

# INTRODUCTION TO POWER SYSTEM PROTECTION

PRESENTED BY  
Mr. RITESH NAGAR  
DEPT. OF ELECTRICAL ENG.  
S.O.E.T. VIKRAM  
UNIVERSITY, UJJAIN

# What is Power System Protection?

- **System protection is the art and science of detecting problems with power system components and isolating these components. Problems on the power system include:**
  - **1.Short circuits**
  - **2.Abnormal conditions**
  - **3.Equipment failures**

# Purpose of System Protection

- **Protect the public**
- **Improve system stability**
- **Minimize damage to equipment**
- **Protect against overloads**
- **Employ relay techs and engineers**

# What Equipment do We Protect?

- Generators
- Transformers, Reactors
- Lines
- Buses
- Capacitors

# Types of Protection

- Protection systems can be classified into two
- Apparatus protection-  
Apparatus protection deals with detection of a fault in the apparatus and consequent protection.
- System protection

# Nature and causes of faults

- The nature of fault simply implies any abnormal condition which causes a reduction in the basic insulation strength between phase conductors, between phase conductor and earth or any earth screen surrounding the conductors.
- The reduction of the insulation is not considered as a fault until it produces some effect on the system i.e. until it results either in an excess current or in the reduction of the impedance between the conductors, between the conductor and earth to a value below the lowest load impedance normal to the circuit.

# Apparatus protection can be further classified into following:

- Transmission Line Protection and feeder protection
- Transformer Protection
- Generator Protection
- Motor Protection
- Bus bar Protection

# Breakdown at normal voltage may occur on account of:

- The deterioration of insulation
- Damage due to unpredictable causes such as perching of birds, accidental short-circuiting by tree branches, etc.



# Breakdown may occur because of abnormal voltages:

- This may happen because of
  - (i) switching surges
  - (ii) surges caused by lightning
- The present practice is to provide a high insulation level of the order 3 to 5 times the normal voltage, but still

The present practice is to provide a high insulation level of the order 3 to 5 times the normal voltage, but still:

- (i) The pollution on an insulator string caused by deposited soot or cement dust in industrial area.
- (ii) Salt deposited wind borne sea spray in coastal area.
- These will initially lower the insulation resistances and causes a small leakage current to be diverted, thus hastening the deterioration

Secondly, even if the insulation is enclosed, such as sheathed and armoured, the deterioration of the insulation occurs because of:

- (a) Ageing
- (b) Void formation in the insulation compound of underground cable due to unequal expansion and contractions caused by the rise and fall of temperature.

Thirdly, insulation may be subjected to transient over voltages because of switching operation.

- The voltage which rises at a rapid rate may achieve a peak value which approaches three times phase to neutral voltages.
- Lightning produces very high voltage surges in the power system in the order of million volts. These surges travel with the velocity of light in the power circuit.
- The limiting factors are the surge impedance and the line resistance.

# Consequences of Faults

- Serious results of the un cleared fault, is fire which may not only destroy the equipment of its origin but also may spread in the system and cause total failure Consequences;
- 1. A great reduction of the line voltages.
- 2. Damage caused to the element of the system by the electrical arc.
- 3. Damage to other parts due to overheating.
- 4. Disturbance to the stability of the electrical system and this may even lead to a
- complete shutdown of the power system.
- 5. Reduction in the voltage may fail the pressure coil of the relay.
- 6. Considerable reduction in the voltage on healthy feeder connected to the system having fault.

# System Protection

- System protection deals with detection of proximity of system to unstable operating region and consequent control actions to restore stable operating point and/or prevent damage to equipments.
- Loss of system stability can lead to partial or complete system blackouts. Under-frequency relays, outof-step protection, islanding systems, rate of change of frequency relays, reverse power flow relays
- Voltage surge relays etc are used for system protection.
- Wide Area Measurement (WAM) systems are also being deployed for system protection.
- Control actions associated with system protection may be classified into preventive or emergency control actions.



# THANK YOU

Prepared By- Mr. Ritesh Nagar