ESCOMS.

## 1.4-Mission

- The mission of Karnataka Power Transmission Corporation Limited (KPTCL) is to ensure reliable quality power to its customers at competitive prices. The KPTCL is
- Committed to achieving this mission through:
  - Encouraging Best practices in transmission &distribution.
  - Ensuring high order maintenance of all its technical facilities.
  - Emphasizing the best standards in customer service.
- To be the best electricity utility in the country, the KPTCL pledges to optimize its human and technical resources for the benefit of all its customers.


## 1.5-Vision

- The vision of Karnataka power Transmission Corporation Limited (KPTCL) is to
  - To improve viability and customer standards in the past sector through reforms package.
  - To usher great transparency and accountability in the working of power utilities.
  - Changing environment as part of global movement.
  - To gear itself to be market driven and customer friendly.

## 1.6 - Major Achievements of KPTCL

- Dedication of improved power distribution network in Bijapur.
- Inaugurations of multi circuit transmission lines from Khemar to Guruvaynakere sub-station in Belthangdi Taluk Dakshina Kannada district.
- Launching of E-tendering in KPTCL.
- Inauguration of substation at Kanpur and transmission from RTPS (Raichur Thermal power station) to Gulbarga.
- Laying of foundation stone for power sub-station at Humanabad Taluk, Bidar District.
- Highest ever-thermal generation of 10,292 milliunits.
- Highest wind generation 11.16-milliunit.
- Highest plant load factor of 90.39% (eligible for gold medal) at RTPS.
- Silver medal from central electricity authority for RTPS plant performance, reduction in auxiliary and fuel consumption.

# CHAPTER 2
# ABOUT THE DEPARTMENT

The primary and the foremost responsibility of this department is to fulfill the customers energy demand, provide quality energy through its distribution network and to service customer's various service requirements related to distribution of power.

BESCOM receives its bulk energy requirements through both state and central allocations and through power purchase agreements. The electrical energy is received through transmission network owned by KPTCL. The KPTCL purchases power from KPCL and also from stations like National Thermal Power Corporation owned by central government. The energy so received by KPTCL is distributed to consumers through the distribution network consisting of 11 KV, 400 V and 230 V by overhead and underground lines owned and maintained by BESCOM.

Depending on the geographical locations and constraints, the distribution network can be in the form of either overhead lines or underground cables.

## 2.1-HISTORY:

The transmission and distribution system in the state was under the control of State Government (Mysore) till 1957. It was called as Karnataka Electricity Board (KEB). In subsequent years KEB started incurring losses.

To improve the performance of this power sector Government of India proposed an act, according to that act Karnataka Electricity Reforms Act was passed by Karnataka Legislature. As a part of this KEB was ceased to exit and Karnataka Power Transmission Corporation Limited(KPTCL) was constituted from August1999.

As a part of reforms, the distribution sector is further divided into companies. BESCOM - Bangalore Electricity Supply Company Limited; HESCOM - Hubli Electricity Supply Company Limited; MESCOM - Mangalore Electricity Supply Company Limited; GESCOM - Gulbarga Electricity Supply Company Limited, CESCOM – Chamundeshwari Electricity Supply Company Limited.

## 2.2-BESCOM

Bangalore Electricity Supply Company Limited (BESCOM) has taken over the responsibility from KPTCL for the distribution of electricity in 8 districts. It operates under a license issued by Karnataka Electricity Regulatory Commission (KERC).

Districts, which are serviced by BESCOM:

- Bangalore urban
- Bangalore rural

- Kolar
- Tumkur
- Chitradurga
- Davanagere
- Chikkaballapura

## 2.3-SUBSTATION

Substations transform voltage from high to low, or reverse or perform other functions. Between generating station and consumer electric power flow through several substation at different voltage level. Substation may include transformers to change voltage levels. A substation that has step up transformers increases the voltage while decreasing the current, and step down transformer decreases voltage while increasing current for domestic and commercial distribution.

### SINGLE LINE DIAGRAM

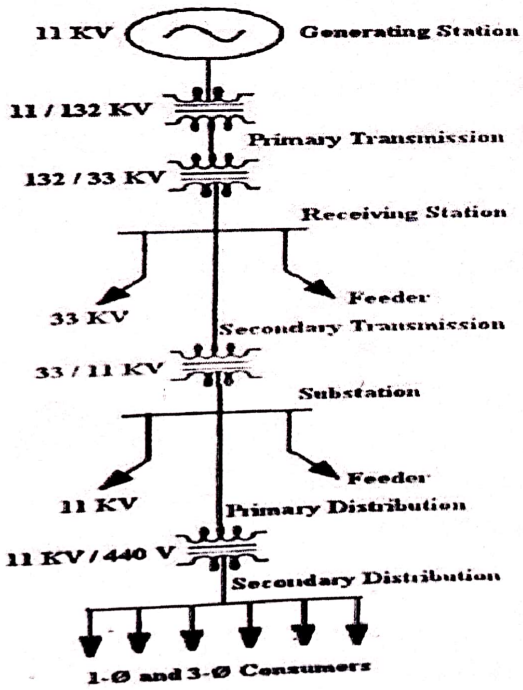



Figure 2.3: SINGLE LINE DIAGRAM OF SANTHEMAVATHUR SUB STATION

# CHAPTER 3

# SUBSTATION VISIT

A Substation is a part of an electrical generation, transmission, and distribution system. Substation transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage level. A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages. The substation has an additional function like they provide points where safety devices may be installed to disconnect equipment or circuit in the event of the fault. Street lighting, as well as the switching control for street lighting, can be installed in a substation.

## 3.1- CLASSIFICATIONS

### 1. On the basis of nature of duty:-

**Step-up or primary sub-station**:- These are the sub- station where form power is transmitted to various load centers in the system network.

**Step-up & step-down or secondary sub-station**:- Sub-station of this type may be located at generating points where from power is fed directly to the loads and balance power generated is transmitted to the network for transmission to other load centers.

**Step-down or distribution sub-station:-** Such sub- station receive power from secondary sub-station at extra high voltage and step down its voltage for secondary distribution.

### 2. On the basis of operating voltage:-

High voltage sub-stations involving voltage between 11KV &66KV.
Extra high voltage substations involving voltages between 132KV & 400KV.
Ultra high voltage sub-station operation on voltage above 400KV.

