INDUSTRIAL TRAINING

REPORT

Submitted by

Vivek Faujdar

Roll No. 192094

In partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

Electrical Engineering

AT

NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR

HIMACHAL PRADESH

177005

ACKNOWLEDGEMENT

I am very much thankful to the H.R.D department of RVPN, VIDYUT VIBHAG, DEEG authority for providing me the opportunity of Vocational Training at their substation. I am especially thankful to Sri. THAN SINGH, Asst. Engineer DEEG substation for his kind attention. I am also thankful to the other officers for sharing their valuable experiences at the yard by making me acquainted with the practical phenomenon.

I also got the opportunity to understand the load flow graph, be familiar with the Electricity Act.2002, the status of import-export of RVPNL & the overall view of the Grid System apart from the structures of substations and the detailed of its various substations. So, I feel thankful to all of them who made this possible.

VIVEK FAUJDAR
192094

ANNEXURE XXIII (P)

PRACTICAL TRAINING RATING SHEET

These rating sheet summaries the assessment of the student's professional personality as well as progress during the Training period as observed by the Training officer of factory/ establishment: -

1. Name of Student : VIVEK FAUJDAR
2. SPN :
3. Semester & Branch : Electrical
4. Name of Institute : NIT HAMIRPUR (H.P.)
5. Training Period from : 9.6.22 to 25.7.22
6. Name of training Establishment : A. En. 132 KV GSS (RRVPNL) DEEG (Bharatpur) (Raj)

(A) PERSONALITY TRAILS :-	RATING *
(i) Knowledge & application of fundamental principles	E/G/A/P
(ii) Problem solving ability	E/G/A/P
(iii) Ability to communicate	E/G/A/P
(iv) Punctuality	E/G/A/P
(v) Sense of responsibility	E/G/A/P

(B) PROGRESS REPORT :-	
(i) Aptitude for training	E/G/A/P
(ii) Performance during the training	E/G/A/P
(iii) Shortcoming, if any	
(iv) Working hours completed during training	
(v) Remarks, if any	

Date

Manager / Owner of the Establishment (Seal & Signature)

ASSISTANT ENGINEER
132. KV GSS RVPNL
DEEG (BHARATPUR) RAJ.

Training officer (Seal & Signature)

Junior Engineer (M)
132kV GSS RVPN. Deeg

1. The Training Establishment under sealed cover through the Trainees must send this rating sheet to Principal/Asst. Director, SGV Govt. Polytechnic College, Bharatpur (Raj.)
2. The student trainee must be asked to bring back one copy of the sheet under sealed cover and that must be handed over to Head of Department.
3. After assessment the original can be handed over to the student, if required, but a photocopy (supplied by student) of the same must be kept in record.

*E - Excellent G - Good A - Average P - Poor

RAJASTHAN RAJYA VIDHYUT PRASARAN NIGAM LIMITED

(An ISO 9001:2015 Certified Company)

(Regd. Office VidyutBhawanJanpath, Jaipur 302005)

Office ofthe Assistant Engineer 132 KV G.S.S. (RRVPNL) Deeg (Bharatpur)

S.NO. 02 **Date: 25/ 07 /2022**

*This is certified that **Mr. Vivek Faujdar**S/O **Sh. Ramesh Chand Faujdar** is a student of National Institute Of Technology Hamirpur (H.P.) 177005 (India) undergone 42 days practical training from 09/ 06 / 20 22 to 25 / 07 /2022 at 132 KV G.S.S RRVPNL, Deeg (Bharatpur) Rajasthan. He has undergone training of All equipments of this G.S.S. and his performance during period is found Satisfactory.*

Assistant Engineer
132 KV G.S.S. RRVPNL Deeg (Bharatpur)

ASSISTANT ENGINEER
132 KV GSS RVPNL
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ABSTRACT

A **substation** is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and the consumer, electric power may flow through several substations at different voltage levels. 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.

Substations may be owned and operated by an electrical utility or may be owned by a large industrial or commercial customer.

The word *substation* comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed and were subsidiaries of that power station.

