Lecture-15

Nature and causes of faults, consequences

Topic Covered

- System Protection
- Types of Protection

Introduction

- System Protection: the equipment use to detect and isolate the faulty section from the system automatically.

Function of System Protection

- Why do we need system protection:
  - Detect fault
  - Isolate faulted component
  - Restore faulted component
- Aims:
  - Continued supply for rest of system
  - Protect faulted part from damage

Introduction

- Short circuit occur when equipment insulation fails due to system overvoltages caused by:
  - Lightning or switching surges
    - Flashover line-line (caused by wind)
    - Flashover to tree
  - Insulation contamination by dirt/salt
  - Mechanical failure
    - Cable insulation failure
  - Natural causes
    - Tower/pole or conductor falls
    - Objects fall on conductors

Introduction

- Short circuit currents can be several orders of magnitude larger than normal operating currents
- If it is allowed to persist, may cause:
  - Damage to the equipment due to heavy currents, unbalanced current, or low voltage produces by the short circuit
  - Fire and explosion effect equipment/people
  - Disruption of service in the entire power system area

Function of System Protection

- Cause the prompt removal from service of any elements of power system when it suffers a short circuit, or when it start to operate in any abnormal manner that might cause damage or otherwise interfere with the effective operation of the rest of the system.
- Provide indication of the location and type of failure so that the data can be used to assist in expediting repair and analyzing the effectiveness of fault-prevention and mitigation features.

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Types of Protection

A – Fuses

- For LV Systems, Distribution Feeders and Transformers, VT's, Auxiliary Supplies

B - Over current and earth fault

- Widely used in All Power Systems
  - Non-Directional
  - Directional

Types of Protection

C - Differential

- For Distribution Feeders, Busbars, Transformers, Generators etc

High Impedance
Low Impedance
Restricted E/F
Biased
Pilot Wire

Types of Protection

D - Distance

- For Transmission and Sub-transmission Lines and Distribution Feeders,
- Also used as back-up protection for transformers and generators without signaling with signaling to provide unit protection e.g.:
  - Time-stepped distance protection
  - Phase comparison for transmission lines
  - Directional comparison for transmission lines

Types of Protection

E - Miscellaneous:

- Under and over voltage
- Under and over frequency
- A special relay for generators, transformers, motors etc.
- Control relays: auto-reclose, tap change control, etc.
- Tripping and auxiliary relays