### 3. On the basis of importance's:-

**Grid sub-station:-** These are the sub-station form where bulk power is transmitted form one point to another point in the grid. These are important because any distribution in these sub-station may cause the failure of grid.

**Town sub-station:-** These sub-station are EHV sub- station, which step down the voltage at 33/11KV for further sub-station results in the failure of supply for whole of the town.

### 4. On the basic of design:-

**In door type sub-station**:-In such substation the apparatus is installed with in the substation

building. Such sub-station are usually for a voltage up to 11 KV but can be erected for the 33KV to 66KV when the surrounding atmosphere is contaminated with impurities such as metal corroding gases and fumes conductive dust etc.

Figure 3.1 (4a): INDOOR TYPE SUBSTATION

**Out door type sub-station**:- These substation are further subdivided into **Pole mounted sub-station:-** such sub- station are erected for distribution of power in localities. Single stout pole H-pole & 4-pole structures with suitable platforms are employed for transformers capacity up to 25KV, 100KVA and 1 KV respectively

Figure 3.1(4b) OUT DOOR TYPE SUBSTATION

**Foundation mounted sub-station:-** For transformer of capacity above 250KVA the transformer are too heavy for pole mounting. Such sub-station are usually for voltage of 33000 V & above.

**Selection and location of site:-**

a) Type of sub-station
b) Available of suitable and sufficient land
c) Communication facility
d) Atmospheric pollution

## 3.2-INTRODUCTION OF SANTHEMAVATHUR STATION (66/11KV)

Figure 3.2: SUBSTATION VIEW OF SANTHEMAVATHURU

This is the 66/11KV Substation at Santhemavathur. Here 66KV, voltage is received from Anchepalya substation 220KV. This voltage stepped down to the 11KV using 12MVA and 8MVA power transformer and this voltage is supplied to the consumer ends. For the protection of switch gear, transformers, associated equipment of 66KV and 11KV lines against large over-voltages/surges, Lightning arrestors/surge arrestors are used in each line. Line isolators or GOS are used to isolate the lines from healthy lines, under maintenance. SF6 circuit breakers are used for protections from damage caused by over current resulting from overload or faults. Current and voltage transforms are used to electrically isolate the high voltage primary circuit from the low voltage secondary circuit and, thus provide a safe means of supply for indicating instruments, meters and relays. In addition, shunt capacitors bank is used for reactive power compensation and power factor correction. This substation consists of 8 outgoing feeders.

## 3.3-SINGLE LINE DIAGRAM OF SANTHEMAVATHUR SUB STATION

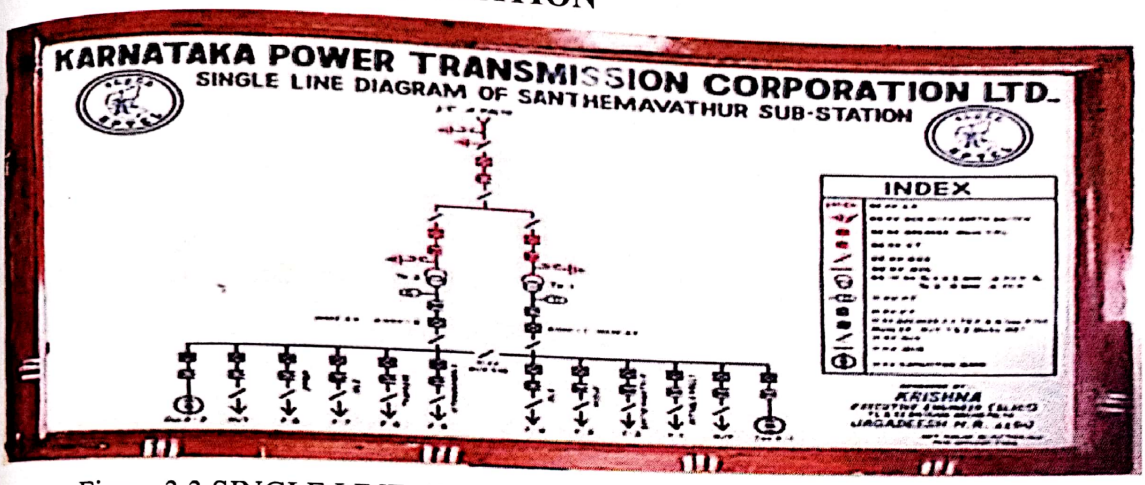



Figure 3.3 SINGLE LINE DIAGRAM OF SANTHEMAVATHUR SUB STATION

## 3.4-CONTROL DESK

Annunciators in electrical substation and generating plants provide immediate visual indication of alarm conditions, accompanied by audible sounds to call attention to the visual information displayed.

Typically, the supervisory control and data acquisition (SCADA) systems that substation and control centers were entirely separated from the annunciators. Applying microprocessors technology to protective relays, SCADA systems, meters, and other intelligent electronic devices enabled new system architectures.

Annunciators in electrical substations provide concise visible and audible notification. An annunciator has a legend area, referred to as an annunciator window that contains a concise text description of a conditions to be alarmed.

An alarm indicator illuminates for the visible indication of the alarm conditions. Different annunciator models use light bulbs or light emitting diodes(LED) as separate indicators or to back light an engraved, translucent window. An audible alarm demands the attention of people near the annunciator. Push buttons allow the audible horn to be silenced and to acknowledge that the operator has observed an alarm.

Figure 3.4 Control desk

## 3.5-SUBSTATION EUIPMENTS AND ITS FUNCTION

### 1. BUS BARS

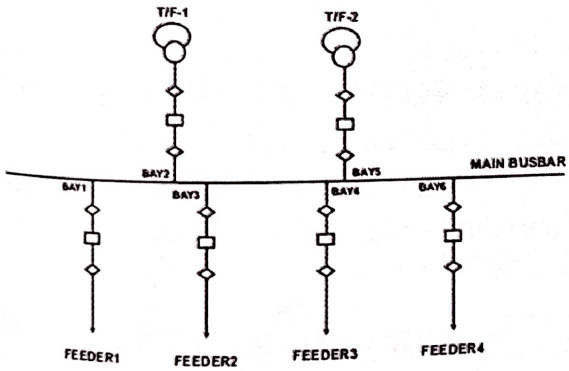
Various incoming and outgoing circuits are connected to bus bars. It receive power from incoming circuits and deliver power to outgoing circuits.