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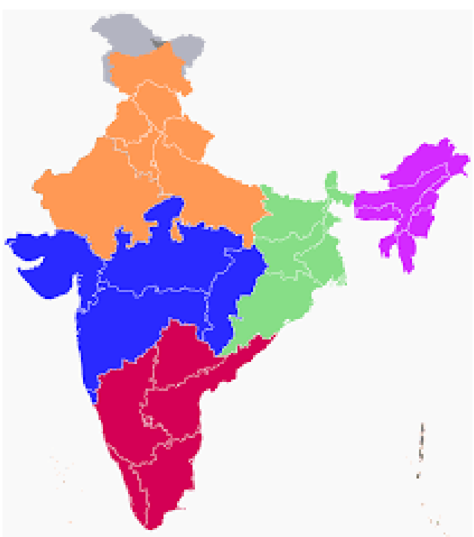
INTRODUCTION

The **National Grid** is the high-voltage electricity transmission network in India, connecting power stations and major substations and ensuring that electricity generated anywhere in India can be used to satisfy demand elsewhere. The National Grid is owned, and maintained by the state-owned Power Grid Corporation of India and operated by the state-owned Power System Operation Corporation. It is one of the largest operating synchronous grids in the world with 371.054 GW of installed power generation capacity as of 30 June 2020.

India began utilizing grid management on a regional basis in the 1960s. Individual State grids were interconnected to form 5 regional grids covering mainland India. The grids were the Northern, Eastern, Western, North Eastern, and Southern Grids. These regional links were established to enable the transmission of surplus electricity between States in each region. In the 1990s, the Indian government began planning for a national grid.



India began cross-border electricity trade in the mid-1980s. India established 33 kV and 132 kV interconnections in radial mode from Bihar and Uttar Pradesh to Bhutan and Nepal respectively. The first interconnection with Bangladesh was commissioned in December 2013, connecting Berhampore with Bheramara. As of April 2017, there are 12 cross-border interconnections between India and Nepal.

India became a net exporter of electricity for the first time in the 2016-17 fiscal year.

OVERVIEW OF RAJASTHAN STATE ELECTRICITY BOARD (RSEB)

The Rajasthan State Electricity Board was constituted with effect from 1st July 1957 by the Government of Rajasthan Notification No. F.11/OSD(PWD)/57 dated the 28th June 1957 under the Electricity (Supply) Act,1948 which enactment has for its object, the co-ordinated development and rationalization of generation and supply of electricity on a regional basis throughout the country in the most efficient and economical way.

The government of Rajasthan on 19th July 2000, issued a gazette notification unbundling Rajasthan State Electricity Board into

- Rajasthan Rajya Vidyut Utpadan Nigam Ltd.(RVUN), the generation Company;
- Rajasthan Rajya Vidyut Prasaran Nigam Ltd.,(RVPN), the transmission Company
- Three regional distribution companies namely:
  - Jaipur Vidyut Vitran Nigam Ltd.,(JVVNL)
  - Ajmer Vidyut Vitran Nigam Ltd.(AVVNL)
  - Jodhpur Vidyut Vitran Nigam Ltd.(JdVVNL)

The Generation Company owns and operates the thermal power stations at Kota and Suratgarh, Gas based power station at Ramgarh, Hydel power station at Mahi and mini hydel stations in the State.

The Transmission Company operates all the 765 kV, 400 kV, 220 kV, and 132 kV electricity lines and systems in the State.

The three distribution Companies operate and maintain the electricity system below 132kV in the State in their respective areas.

SUB-STATION

“The assembly of apparatus used to change some characteristics (e.g. Voltage ac to dc freq. p.f. etc) of electric supply is called sub-station”.

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

FUNCTIONS OF A SUB-STATION

An electricity supply undertaking generally aims at the following:

- Supply of required electrical power to all the consumers continuously at all times.
- Maximum possible coverage of the supply network over the given geographical area.
- Maximum security of supply.
- Shortest possible fault duration.
- Optimum efficiency of plants and the network.
- Supply of electrical power within targeted frequency limits.
- Supply of electrical power within specified voltage limits.
- Supply of electrical energy to consumers at the lowest cost.

