

EXPERIMENT: 7

Object: Study of substation and draw its single line diagram.

Laboratory Task: Visit the 33kV/11kV JIET-GSS and collect all data.

Brief Theory:

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 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. 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.

The elements of Grid Sub Station (JIET-GSS)

- 1. Primary power Line: 3- phase and 3- wire , 33KV line**
- 2. Isolators/ disconnect switches:** High voltage disconnect switches or isolators are used in electrical substations to allow isolation of apparatus such as circuit breakers, transformers, and transmission lines, for maintenance. Such switches are often found in electrical distribution and industrial applications. Isolators can be operated either manually or automatically.

Unlike load switches and circuit breakers, isolators does not have the of electric arcs, which occurs when conductors carrying high currents are electrically interrupted. Thus, they are off-load devices, with very low breaking capacity, intended to be opened only after current has been interrupted by some other control device.
- 3. Drop Out Fuse:** Drop Out fuse is an electrical safety device that operates to provide overcurrent protection of an electrical circuit.
- 4. Lightning Arrestor:** A lightning arrester (also called lightning diverter) is a device used on electric power systems and telecommunication systems to protect the insulation and conductors of the system from the damaging effects of lightning. The typical lightning arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge, which is very similar) travels along the power line to the arrester, the current from the surge is diverted through the arrester, in most cases to earth.
- 5. Current Transformer(CT) & Potential transformer(PT):** A current transformer (CT) is a type of transformer that is used to measure alternating current (AC). It produces a current in its secondary which is proportional to the current in its primary.

Current transformers, along with voltage or potential transformers, are instrument transformers. Instrument transformers scale the large values of voltage or current to small, standardized values that are easy to handle for instruments and protective relays. The instrument transformers isolate measurement or protection circuits from the high voltage of the primary system. A current transformer provides a secondary current that is accurately proportional to the current flowing in its primary. The current transformer presents a negligible load to the primary circuit.

Current and potential transformers are used at generating stations, electrical substations, and in industrial and commercial electric power distribution.

6. **Energy meter:** An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour (*kWh*). They are usually read once each billing period.
7. **Cable:** The cable used in this GSS is XLPE(Cross Linked Poly Ethylene cable) used for high voltage 33/11kV.
8. **Auxiliary or bypass Isolator:** Bypass Isolator is used to maintain the continuity of circuit when the VCB (Vacuum circuit breaker) becomes faulty or is under repair.
9. **Circuit Breakers:** Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

The circuit breaker used here is Vacuum circuit breaker (VCB), at 33kV when we break the circuit, the high current flowing in the cable will produced very high spark and will cause fire and may damage the entire substation. To prevent this circuit breakers are made with some provision to prevent this unwanted accidental fire.

In VCB we have vacuum with a very high pressure which compensate the spark produced at the time when we break the circuit.

10.Power transformer

- (i) Input/output Bushing, Bushing angle, Testing of bushing
- (ii) Transformer oil and its characteristics
- (iii) WTI, OTI
- (iv) Conservator, Silica gel Breather
- (v) Buchholz Relay
- (vi) Transformer Earthing
- (vii) Tap-changers
- (viii) Transformer name plate

11.Secondary power lines (11kV feeders for JIET Co-ed & JIETSETG)

Panel Diagram of Vacuum Circuit Breaker



Single Line Diagram of 33kV/11kV Grid Sub Station, JIET, JODHPUR