Bus bars are of two types

a] Rigid aluminium tubular bus bars supported on post insulators.

b] Flexible ACSR or all aluminium stranded bus bars supported from two ends by strain insulators.

**SINGLE BUS SYSTEM**




### 2. ISOLATORS (DISCONNECTING SWITCH)

These are used to provide isolation from live parts for the purpose of maintenance. Isolators are located at each side of circuit breakers.

Isolators are of two types;

A] Centre rotating, horizontal swing

B] Centre break, vertical swing

## 3. EARTHING SWITCH

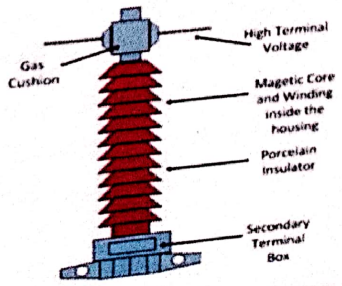
These are used for discharging any induced voltage on the circuit to earth for safety.


## 4. INSTRUMENT TRANSFORMERS

The substations have current and voltage transformers designed to isolate electrically the high voltage primary circuit from the low voltage secondary circuit and, thus, provide a safe means of supply for indicating instruments, meters and relays.

## 5. CURRENT TRANSFORMER

Current transformers are used for stepping down current for measurement, protection and control.



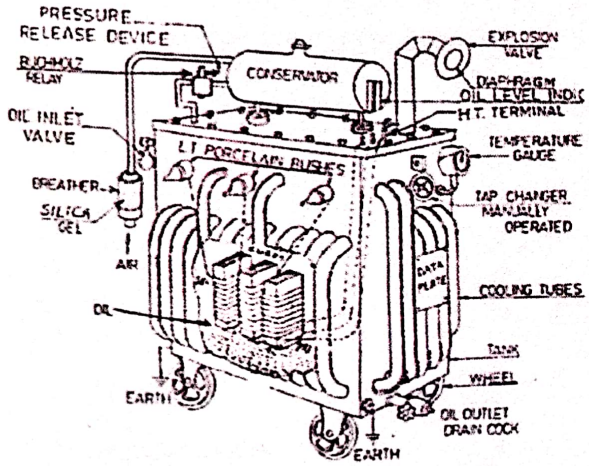

Current Transformer

## 6. VOLTAGE TRANSFORMER

Voltage transformers are used for stepping down voltage for measurement, protection and control. Electromagnetic and capacitive (CVT) are two main types and is located on the feeder side on the breaker.

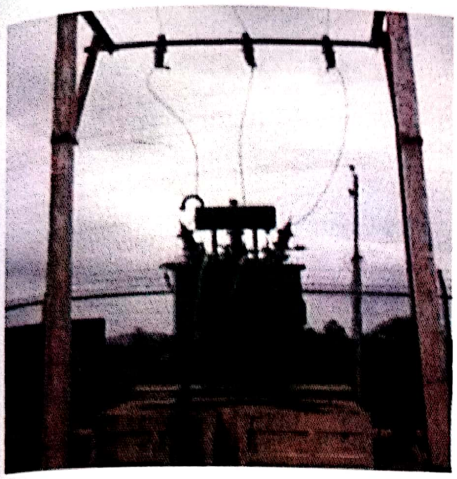
## 7. POWER TRANSFORMERS

To step-up or step-down ac voltages and to transfer electrical power from one voltage level to another. Tap changers are used for voltage control. Usually transformers for outdoor use are oil filled. For large capacity, three single phase units are used to form a three phases bank.




## 8. AUXILIARY TRANSFORMER

Auxiliary transformer is used to supply low voltage for AC power system inside substation such as lighting, air conditioners and other AC supply system and DC power system such as protection relays, batteries, SCADA & telecom system and other DC supply system.

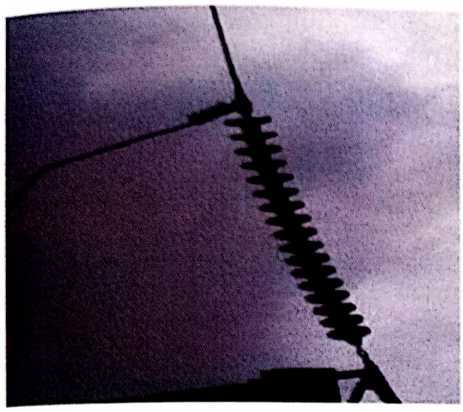


## 9. REACTIVE COMPENSATION

Reactive compensation (as indicated by system studies of the network) has to be provided. It is always a good idea to ensure a power factor correction for transformers, since even when they are operating on low load (e.g., during the night) they absorb reactive power, which must be compensated to avoid unnecessary loadings and losses. Shunt capacitors are connected on the secondary side (11kV side) of the 33/11kV power transformers. The capacitors are generally of automatic switched type. The automatic system of the capacitor bank has the task of switching in the necessary capacitance according to the load requirements at each given moment

## 10. INSULATORS

To insulate live parts- string insulators of tension or suspension and post insulators made of porcelain, glass and epoxy material for indoor use.



## 11. CARRIER EQUIPMENT

Used for protection and communication signalling, voice communication, protection signalling, telex channel, control and monitoring signals. The PLCC panel is located in control room. The wave trap unit is usually mounted above CVT or on separate structure.

## 12. STATION BATTERY/DC SYSTEM

To meet energy requirement of tripping and closing of breakers independently. To meet annunciation, lighting and indication requirement as well as protective relays.

## 13. EARTHMAT

The grounding system in substation is very important. The functions of grounding systems or earth mat in include:

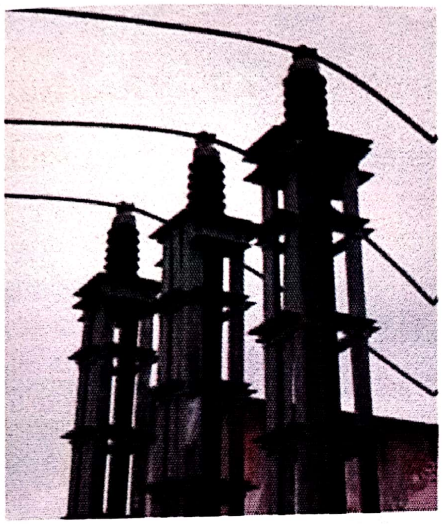
- To ensure safety to personnel in substations against electrical shocks.
- To provide the ground connection for connecting the neutrals of stat connected transformer winding to earth (neutral earthing)
- To discharge the over voltages from overhead ground wires or the lightning masts to earth. To provide ground path for surge arresters.
- To provide a path for discharging the charge between phase and ground by means of earthing switches.