As a result of these objectives, there are various tasks that are closely associated with the generation, transmission, distribution, and utilization of electrical energy.

These tasks are performed by various, manual, semi-automatic, and fully automatic devices located in generating stations and substations.

The tasks associated with a major substation in the transmission system include:

- Controlling the exchange of en 7 Protection of the transmission system
- Ensuring steady state and transient stability
- Load shedding and prevention of loss of synchronism.
- Maintaining the system frequency within targeted limits
- Voltage control, reducing the reactive power flow by compensation of reactive power, tap-changing.
- Securing the supply by providing adequate line capacity and facility for changing the transmission paths.
- Data transmission via power line carrier for the purpose of network monitoring, control, and protection.
- Determining the energy transfer through transmission lines and tie-lines.
- Fault analysis and pinpointing the cause and subsequent improvements.
- Securing supply by feeding the network at various points.

All these tasks are performed by the teamwork of the load-control center and control rooms of substations. The substations perform several important tasks and are an integral part of the power system

VOLTAGE LEVELS IN AC SUBSTATION

A substation receives power via the incoming transmission lines and delivers power via the outgoing lines. The substation may have step-up transformers or step-down transformers. Generally, the switchyards at sending end of lines have step-up transformers, and switchyards at the receiving end have step-down transformers. The rated voltage level refers to the nominal voltage of 3 phase AC system and is expressed as r.m.s. a value between phases. An AC substation has generally 2 or 3 main voltage levels. The long-distance transmission is generally at extra high voltages such as 132 kV, 220 kV, and 400 kV AC. The Sub-transmission is at a medium-high voltage such as 33 kV, 11 kV AC. The choice of incoming and outgoing voltages of substations is decided by the rated voltages and rated power of corresponding lines. Long-distance and high-power transmission lines are at higher voltages. The nominal voltages are selected from the standard values of rated voltages specified in Indian Standards or relevant national standards.

The standards also specify the following steady-state voltage within the limits specified below:

S.NO.	Nominal System Voltage (kV RMS)	Maximum (kV RMS)	Minimum (kV RMS)
1	765	800	728
2	400	420	380
3	220	245	198
4	132	145	122
5	33	36	30

CONSTRUCTION OF SUB-STATION

EQUIPMENT IN A SUBSTATION

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

1) Bus-bar:

When a no. of lines operating at the same voltage have to be directly connected electrically, a bus-bar is used, it is made up of copper or aluminum bars (generally of rectangular X-Section) and operates at a 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 a double line in the bus so that if any fault occurs in one, the other can still have the current and the supply will not stop. The two lines in the bus are separated by a little distance by a Conductor having a connector between them. This is so that one can work at a time and the other works only if the first is having any fault.

2) Insulators:

The insulator serves two purposes. They support the conductor (or bus bar) and confine the current to the conductor. The most commonly used material for manufacturers of insulators is porcelain. There are several types of insulators (i.e. pine type, suspension type, etc.) and their use in the 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 greater tension, strain insulators are used. When tension in a line is exceedingly high, two or more strings are used in parallel.

3) Isolating Switches:

In Sub-Station, it is often desired to disconnect a part of the system for general maintenance and repairs. This is accomplished by an isolating switch or isolator. An isolator is essentially a knife Switch and is designed to often open a circuit under no load, in other words, isolator Switches operate only when the line in which they are connected carries no load. For example, consider that the isolator is connected on both sides 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.

4) Circuit breaker:

A circuit breaker is equipment that can open or close a circuit under normal as well as fault conditions. This circuit breaker breaks for a fault which can damage another 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 conditions. A circuit breaker consists of fixed & moving contacts, which are touching each other under normal conditions i.e. when the breaker is closed. Whenever a fault occurs trip coil gets energized, and the moving contacts are pulled by some mechanism & therefore the circuit is opened or circuit breaks. When the circuit breaks, an arc is stacked between contacts, the production of the arc not only interrupts the current but generates an enormous amount of heat which may cause damage to the system or the breaker itself. Therefore the main problem in a circuit breaker is to extinguish the arc within the shortest possible time so that the heat generated by it may not reach a dangerous value. The medium used for arc extinction is usually Oil, Air, Sulfur Hexafluoride (SF6), or vacuum.

