



EE167

Modern Power System Protection & Relaying Applications & Analysis

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- Apply proper techniques in power systems protection and relaying
- Identify various faults and their effects including the effect of faults on equipment
- Recognize the implications of various system grounding techniques on system performance
- Explain protection devices and technology including history, construction and principles of protection relays
- Discuss instrument transformers including current and voltage transformers as well as types, construction, performance, specification and applications
- Review tripping devices of circuit breakers and illustrate the mechanism of electric arc breakdown
- Explain the principles & calculation of settings for grading and protection coordination & cite practical examples
- Analyze overhead lines protection including the common types of faults and causes
- Implement the proper procedure for transformer protection related to restricted Buchholz relay, overpressure, oil and winding temperature
- Apply the proper procedure for motor protection by analyzing motor data requirements as well as identifying various electrical and mechanical faults
- List the various generator data requirements, types of faults, excitation fault protection and mechanical fault protection
- Identify miscellaneous protection including voltage and frequency protections, bus bar protection and circuit breaker failure protection

Who Should Attend?

This course is intended for electrical engineers, managers, supervisors, foremen and other technical staff involved in power systems protection and relaying.

Course Outline:

DAY 1:

- **Basic Concepts**
 - Introduction to the Topic
 - Main Electric Parameters and Laws

- Standards and Regulations
- Standard Voltages
- **Faults & Their Effects**
 - Types of Faults and Causes
 - Lightning, Switching Overvoltage and Use of Surge Arresters
 - Safety, Safety Distances and the Dangers of Faults
 - Short-circuit Faults (Phase and Earth Faults)
 - The Effect of Faults On Equipment (Thermal and Electromechanical Stress)
 - Short-circuit Calculations
 - Examples and Exercises
- **System Grounding**
 - Solid, Impedance and Ungrounded Systems
 - The Implications of Various Grounding Techniques on System Performance

DAY 2:

- **System Grounding (cont'd)**
 - Earth Grid and Calculations
 - Touch and Step Potentials
 - Examples and Exercises
- **Protection Devices and Technology**
 - Introduction to Protection
 - Protection Relays (History; Construction and Principles of Operation; Modern Technology)
 - Classification of Protection Relays and Codes
 - Main Protection and Back-up Protection
 - Intelligent Electronic Devices (IED's)
 - Fuses (Characteristics, Applications and Special Cares)
 - Examples and Exercises
- **Instrument Transformers**
 - Current & Voltage Transformers
 - Types, Construction, Performance, Specification and Applications
 - Magnetisation Curve and Characteristics (Ratio, Accuracy and Burden Power)
 - Testing
 - Examples
- **Tripping Devices – Circuit Breakers**
 - The Mechanism of Electric Arc Breakdown
 - Types of Circuit Breakers and Applications (LV, MV and HV)
 - Main Characteristics
 - Operating Mechanism, Tripping Circuits and Control Systems

- Examples

DAY 3:

- **Grading & Protection Co-ordination**

- Principles
- Analysis in HV, MV and LV Networks (Transmission and Distribution Networks; Users' Networks)
- Calculation of Settings
- LV Approach (Typical Time-Current Curves and Selectivity of LV Circuit Breakers)
- Practical Examples

- **Overhead Lines Protection**

- Analysis in HV, MV and LV Networks (Transmission and Distribution Networks) – Common Types of Faults and Causes
- Distance Protection (Principle and Application)
- Line Differential Protection (Principle and Application)
- Overcurrent Protection
- Temporary Faults and Auto-Reclosing
- Practical Examples

- **Cable Protection**

- Common Types of Faults and Causes
- Differential Protection
- Overcurrent Protection (Thermal and Short-circuit)

- **Transformer Protection**

- Basic Theory of Transformers
- Types of Transformers and Applications

DAY 4:

- **Transformer Protection (cont'd)**

- Main Electric Characteristics and Vector Group
- Built-on Protections (Buchholz Relay, Overpressure, Oil and Winding Temperature)
- Transformer Differential Protection (Principle and Application)
- Overcurrent Protection
- Practical Examples

- **Motor Protection**

- Motor Data Requirements
- Common Types of Faults (Electrical and Mechanical)
- Motor Controllers and Starters

- Overcurrent (Phase-to Earth and Phase-to-Phase Short-circuit) and Thermal Overload Protection
- Negative Phase Sequence, Phase Unbalance and Phase Reversal Protections
- Bearing Temperature, Winding Temperature, Vibration and Blocked Rotor Protections
- Practical Examples and Exercises
- **Generator Protection**
 - Generator Data Requirements and Basic Theory
 - Common Types of Faults (Electrical and Mechanical)

DAY 5:

- **Protection (cont'd)**
 - Rotor and Stator Electric Faults Protection
 - Excitation Fault Protection
 - Voltage and Power (Reverse Power) Protections
 - Overfrequency and Overspeed Protections
 - Mechanical Faults Protection
 - Practical Examples and Exercises
- **Miscellaneous Protections**
 - Voltage and Frequency Protections
 - Bus Bar Protection
 - Circuit Breaker Failure Protection
- **Protection Relay Management**
 - Scheme Design
 - SAT and FAT
 - Commissioning
 - Maintenance and Testing

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play

- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per the course location. This rate includes participant's manual, and-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee / Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee / Tea / Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Lunch Break & Prayer Break
13:30 - 15:00	Last Session