## 14. LIGHTNING PROTECTION – SURGE ARRESTOR

Large over voltages that develop suddenly on electric transmission and distribution system are referred to as "surges" or "transients". These are caused by lightning strikes or by

circuit switching operations. Surge arrestors is a protective device for limiting surge voltages on equipment by discharging or bypassing surge current.

The surge arrestor which responds to over-voltages without any time delay is installed for protection of 33kV switchgear, transformers, associated equipment and 11kV and 33kV lines. The rated voltage of arrestors for 33kV should be 30kV for use on 33kV systems and with nominal discharge current rating of 10kA. The rated voltage of lightning arrestors should be 9kV (rms) for effectively earthed 11kV system (coefficient of earth not exceeding 80 % as per IS: 4004) with all the transformer neutrals directly earthed. The nominal discharge current rating should be 5kA.



## 15. CIRCUIT BREAKERS

A circuit breaker is a switching device built ruggedly to enable it to interrupt/ make not only the load current but also the much larger fault current, which may occur on a circuit. A circuit breaker contains both fixed contacts and moving contacts. The purpose of circuit breakers is to eliminate a short-circuit that occurs on a line. Circuit breakers are found at the arrivals and departures of all lines incident on a substation. When the circuit breaker is closed these contacts are held together. The mode of action of all circuit breakers consists in the breaking of the fault current by the separation of the moving contacts away from the fixed ones. An arc is immediately established on separation of the contacts. Interruption of the current occurs after the arc at these contacts is extinguished and current becomes zero.

**Elements of a Circuit Breaker**

Circuit breakers contain the following elements, irrespective of the medium for arc quenching and insulation:

- Main contact at system voltage
- Insulation, such as porcelain, oil or gas, between the main contacts and ground potential
- Operating and supervisory accessories, of which tripping facilities are most important. A wide variety of closing and tripping arrangements (using relays with variable time delay) and a number of operating mechanisms (based on solenoids, charged springs or

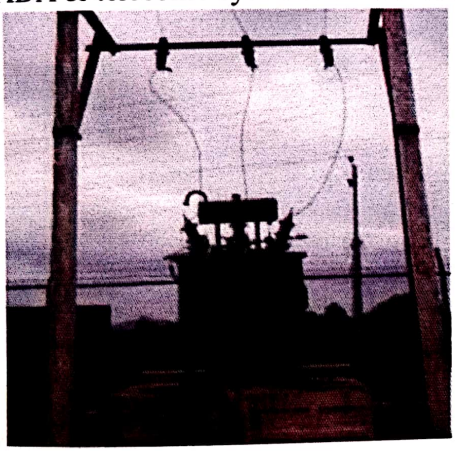
pneumatic arrangements) are available now-a-days. The types of breakers used in a distribution system are:

- Air break type;
- Oil break type;
- Vacuum break;
- SF 6 gas breaker.
- The rated voltage of circuit breakers for 66KV level is 68KV, and for 11KV, it is 12KV. The short circuit current rating is 25kA. The 1 KV switchgear is generally metal enclosed indoor type. In this station they used SF6 gas breaker.

## 16. AUXILIARY TRANSFORMER

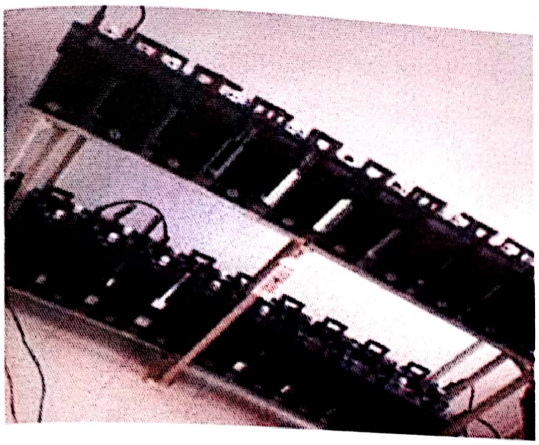
- Auxiliary transformer is used to supply low voltage for AC power system inside substation such as
- lighting, air conditioners and other AC supply system and DC power system such as protection relays, batteries,

SCADA & telecome system and other DC supply system.



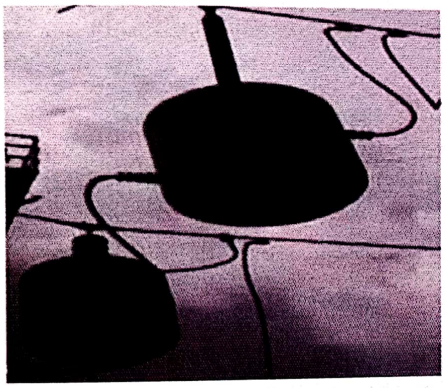
## 17. STATION BATTERY/DC SUPPLY ARRANGEMENT

Station batteries supply energy to operate protection equipment such as breakers and other control, alarm and indicating equipment. The station batteries are a source for operating DC control system equipment during system disturbances and outages. During normal conditions the rectifier provides the required DC supply. However, to take care of rectifier failure, a storage battery of adequate capacity is provided to meet the DC requirements. Normally, in a 33/11 KV substation, the DC system is of 30 cells consisting of 15 lead acid storage batteries or Nickel-Cadmium batteries. The battery is connected in parallel with a constant voltage charger and critical load circuits. The charger maintains the required voltage at battery terminal and supplies the normally connected loads. This sustains the battery in fully charged condition. The correct size battery charger condition. The correct size battery charger has to be selected for the intended application



## 18. WAVETRAP

Wave trap is an instrument using for trapping of the wave. The function of this wave trap to trap the unwanted waves. It is connected to the main incoming feeder so that it can trap the waves which may be dangerous to the instruments in the substation. Generally, it is used to exclude unwanted frequency components, such as noise or other interference, of a wave. This is relevant in power line carrier communication (PLCC) systems for communication among various substations without dependence on the telecome company network.



## 19. FIRE FIGHTING SYSTEM

In view of the presence of oil filled equipment in a substation, it is important that proper attention is given to isolation; limitation and extinguishing of fire so as to avoid damage to costly equipment and reduce chances of serious dislocation of power supply as well as ensure safety of personnel. The layout of the substation itself should be such that the fire should not spread to other equipment as far as possible. Fire extinguishers of the following type must be provided:

- Carbon dioxide extinguisher, and
- Dry chemical powder extinguisher.