5) Protective relay:

A protective relay is a device that detects the fault and initiates the operation of the C.B. to isolate the defective element from the rest of the system”. The relay detects an abnormal condition in the electrical circuit by constantly measuring the electrical quantities, which are different under normal and faulty conditions. The electrical quantities which may change under fault conditions are voltage, current, frequency, and phase angle. Having detected the fault, the relay operates to close the trip circuit of C.B. There are two principal reasons for this; Firstly, if the fault is not cleared quickly, it may cause an unnecessary interruption of service to the customer. Secondly, rapid disconnection of faulty apparatus limits the amount of damage to it & prevents the effects from speeding into the system.

A protective relay is a device that detects the fault & initiates the operation of the circuit breaker to isolate the defective element from the rest of the system. Most of the relays operate on the principle of electromagnetic attraction or electromagnetic induction. The following important types of relays are generally used in electrical distribution & transmission lines:

I. Induction Type Over Current Relay
II. Induction Type Over Voltage Relay
III. Distance Relay
IV. Differential Relay
V. Earth Fault Relay

Induction Type Over Current Relay:

This type of relay operates on the principle of electromagnetic induction initiates corrective measures when current in the circuit exceeds a predetermined value . The actuating source is a current in the circuit supplied to the relay by a current transformer . These relays are used on ac circuits only and can operate for fault flow in either direction. Under normal condition the resulting torque is greater than the driving torque produced by the relay coil current. Hence the Aluminum disc remains stationary, by during fault current in the protective circuit exceeds the preset value. The driving torque becomes greater than the starting torque & the disc starts to rotate, hence moving contact bridges are fixed contact when the disc rotates to a preset value. Trip circuit operates the circuit breaker, which isolates the faulty section.

Induction Type Over Voltage Relay:

This type of relay operates on the principle of electromagnetic induction & initiates corrective measures when current in the circuit exceeds a predetermined value. Under normal condition the aluminum disc remains stationary. However if the voltage increases at any cost the disc starts to rotate, hence moving contact bridges to the fixed contact when the disc rotates through a preset angle. Trip circuit operates the circuit breaker, which isolates the faulty section.

Distance Relay:

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

Differential Relay:

It compensates the phase difference between the power transformer's primary & secondary. The C.T.s on the two sides are connected by pilot wires at both ends are same & no current flows through the relays. If a ground or phase-to-phase fault occurs, the currents in the C.T.s no longer will be the same & the differential current flowing through the relay circuit will clear the breaker on both sides of transformers. The protected zone is limited to the C.T.s on the low voltage side & C.T.s on the high voltage side of the transformer. This scheme also provides protection for short circuits between turns of the same phase winding. During a short circuit, the turn ratio of power transformer is altered & cause unbalance in the system which cause the relay to operate. However, such sorts are better taken care by Buchholz relay.

Earth Fault Relay:

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

6) Instrument Transformers:

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

There are two types of instrument transformers.

i) 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 a thick wire connected in series with a line having a 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 amps to 1amp. 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;

(c) measurement.

ii) Voltage Transformer or Potential Transformer:-

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

7) Metering and Indicating Instrument:-

There are several metering and indicating Instruments (e.g. Ammeters, Voltmeters, energy meter etc.) installed in a Substation to maintain which over circuit quantities. The instrument transformer are invariably used with them for satisfactory operation.

8) Miscellaneous equipment:-

In addition to the above, there may be the following equipment in a Substation:

