

MODULE : TB1

POWER SYSTEM PROTECTION

COURSE DESCRIPTION:

Current Transformers :

Distinction between CT and conventional transformers; Equivalent circuit and phasor diagrams; errors; ALF; Voltage developed across CT secondary ; CT ratio; Short time withstand current; Bar and wound primary CTs Classification based on application. (Metering, Protection and PS class.) ; CT specification.

Potential Transformers :

Errors; voltage factor; connections (star, delta, open delta and 'V' connections); PT ratio; Insulation level ; Classification based on application (Metering, Protection class) ; Protection of PT; PT specification.

Fault Level Calculations :

Impedance diagram; per unit and percentage impedance; sequence components; impedance to be considered for different network elements like generator, transformer, transmission line, motor, cable, etc; default figures where data not available; fault calculation procedures; step by step fault level evaluation exercise for phase fault and ground faults.

Relay Setting & Co-ordination :

Primary & back up protection; need for co-ordination; functional characteristics of protection scheme, including sensitivity, selectivity (discrimination by time, current and both time and current), and speed; Discrimination time (co-ordination interval); Criteria for setting pick ups and time dial for DMT and IDMT relays.

Tools available to reduce fault clearance time like instantaneous over-current; Instantaneous earth fault & Pilot wire protection; overload vs over current protection.

HT Motor Protection :

Major protection elements; thermal over load; over current vs overload; critical review of motor and relay thermal characteristics; major short comings; locked rotor; speed switch; negative sequence; unbalance vs negative sequence; short-circuit; ground fault (zero sequence); use of residual connected CT and CBCT; differential protection; under voltage protection; under current protection; special protection requirement for wound motor; rotor unbalance; additional protection for synchronous motor; loss of field.

LT Motor Protection :

Causes for LT Motor damage, Bimetal overload relay, HRC fuses, cost effective Motor Protection relay for contactor controlled motor, co-ordination between fuse and relay, Application of thermistors.

Generator Protection :

Protection elements; Stator over current; Stator earth fault (95% and 100%); Differential High impedance and low impedance schemes; Over voltage protection; Over fluxing protection; Rotor earth fault; Field over heating; Loss of excitation; Bearing vibration; Motoring (reverse power and low forward power) protection; Unbalanced armature current protection; Voltage controlled over current protection; Voltage restrained over current protection; Under frequency protection, withstand times for steam, hydro, DG and gas units; Comparison of protection practices from different references.

Busbar Protection :

Protection classification; High, medium and low impedance schemes; High impedance – current based scheme, AC & DC schematics, CT specification, work out for exciting current, KPV and stabilizing resistor, need for non-linear resistor, location of CTs to avoid blind spots; High impedance – Voltage based scheme, performance for internal and external faults, voltage setting calculations; Medium impedance scheme, one cycle protection, relay operation and characteristics for internal and external fault conditions; Low impedance schemes, numerical bus bar protection, stabilized differential algorithm & directional current comparison algorithm; Isolator auxiliary contacts – need for reliability.