Carbon dioxide (CO 2 type) extinguisher and Dry chemical powder type extinguisher should conform to IS:2878 and IS:2171, respectively. For oil fire, foam type extinguishers are used (see Unit 7, BEE-002 also). The firefighting equipment should be maintained and kept in top condition for instant use as per IS: 1948- 1961 "Fire Fighting Equipment and its Maintenance including Construction and Installation of Fire Proof Doors Fire Safety of Buildings (General)". So far, we have described the equipment in a 66-33kV/11kV substation. The ground of the substation yard is filled with crushed gravel stones. This is because of the following reasons that pertain to safety from shock Although substation grounding is chosen to provide low resistance path, the entire ground is filled with crushed stones to provide a high resistance layer so that it can act as insulation between our foot and the ground.

- The stone layer on the substation ground provides high resistance so that the fault currents flow into the ground but not along the ground.
- To minimize step potential and touch potential voltages.
- It avoids pool of inflammable oil etc. on the substation ground in case of any spilling of insulation oil from the equipment. This also avoids spreading of fire from one equipment to the other in the substation.
- The rocky outer layer slows down the evaporation of moisture in the earth's upper layers.
- It restricts entering of snakes and other reptiles as the surface would be inconvenient to crawl.
- It avoids growth of plants and weeds in the substation yard to some extent.
- Generally, 20 to 25mm baby gravel stones are used instead big size stones to facilitate movement of persons and equipment in the substation yard.

## 20. FEEDERS

Santhemavathur substation has 2 banks and from the 2 banks it has 10feeders. Isolated to prevent hazards to the general public and utility personnel. Protective relays are used to sense short circuit conditions caused by faults in distribution protection schemes and the use of proper schemes and settings can help to maximize sensitivity and select coordination between over-current devices that may operate for a specific fault event.

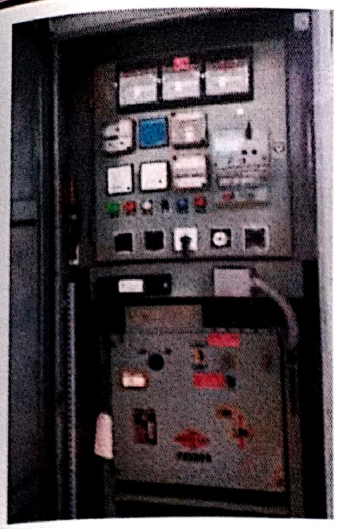


Figure 3.15: Inside view of feeder

Figure 3.16: outside view of feeder

## 21. Relays

A relay is an electrically operated switch which controls a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. There are various relays are been used to protect the transformer they are:

- Oil surge relay
- Buchholz relay
- Earth fault relay
- Over current relay

# CHAPTER 4
# INTRODUCTION

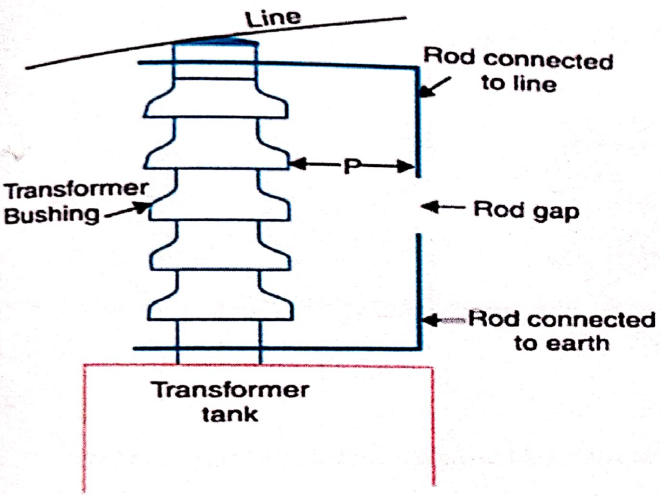
The circuit which is protected from the strokes of lightning with the help of a protection device is known as lightning arrester. Here the lightning strokes are nothing but surges with high transient voltage, arcs of isolation, spark, and surge currents because of lightning, etc. These devices are used to defend the power systems by forwarding the high voltage surges in the direction of the ground. And these power systems and over headlines can also be protected by using ground wire or the earthing from the direct strikes of lightning The arrangement of these devices can be done on the towers, transmission poles and buildings to give a secure lane to the voltage & discharging current. Here these can be occurred during the strokes of lightning toward the ground to defend the system from the induced problems of lightning

Lightning arrestor working principle is, once the voltage surge travels throughout the conductor then it reaches the location of the arrestor where it is installed. So it will break down the insulation of the lightning arrestor for a moment, so voltage surge can be discharged toward the ground. Once the voltage of the system falls under the fixed value, then the insulation will be restored among the ground & conductor. Further, the current flow toward the ground will be stopped.

# TYPES OF LIGHTNING ARRESTERS

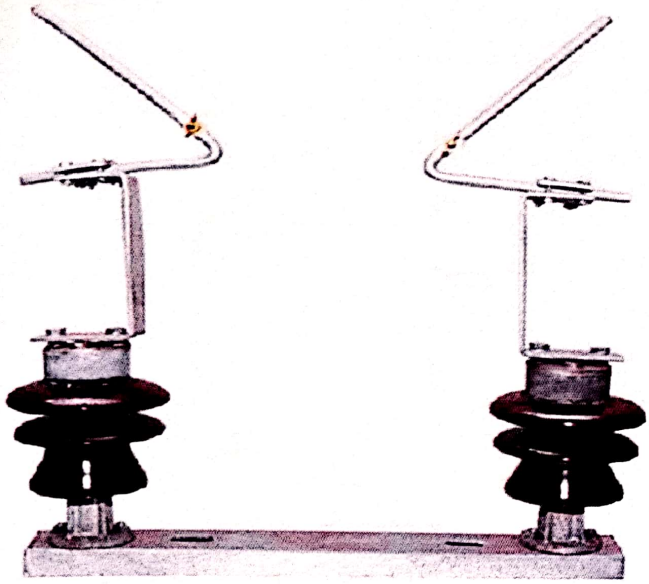
Generally, lightning arresters are classified into different types. The construction of lightning arresters is different based on its type but the working principle is the same. It provides a low resistance pathway to the surges in the direction of the ground. The types are