i) Fuses
ii) Carrier-current equipment
iii)Sub-Station auxiliary supplies

9) Transformer:-

There are two transformers in the incoming feeders so that the three lines step down at the same time. In case of 220KV or more Autotransformers are used. While in case of lower KV lines such as less than 132KV line double winding transformers are used of lower KV lines such as less than 132KV line double winding transformers are used Transformer is static equipment, which converts electrical energy from one voltage to another. As the system voltage goes up, the techniques to be used for the Design, Construction, Installation, Operation, and Maintenance also become more and more critical. If proper care is exercised in the installation, maintenance, and condition monitoring of the transformer, it can give the user trouble-free service throughout the expected life of the equipment which is of the order of 25-35 years. Hence, it is very essential that the personnel associated with the installation, operation or maintenance of the transformer is through with the Instructions provided by the manufacturer. Basic Principle: The transformer is based on two principles; firstly, an electric current can produce a magnetic field (electromagnetism), and secondly that a changing magnetic field within a coil of wire induces a voltage across the ends of the coil (electromagnetic induction). Charging the current in the primary coil changes the magnetic flux that is developed. The changing magnetic flux induces a voltage in the secondary coil. The two circuits are electrically isolated but magnetically linked through a low reluctance path. If one coil is connected to a.c supply, an a.c is set up in both of these circuits. This helps to transfer the voltage from one side to another. We have observed five at KLSD along with two station transformers. Out of these five, two are 132/33 kV in y-d mode & others are 33/11 kV in d-Y mode.

Accessories of transformers:

Core & Winding: It may be of various shapes i.e. core, shell. It is made of cold rolled-grain-oriented Silicon-steel of varnish insulation on the lamination. The core is laminated to reduce the core loss. The laminations are made in steps & try to give a circular cross-section. Bolts 7 nuts secure the lamination. The core is placed at the bottom of the tank. The tanks are constructed from sheet steel 31.5 MVA Transformer for small tank & boiler sheet for large tanks. There are thermometer pockets and radiator tubes for increasing cooling surfaces. A 3-phase transformer has six separate windings, three primary & three secondary wound iron cores. Enameled copper with insulation is used for winding. Insulated papers are used for interlayer insulation. Paper in the form of tape may be utilized for tapping winding leads and other parts. Pressboards are used for insulation between windings & core. Pressboards are also used to separate HV windings from LV windings inputs nearer the core.

Transformer Oil: The tank is filled with transformer oil; & sealed. It is a mineral oil obtained by refining crude petroleum. It serves the following purposes:-
I. Provides additional insulation

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

- High dielectric strength.
- Low viscosity to provide good heat transformation.
- High flash/fire point Free from inorganic acid, alkali & corrosive Sulfur
- Free from sludging under normal operating condition
- It is Important to check the oil in regular intervals.

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

Breather: When the temperature changes, expansion of contacts & there is a displacement of air . When the transformer cools the oil level goes down 7 air is drawn in. The oil should not be allowed to come in contact with the atmospheric air as it may take moisture, which may spoil its insulating properties. Air may cause acidity or sludging of oil, so, the air coming in is passed through an apparatus called a breather for extracting moisture. The breather consists of a small vessel, which contains a drying agent like Silica gel crystal.

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

Radiator: It is of small thickness & large diameter plates & used for heat dissipation during operation. Large diameter means large surface area 7 better cooling.

Temperature Indicator: There are two temperature indicators on the transformer tank one for oil temperature measurement & another for core temperature measurement. In 31.5 MVA Transformers when oil temperature reaches 65o c cooling fans start automatically but when the oil temperature rises at 75o c or the winding temperature rises to 85o c the alarm circuit will be closed. Further, increase in oil or winding temp. the circuit will trip automatically. Cooling fans are placed beside the radiator tube, which is used for oil cooling. Generally, the cooling fans start automatically but when needed they can be started manually.

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

Buchholz relay: It Is a gas actuated relay installed in oil immersed transformers for protection against all kinds of faults. Any fault produces heat & forces the evolution of gas. It mainly consists of two float switches 7 placed in the connecting pipe between the main tank & conservator. Under normal condition they main tank and Buchholz relay is completely filled up with oil & the conservator tank is about half full. When the fault occurs, produces gas & collect in the container so the oil level gradually falls & closing the alarm circuit. If no attention is paid to it, the gas collection will be more & closes another circuit which will cut out the transformer from the line.

Explosion Vent/ Pressure Release Vent: When the gas pressure on the container is heavy, the explosion vent is released. The alarm circuit & trip circuit will close by Buchholz Relay, before opening the explosion vent it is used nowadays.

