



Training Program:

Transmission Line Protection

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Introduction:

This workshop has been designed to give plant operators, electricians, and field technicians and engineers a better appreciation of the role played by Power System Protection systems. An understanding of power systems along with correct management will increase your plant efficiency and performance as well as increasing safety for all concerned. The workshop is designed to provide excellent understanding on both a theoretical and practical level. The workshop starts at a basic level, to ease the engineer and technician into the perhaps forgotten art of studying, and provide a refresher to those who are more familiar with the basic topics covered. The workshop then moves onto more detailed applications. The workshop features an introduction covering the need for protection, fault types and their effects, simple calculations of short circuit currents and system earthing. The workshop also includes some practical work, simple fault calculations, relay settings, maintenance and the checking of a current transformer

Who Should Attend?

- Electrical Engineers
- Project Engineers
- Design Engineers
- Instrumentation and Design Engineers
- Electrical Technicians
- Field Technicians
- Electricians

Course Objectives:

This course is designed to enable participants to:

- The need for protection
- An overview of power system fault analysis
- Protection fundamentals
- Relay fundamentals, types and maintenance.
- System grounding principles
- Over-current earth fault protection
- Coordination principles
- Transformer protection
- Generator protection
- Bus protection
- Motor protection
- Line and feeder protection
- Principles of relay application

Course Outline

Basic Concepts of Power System Faults and Protection

- The Reasons For Protection
- Principles of protection
- Disconnection Devices
- Protection and system design

- Nature of short circuit currents
- Sources of Short Circuits
 - Short Circuit Protection Philosophy
 - Short Circuit Calculations
 - Categories of Protection
 - Back-up Protection
 - Unit Protection
 - Differential Relays

Instrument Transformers (CT &VT)

- Introduction To Current Transformers (Ct) And Voltage Transformers (VT)
- Voltage Transformers Theory, Characteristics And Applications
- Installation Of Voltage Transformers
- Maintenance Of Voltage Transformers
- Current Transformers Theory ,Characteristics And Applications
- Installation Of Current-Transformers
- safety Precautions
- Inspection.
- Grounding secondary circuits of instrument transformers

Protection Relays

- Electromechanical Relays
- Digital Microprocessor based Relay

- Time – Overcurrent Relays
- Instantaneous Current –Voltage Relays
- Directional -Sensing Power Relays
- Polar Unit
- Distance Relays (Source Impedance Ratio)
- Directional Comparison Relaying
- Phase Comparison Relaying
- Ground Over-current Relays (Earth fault relays)

Protective Relays Testing And Maintenance

- Introduction
 - Type Tests
 - Routine Factory Production Tests
 - Commissioning Tests
 - Periodic Maintenance Checks
 - Electrical Type Tests
- Electromagnetic Compatibility Tests
 - D.C Interrupt Test
 - A.C. Ripple on D.C. Supply
 - D.C. Ramp Down/Ramp Up
 - High Frequency Disturbance Test
 - Fast Transient Test
 - Surge Immunity Test

- Power Frequency Interference Test
 - Electrostatic Discharge Test
 - Conducted and Radiated Emissions Tests
 - Conducted and Radiated Immunity Tests
 - Power Frequency Magnetic Field Tests
- Product Safety Type Tests
 - Dielectric Voltage Withstand Testing
 - Insulation Withstand for Over-voltages
 - Single Fault Condition Assessment
 - Earth Bonding Impedance
 - CE Marking
- Environmental Type Tests
 - Temperature Test
 - Humidity Test
 - Cyclic Temperature/Humidity Test
 - Enclosure Protection Test
 - Mechanical Tests
- Software Type Tests
 - Static Unit Testing
 - Dynamic Testing
 - Unit Testing Environment
 - Software/Software Integration Testing

- Software/Hardware Integration Testing
 - Validation Testing
 - Traceability of Validation Tests
 - Software Modifications - Regression Testing
- Dynamic Validation Type Testing
 - Use of Power System Analogue Models
 - Use of Microprocessor Based Simulation Equipment
- Production Testing
- Commissioning Tests
 - Insulation Tests
 - Relay Self-Test Procedure
 - Current Transformer Tests
 - Voltage Transformer Tests
 - Protection Relay Setting Checks
 - Schemes using Digital or Numerical Relay Technology
 - Schemes using Electromechanical/Static Relay Technology
 - Test Circuits for Secondary Injection Testing
 - Primary Injection Tests
 - Testing Of Protection Scheme Logic
 - Tripping And Alarm Annunciation Tests
 - Periodic Maintenance Tests
 - Frequency of Inspection and Testing

- Maintenance Tests
 - Protection Scheme Design For Maintenance
 - Maintenance For Microprocessor Relays
- Troubleshooting
 - Troubleshooting Charts

Low Voltage Circuit Breakers

Moulded Case Circuit Breakers (MCCB)

- What Are Moulded Case Circuit Breakers?
- Circuit Breaker Components
- Ratings and Environment
- Motor Circuit Protectors
- Fuse vs. Circuit Breaker
- Accessories and Modifications
- Mounting and Enclosures
- Selection of molded case circuit breakers :
- MCCB CURVES

Air Circuit Breaker (ACB)

- Air Circuit Breaker Components
- Air Break Circuit-breaker Panel
- Air Break Circuit-breaker Truck

- Operating Mechanisms
- Air Blast Circuit Breakers

Fuses

- The High Rupturing Capacity (HRC) Fuse
- Fusing Element
- Fuse Mountings
- Fusing Factor
- Service of Fuses
- Specification of Fuses
- Trigger Fuses

Coordination Of Electrical Power systems

High Voltage Circuit Breakers

Air Break Circuit-Breakers (ACB)

Oil Circuit-Breakers (OCB)

SF6 Circuit-Breakers (SF6 CB)

SF6 Circuit Breaker (GIS)

Vacuum Circuit Breakers (VCB)

Generator Protection

Motor Protection

Transformer Protection

Bus Bar Protection