## 4.1- ROD GAP ARRESTER



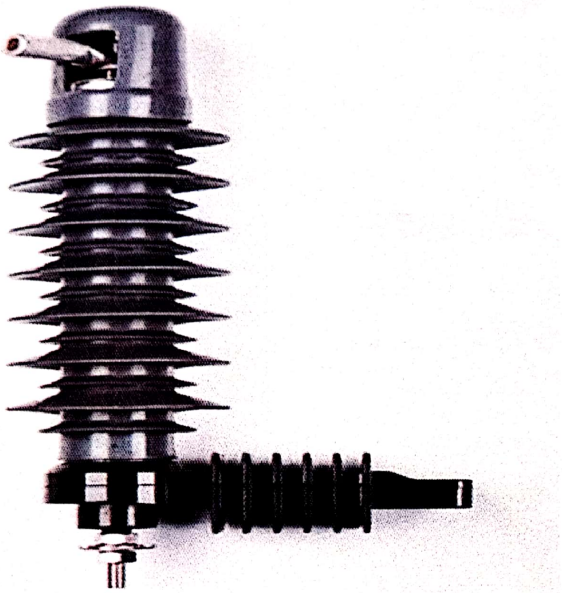

It is a very simple type of diverter and consists of two 1.5 cm rods, which are bent at right angles with a gap in between. One rod is connected to the line circuit and the other rod is connected to earth. The distance between gap and insulator (i.e. distance P) must not be less than one third of the gap length so that the arc may not reach the insulator and damage it. Generally, the gap length is so adjusted that breakdown should occur at 80% of spark-voltage in order to avoid cascading of very steep wave fronts across the. The string of insulators for an on the bushing of transformer has frequently a rod gap across it. Fig 8 shows the rod gap across the bushing of a transformer. Under normal operating conditions, the gap remains non-conducting. On the occurrence of a high voltage surge on the line, the gap sparks over and the surge current is conducted to earth. In this way excess charge on the line due to the surge is harmlessly conducted to earth

## 4.2-HORN GAP ARRESTER



The horn gap arrestor. It consists of a horn shaped metal rods A and B separated by a small air gap. The horns are so constructed that distance between them gradually increases towards the top as shown. The horns are mounted on porcelain insulators. One end of horn is connected to the line through a resistance and choke coil L while the other end is effectively grounded. The resistance R helps in limiting the follow current to a small value. The choke coil is so designed that it offers small reactance at normal power frequency but a very high reactance at transient frequency. Thus the choke does not allow the transients to enter the apparatus to be protected. The gap between the horns is so adjusted that normal supply voltage is not enough to cause an arc across the gap. Under normal conditions, the gap is non-conducting i.e. normal supply voltage is insufficient to initiate the arc between the gap. On the occurrence of an over voltage, spark-over takes place across the small gap G. The heated air around the arc and the magnetic effect of the arc cause the arc to travel up the gap. The arc moves progressively into positions 1, 2 and 3.

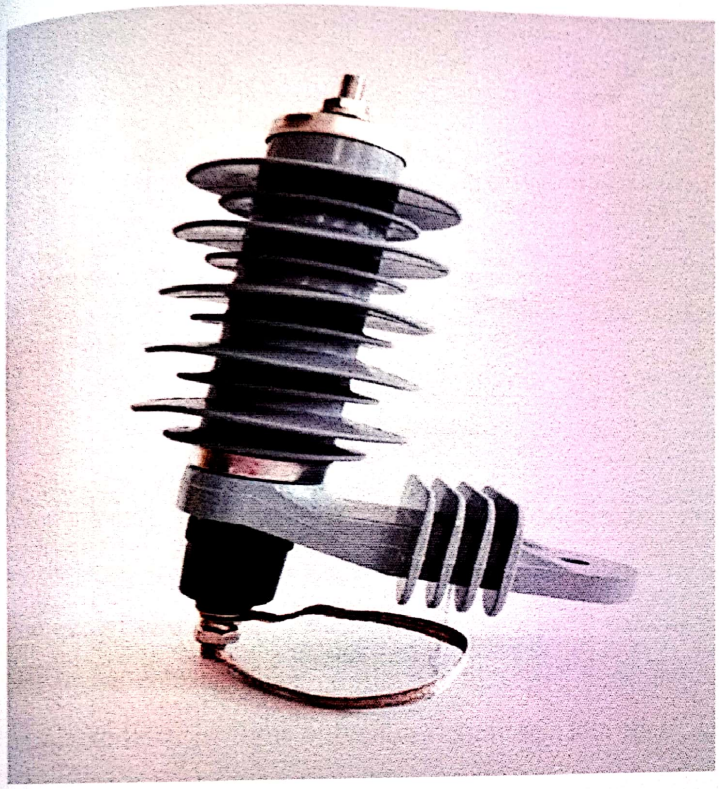
## 4.3- MULTIGAP ARRESTER



The multi gap arrester. It consists of a series of metallic (generally alloy of zinc) cylinders insulated from one another and separated by small intervals of air gaps. The first cylinder (i.e. A) in the series is connected to the line and the others to the ground through a series resistance. The series resistance limits the power arc. By the inclusion of series resistance, the degree of protection against travelling waves is reduced.

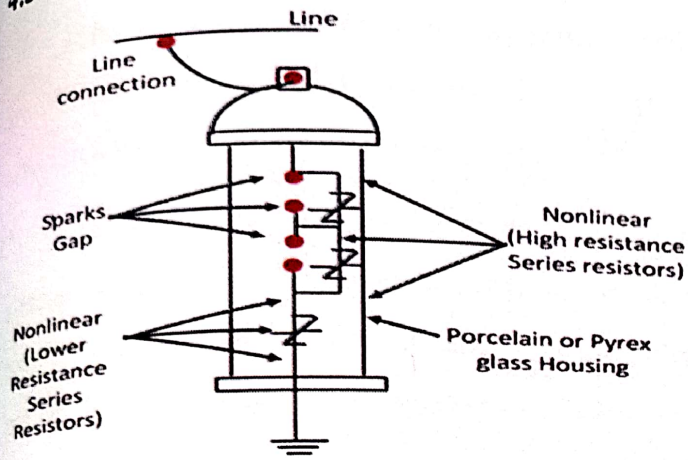
In order to overcome this difficulty, some of the gaps are shunted by resistance. Under normal conditions, the point B is at earth potential and the normal supply voltage is unable to break down the series gaps. On the occurrence an over voltage, the breakdown of series gaps A to B occurs. The heavy current after breakdown will choose the straight – through path to earth via the shunted gaps B and C, instead of the alternative path through the shunt resistance.