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

10) Earthing or Station Transformer:

Two earthing transformers having provided on the 33 kV side of the 132 kV transformer. Power transformers are using Delta-Star connection. So, if any fault occurs on the secondary side, the earthing transformer grounds those currents due to the star connection. So a neutral provided to power transformers. Also, it provides power for the substation. In this type of transformer zigzag star and normal star, connections are used. Zigzag star is used on the H.V. sides and normal stars are used on the L.V. side. Here on the H.V. side, zigzag stars are used, because it reduces the heating effect of fault current & makes it robust.

11) Protection Against Lightning:

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

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

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

2. Overhead Ground Wires: The most effective method of providing protection against direct lightning strokes is by the use of overhead ground wires. The ground wires are placed over line conductors at such a position that practically all lightning strokes are intercepted by them. The ground wire is ground at each tower or pole through as low a resistance as possible. when direct lightning strokes occur on the transmission line will be taken u by the ground wire. The heavy current flows to the ground through the ground wire, so it protects the line from the harmful effects of lightning.

3. Lightning Arrestors: Firstly, we can see lightning arrestors. These lightning arrestors can resist or ground the lightning, if falls on the incoming feeders. The lightning arrestors can work at an angle of 30 degrees around them. They are mostly used for the protection of the instruments used in the substation. As the cost of the instruments in the substation is 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 o the system from the damaging effect of lightning. Metal Oxide arrestors (MOVs) have been used for power system protection the mid-70s.The typical lightning arrestor is also known surge arrestor has a high-voltage terminal and a ground terminal. When a lightning surge or switching surge travels down the power system to the arrestor, the current from the surge is diverted around the protected insulation in most cases to earth. Lightning arrestors with earth switch are used after the current transformers to protect it from lightning i.e. from high voltage entering into it. This lightning arrestor has an earth switch that can directly earth the lightning. The arrestor works at 30 to 45 angle of the lightning making a cone. The earth switch can be operated manually, by pulling the switch towards the ground. This also helps in breaking the line entering the station. By doing so maintenance repair of any instrument could be performed. Types of lightning arrestors:- There are several types of lightning arrestors are in use, differs only in their constructional detail but they are electrically identical & operate on the same principle. They are-

A. Rod gap arrestor
B. Horn gap arrestor
C. Valve-type arrestor

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

b. Horn gap arrestor: It consists of two horn-shaped metal rods separated by a small air gap. The horns have been so constructed that the distance between them gradually increases towards the top. The horns are mounted on porcelain insulators. The end of the horn is connected to the line and another end is efficiently grounded. Under normal conditions the gap is non-conductive. On the occurrence of high voltage, a spark takes place across the gap & the arc travels up the gap. At some positions of the arc, the distance may be for the voltage to maintain the arc. Consequently, the arc is extinguished, & the excess charge on the line is thus conducted to ground through the arrestor.

c. Valve-type arrestors: It consists of a no. of a flat disc of a porous material stacked one above the other & separated by a thin mica ring. The porous material is made of specially prepared clay with a small admixture of powdered conducting substance. The discs are arranged in such a way that the normal voltage may not cause the discharge to occur. The mica rings provide insulation during normal operation. At the time of overvoltage, the glow discharge occurs in the capillaries of the material& the voltage drops to about 350 volts per unit.

CONCLUSION

Now from this report we can conclude that electricity plays an important role in our life. We are made aware of how the transmission of electricity is done.
It was a very good experience of taking vocational training at 132 KV GSS Deeg, Bharatpur. All employees working there were very helpful and were always ready to guide us. They gave their best to make us understand.
The Assistant Engineer, Junior Engineer & Technicians gave us detailed theory. Training at the substation gives us insight into the real instruments used. There are many instruments like transformers, CT, PT, CVT, LA, Relay, PLCC, Bus Bars, Capacitor bank, Insulator, Isolator, Control Room and Battery Room etc.

The training at the grid substation was very helpful. It improved my theoretical concepts of the electric power transmission and distribution. Protection of various apparatus was a great thing. Maintenance of the transformer, circuit breaker, isolator, insulator, bus bar etc. was observable.