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INDUSTRIAL VISIT AT 132 KV SUBSTATION HVPNL, Pali (Distt. Mahendragarh)

The department of Electrical Engineering, Rao Pahlad Singh college of Engineering and Technology, Balana had organized a one-day Industrial visit to 132 KV Substation HVPNL, Pali on 13th October, 2023. There were 48 students from B.Tech (EE and ECE) morning shift along with two teaching faculties Mr. Karambir Sheoran and Mr. Ravi Kumar. We had coordinated with Shri Bir Singh (SSE) & Shri Dinesh (JE) Substation, Pali. At 10:00 AM, we reached at Substation HVPNL, Pali. After reaching there, Shri Bir Singh & Shri Dinesh received us with a warm welcome.

Shri Dinesh sir had explained the working substation in depth. Then we were taken to the control room. In the control room, every quantity of the substation is continuously monitored and we observed the real time data of substation on the panel. Shri Dinesh had brought us to battery room & explained its importance in substation. We interacted with Dinesh sir and had a great technical discussion.

OBJECTIVE OF VISIT

Our main purpose for this visit is to be familiar with industrial environment and to get practical knowledge of electrical power transmission and distribution. Being final year students, we will get to know about basic industrial functioning of power transmission and distribution. Students will also get familiar with Transformer maintenance, circuit breaker, Transformer isolator, bus bar, Protective relays, Lightening arresters, Load break switches, SCADA system, Current and voltage Transformer and Battery room.

EQUIPMENT IN A 132 KV SUB-STATION

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 equipments:

- Bus-bar
- Insulators
- Isolating Switches
- Circuit breaker
- Protective relay
- Instrument Transformer
- Current Transformer
- Voltage Transformer
- Metering and Indicating Instrument
- Miscellaneous equipment
- Transformer
- Lightening arrestors
- Line isolator
- Wave trap

Figure 1: Circuit Breaker

Bus-bar: When a no. of lines operating at the same voltage have to be directly connected electrically, bus- bar are used, it is made up of copper or aluminium bars (generally of rectangular X-Section) and operate at constant voltage. The bus is a line in which the incoming feeders come into and get into the instruments for further step up or step down. The first bus is used for putting the incoming feeders in LA single line. There may be double line in the bus so that if any fault occurs in the one the other can still have the current and the supply will not stop. The two lines in the bus are separated by a little distance by a Conductor having a connector between them. This is so that one can work at a time and the other works only if the first is having any fault.

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 the manufactures of insulators is porcelain. There are several types of insulators (i.e., pine type, suspension type etc.) and there used in Sub-Station will depend upon the service requirement.

Figure 2: Isolator

Isolating Switches: In Sub-Station, it is often desired to disconnect a part of the system for general maintenance and repairs. This is accomplished by an isolating switch or isolator. An isolator is essentially a knife Switch and is design to often open a circuit under no load, in other words, isolator Switches are operated only when the line is which they are connected carry no load. For example, consider that the isolator is connected on both side of a circuit breaker, if the isolators are to be opened, the C.B. must be opened first.

Circuit breaker: A circuit breaker is an equipment, which can open or close a circuit under normal as well as fault condition. These circuit breaker breaks for a fault which can damage other instrument in the station. It is so designed that it can be operated manually (or by remote control) under normal conditions and automatically under fault condition. The use of SF6 circuit breaker is mainly in the substations which are having high input KV input, say above 132KV and more. The gas is put inside the circuit breaker by force i.e., under high pressure. When if the gas gets decreases there is a motor connected to the circuit breaker. The motor starts operating if the gas went lower than 20.8 bar.

There is a meter connected to the breaker so that it can be manually seen if the gas goes low. The circuit breaker uses the SF6 gas to reduce the torque produce in it due to any fault in the line. The circuit breaker has a direct link with the instruments in the station, when any fault occurs alarm bell rings.

Figure 3: Circuit Breaker Name plate


Figure 4: Circuit Breaker

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 the abnormal condition in the electrical circuit by constantly measuring the electrical quantities, which are different under normal and fault condition. The electrical quantities which may change under fault condition are voltage, current, frequency and phase angle. Having detected the fault, the relay operates to close the trip circuit of CB.

Metering and Indicating Instrument: There are several metering and indicating Instrument (e.g., Ammeters, Volt-meters, energy meter etc.) installed in a Substation to maintain which over the circuit quantities. The instrument transformers are invariably used with them for satisfactory operation.

Miscellaneous equipment: In addition to above, there may be following equipment in a Substation:
i) Fuses
ii) Carrier-current equipment
iii) Sub-Station auxiliary supplies

Transformer: There are two transformers in the incoming feeders so that the two lines are step down at the same time. In case of a 132KV or more KV line station auto transformers are used. While in case of lower KV line such as less than 132KV line double winding transformers are used Autotransformer.