## 4.4- EXPULSION TYPE ARRESTER



This type of arrestor is also called 'protector tube' and is commonly used on system operating at voltages up to 33kV. Fig shows the essential parts of an expulsion type lightning arrestor. It essentially consists of a rod gap AA' in series with a second gap enclosed within the fiber tube. The gap in the fiber tube is formed by two electrodes. The upper electrode is connected to rod gap and the lower electrode to the earth. One expulsion arrester is placed under each line conductor

## 4.5- VALVE TYPE ARRESTER




**Valve Type Lightning Arrester**

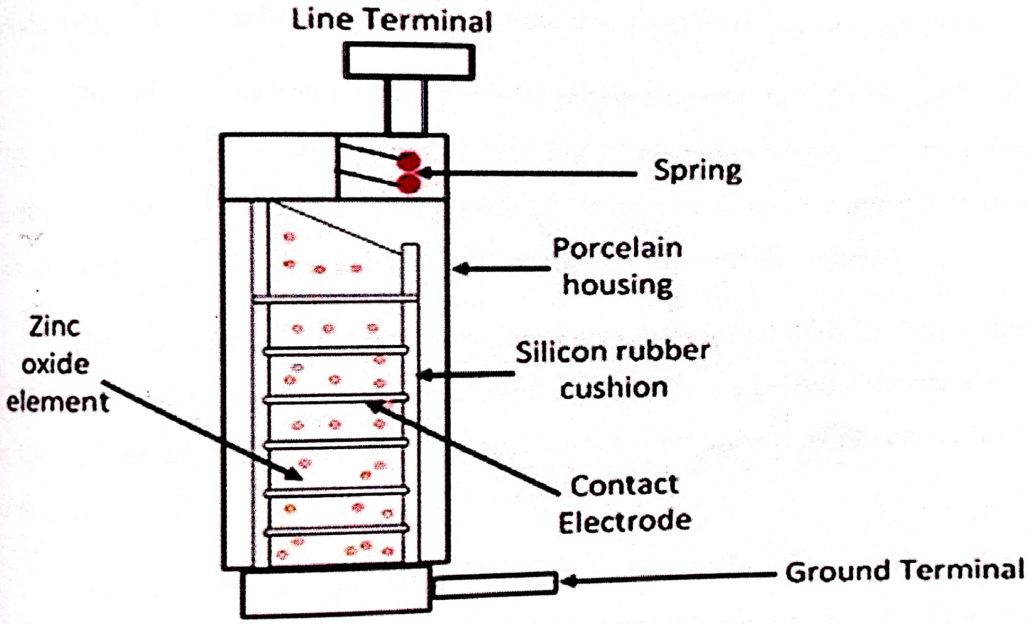
Valve type arresters incorporate nonlinear resistors and are extensively used on systems, operating at high voltages. Fig shows the various parts of a valve type arrester. It consists of two assemblies (i) series spark gaps and (ii) non-linear resistor discs in series. The non-linear elements are connected in series with the spark gaps. Both the assemblies are accommodated in tight porcelain container .The spark gap is a multiple assembly consisting of a number of identical spark gaps in series. Each gap consists of two electrodes with fixed gap spacing. The voltage distribution across the gap is line raised by means of additional resistance elements called grading resistors across the gap. The spacing of the series gaps is such that it will withstand the normal circuit voltage. However an over voltage will cause the gap to break down causing the surge current to ground via the non-linear resistors.

The non-linear resistor discs are made of inorganic compound such as thyrite or metrosil. These discs are connected in series. The non-linear resistors have the property of offering a high resistance to current flow when normal system voltage is applied, but a low resistance to the flow of high surge currents. In other words, the resistance of these non-linear elements decreases with the increase in current through them and vice-versa

## 4.6-METAL OXIDE LIGHTNING ARRESTER

The MOV arrester is the arrester usually installed today. The metal oxide arresters are without gaps, unlike the SIC arrester. This "gap-less" design eliminates the high heat associated with the arcing discharges.

The arrester which uses zinc oxide semiconductor as a resistor material, such type of arrester is known as a metal oxide surge arrester or ZnO Diverter. This arrester provides protection against all types of AC and DC over voltages. It is mainly used for overvoltage protection at all voltage levels in a power system.




Zinc Oxide Surge Arrester

## 4.7-CONSTRUCTION & WORKING OF METAL OXIDE SURGE ARRESTER

The zinc oxide is a semiconducting material of N-type. It is pulverised and finely grained. More than ten doping materials are added in the form of fine powders of insulating oxides such as Bismuth ($Bi_2O_3$), Antimony Trioxide ($Sb_2O_3$), Cobalt Oxide (CoO) , Manganese Oxide ($MnO_2$), Chromium oxide ($Cr_2O_3$). The powder is treated with some processes, and the mixture is spray dried to obtain a dry powder.

The dry powder is compressed into disc-shaped blocks. The blocks are sintered to obtain a dense poly- crystalline ceramic. The metal oxide resistor disc is coated with a conducting compound to protect the disc from undesirable environmental effect.

The conducting coating also provides proper contacts and uniform current distribution. The disc then enclosed in a porcelain housing filled with nitrogen gas or $SF_6$ gas. Silicon rubber is used to keep the disc in a position. It also helps in heat transfer from disc to the porcelain housing. The disc is held under pressure using suitable springs.

The ZnO element eliminates series sparks gaps in the diverter. The voltage drop in ZnO diverter takes place at the grain boundaries. There is a potential barrier at the boundary of the each grain of ZnO and this potential barrier control the flow of current from one grain to the next.

At normal voltage, the potential barrier does not allow the current to flow through it. At over voltage the barrier collapse and sharp transition of current from insulating to conducting state take place. The current start flowing and the surge is diverted to ground.

After the travelling of the surge, the voltage across the diverters falls, and the current is reduced to the negligible value of the resistor units, and there is no power follow current

The MOV arrester has two-voltage rating: duty cycle and maximum continuous operating voltage, unlike the silicon carbide that just has the duty cycle rating. A metal-oxide surge arrester utilizing zinc-oxide blocks provides the best

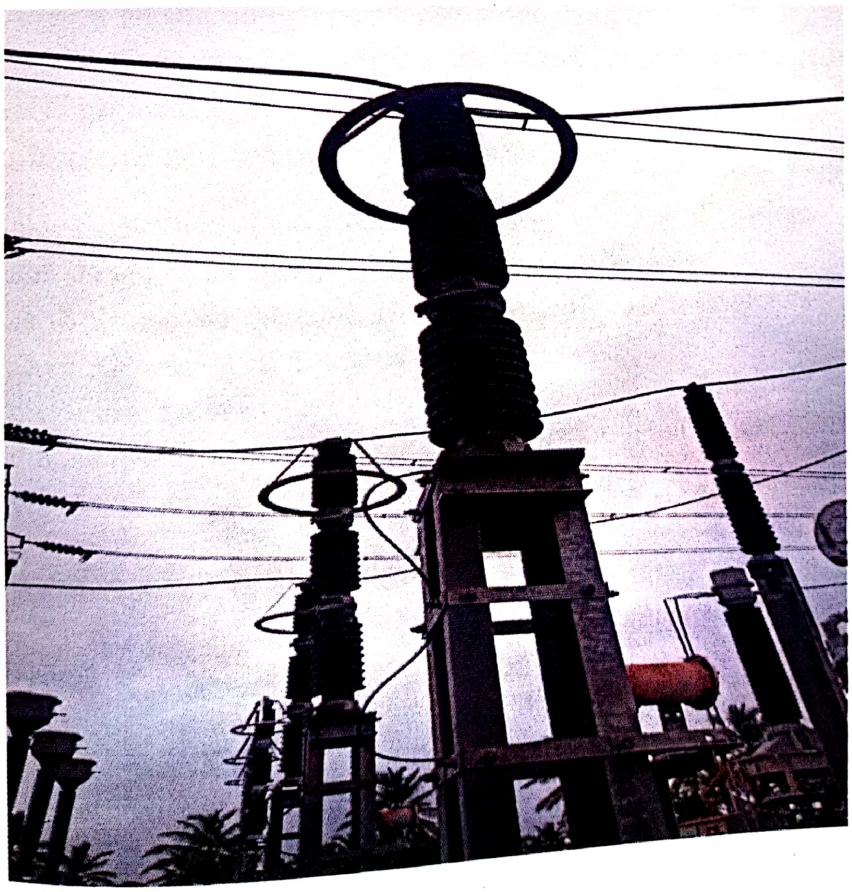


Fig 4.7 Metal oxide surge arrester

## 4.8- ADVANTAGES OF METAL OXIDE LIGHTNING ARRESTER

The metal oxide surge arrester has the following merits:

- It eliminates the risk of spark over and also the risk of shock to the system when the gaps break down.
- It eliminates the need of voltage grading system.
- At the normal operating condition, the leakage current in the ZnO is very low as compared to other diverters.
- There is no power follow current in ZnO diverter.
- It has high energy absorbing capability.
- ZnO diverters possess high stability during and after prolonged discharge
- In ZnO diverter, it is possible to control the dynamic over voltages in addition to switching surges. This results in economic insulation coordination

## 4.9- Installation of Lightning Arresters

- The arrester should be connected to ground to a low resistance for effective discharge of the surge current.
- The arrester should be mounted close to the equipment to be protected & connected with shortest possible lead on both the line & ground side to reduce the inductive effects of the leads while discharging large surge current.

## 4.10- Maintenance of Lightning Arresters

- Cleaning the outside of the arrester housing.
- The line should be de-energized before handling the arrester.
- The earth connection should be checked periodically.
- To record the readings of the surge counter.
- The line lead is securely fastened to the line conductor and arrester
- The ground lead is securely fastened to the arrester terminal and ground.

## 4.11- Location of Lightning Arrester

- The lightning arrester is located close to the equipment that is to be protected. They are usually connected between phase and ground in an AC system and pole and ground in case of the DC system. In an AC system, separate arrester is provided for each phase.
- In an extra-high voltage AC system the surge diverter is used to protect the generators, transformers, bus bars, lines, circuit breakers, etc. In HVDC system the arrester is used to protect the buses, valves converter units reactors, filter, etc.

# CHAPTER 5
# REFLECTION NOTES

Internship carried out at KPTCL is very good opportunity for an Electrical Engineer because of core sector. Power system is vast network and there are many things to learn. As a part of our academics under VTU, BE 7th semester students need to do their Internship program for a duration of four weeks in a company or organization to get exposure of concepts studied in our academics in a real time application. During the vacation of seventh semester, we did our internship in KPTCL on the topic substation and planning.

I thank our HOD for giving us the permission to do our internship in KPTCL station and also for extending his support in completing our internship. In Substation I was guided under AEE,AE. Here the AE (Elec) is very knowledgeable with 15+ years of experience in KPTCL also with strong technical knowledge guided me throughout my internship tenure. And also during substation visits every staff of substation helped me for successful completion of internship.

**OUTCOMES**

1. During my internship period I learnt that electricity plays an important role in our life. The three important wings of electrical system are generation, transmission and distribution are connected to each other and that too very perfectly.
2. I am aware of how the transmission and distribution of electricity is done.
3. I came to know about the various parts of the substation. I learnt the operations & maintenance of various equipment in power stations.
4. Performed the line clear, fault clearing process in the station under the supervision of engineers and staff.
5. I am also aware of how load is managed during the variations of input and output of substation. Here load is managed accordingly by load monitoring and load shedding.

# CONCLUSION

In a nutshell, the internship at Santhemavathuru has been an excellent and rewarding experience. We have been able to meet and network with so many people that I am sure will be able to help us with opportunities in the future. This internship has been very beneficial in bridging the gap between our theoretical knowledge and the practical scenario. The substation visits helped us immensely in through learning and understanding of all the equipment in the substation, their working and the protective measures employed there. We also learnt about transformer testing. Overall, this internship was very useful in gaining the practical understanding of our theoretical knowledge. We believe this internship would help us in building a good platform for our career.

# REFERENCES

[1] Electrical Power systems by C.L. Wadhwa

[2] https://www.electrical4u.com/electrical-power-substation-engineering-and-layout

[3] Rao, S. S. (2017). Switchgear Protection and Power Systems. Delhi: Khanna Publishers.

[4] Retrieved from https://www.electrical4u.com