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 equipment which 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 manufacture diverted around the protected insulation in most cases to earth.

Figure 7: Power transformer

Auto transformer: 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 equipment which 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 manufacture.

Lightening Arrester: To discharge the switching and lightening voltage surges to earth.

Wave trap: Wave trap is an instrument using for tripping of the wave. The function of this trap is that it traps the unwanted waves. Its function is of trapping wave. Its shape is like adrum. It is connected to the main incoming feeder so that it can trap the waves which maybe dangerous to the instruments here in the substation.

Figure 8: Wave Trap

SINGLE LINE DIAGRAM (SLD)

A Single Line Diagram (SLD) of an Electrical System is the Line Diagram of the concerned Electrical System which includes all the required ELECTRICAL EQUIPMENT connection sequence wise from the point of entrance of Power up to the end of the scope of the mentioned Work. As these feeders enter the station they are to pass through various instruments. The instruments have their usual functioning.

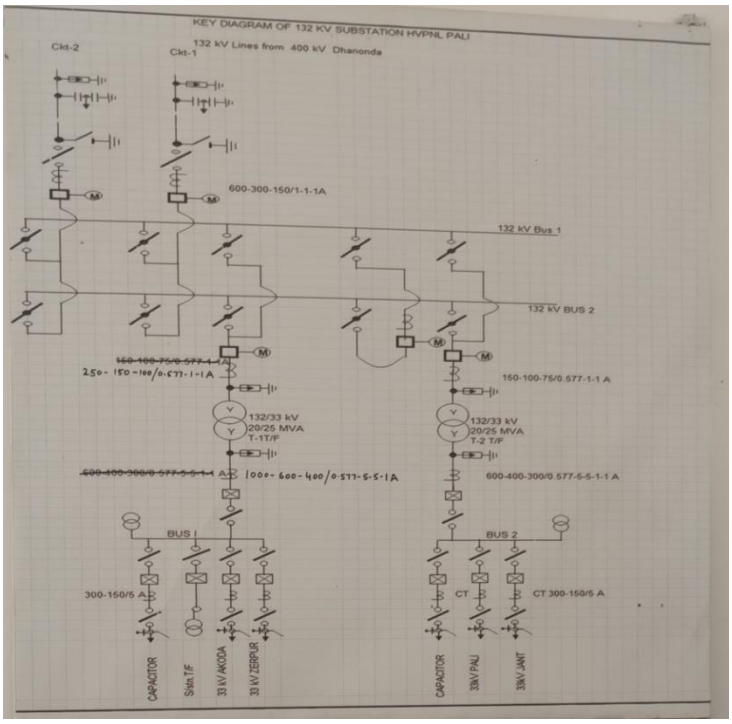

Figure 9: SLD of 132 KV Substation HVPNL, Pali

CONTROL & RELAY ROOM

The control room has various control panels which shows the information like incoming power, outgoing power, frequency, time common to all sub-stations, status of various lines (healthy, faulted, under outage or maintenance), status of various protective instruments like isolators, circuit breaker, temperature of various instruments, working tap of transformer etc.

The DAS (Data Acquisition System) is used to accumulate the data received from various sources. The relay room is separate from the control room. The protection system is so fast that it can detect a fault within 30ms and hence the circuit breaker can be operated within as less as 80ms. For 400KV side C.B., one time auto re-closure is allowed in order to clear the faults automatically.

BATTERY ROOM: The control panels and relays of the sub-station required DC supply of 110 V. The DC supply is made with the help of battery bank reserve normally kept in a separate room called battery room. The batteries used in this sub-station are Nickel-Cadmium (NI-Cd) batteries. These batteries re-used due to their advantages like low maintenance, longer life (15-20 years) etc. Batteries at sub-station Storage battery system is used in emergency situation for the working of electrical equipment. To open and close the switch gear. For indication and control. Emergency lighting Relay and interlocking equipment for working of alarm circuit.

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 the transmission of electricity is done. We too came to know about the various parts of the substation system. The three wings of electrical system viz. generation, transmission and distribution are connected to each other and that too very perfectly. Thus, for effective transmission and distribution a substation must:

- Ensure steady state and transient stability
- Effective voltage control
- Prevention of loss of synchronism
- Reliable supply by feeding the network at various points
- Fault analysis improvement in respective field
- Establishment of economic load distribution

We are very grateful to 132 KV Substation HVPNL, Pali for giving permissionfor this visit. Students got an opportunity to know regarding practical aspects about what they are learning in theory. We hope that such kind of permission will be given in future also. It was an informative, interesting and a successful visit.