



ELECTRICAL FAULTS:

Causes, Analysis, Detection & Remedies

Course Introduction:

It is essential to know the short circuit current and KVA that the system will carry under different fault conditions and at different points in the system. The faults may be single line to ground, double line to ground, three line fault or line to line fault. Selection of circuit breakers, protective devices are mainly required information about the short circuit current.

Moreover fault analysis is essential in order to have safety operation of the power systems and to know the fault causes. It is important for engineers and technicians to be aware by fault causes, fault detection, fault protection and fault analysis. This course is designed to provide the participants with complete knowledge about fault calculations, fault detection and protective relays used for power systems and networks.

Course Objectives:

The objectives of this program are to present:

- The basic theory of three phase power system under balanced and unbalanced conditions.
- The per-unit system and analytical circuit based techniques to calculate industrial power systems for faults.
- Advanced engineering mathematical software that can be used to make difficult and complicated calculations an easy task.
- Balanced three-phase faults and unbalanced faults and their analysis using symmetrical components.
- Application of impedance reduction techniques and positive, negative and zero sequence circuits and their interconnection for faults.

Who Should Attend?

The course is designed to Electrical Engineers and Highly Qualified Technicians those working in Operation and Maintenance of Electrical Networks. Also, Engineers and Technicians those working in Protection of Electrical Networks.

Course Outline:

Module (1) Power System Sources and Configurations

- 1.1 Electrical Engineering Basic Concepts
- 1.2 Voltage Levels,
- 1.3 One Line and Three Line Diagram

- 1.4 Generation System Layout
- 1.5 Transmission Layout
- 1.6 Distribution Layout
- 1.7 Substation Layout
- 1.8 Case Study

Module (2) Utility Load Classifications

- 2.1 Residential loads
- 2.2 Commercial loads
- 2.3 Power Factor Correction
- 2.4 Utility factor

Module (3) The Per Unit System

- 3.1 General
- 3.2 Single Phase System
- 3.3 Three Phase System
- 3.4 Transformer Representation in the Per Unit System
- 3.5 System Analysis in the Per Unit System
- 3.6 Transformers with Off-Nominal Turns Ratios
- 3.7 Solid resistive earthing systems.
- 3.8 Summary
- 3.9 Case Study

Module (4) Symmetrical Components

- 4.1 General
- 4.2 Transformation of Phase Quantities to Sequence Quantities
- 4.3 Line and Cable Sequence Impedances
- 4.4 Transformer Sequence Networks
- 4.5 Rotating Machine Sequence Networks
- 4.6 Sequence Filters

Module (5) System Behavior due to Abnormal Conditions

- 5.1 Abnormal Operating Conditions Shortage of Reactive Power (Frequency
- 5.2 Deviations / Voltage Deviations / Collapse of Voltage / Voltage Stability / Voltage Rise) Electrical Faults:
 - 5.3.1 Generator Faults
 - 5.3.2 Motor Faults
 - 5.3.3 Transformer Faults
 - 5.3.4 Cables Faults
 - 5.3.5 Feeders Faults External Faults:
- 5.4.1 Lightning

- 5.4.2 Pollution
- 5.4.3 Switching
- 5.4.4 Transients
- 5.4.5 Harmonics

Module (6) Short Circuit Calculations & Circuit Interruption

- 6.1 Three Phase Faults
- 6.2 Line to Line Faults
- 6.4 Line to ground Faults
- 6.5 Equivalents System Impedance
- 6.6 Current Limiting Inductors
- 6.7 Short Circuit Level
- 6.8 Effect of Induction Machines on Short Circuit Level
- 6.9 CB Rupture Capacity
- 6.10 Example of Short Circuit Calculations

Module (7) Types of Earthing and Faults Current Level

- 7.1 Introduction
- 7.2 Selection of Grounding Method / System
- 7.3 Understanding Ground Resistance
- 7.4 Ground Resistance Value & Measurements
- 7.5 Effect of type of earthing on fault Current Level

Module (8) Transmission Lines and Feeders Faults Analysis and Protective Relays

- 8.1 Introduction
- 8.2 Transmission Lines Faults
- 8.3 Line to Ground Faults
- 8.4 Phase Faults
- 8.5 Transmission Line Protection
- 8.6 Directional - Non Directional - Over Current & Earth Fault Relays / Differential Relays
- 8.7 Male and False Operation Considerations 8.8 Case Study

Module (9) Power Transformers Faults Analysis and Protective Relays

- 9.1 Types of Faults
- 9.2 Through Faults
- 9.3 Internal Faults
- 9.4 Phase Faults
- 9.5 Earth Faults
- 9.6 Tank faults
- 9.7 Gas Actuated Relays 9.8 Buchholz Relays
- 9.9 Electrical Relays, Differential, Restricted Earth 9.10 Transformer with Ground Neutral

9.11 Case Study

Module (10) Motor and Generator Fault Analysis and Protective Relays

- 10.1 Stator / Rotor Faults
- 10.2 Ground Faults
- 10.3 Unbalance Current
- 10.4 Abnormal Voltage and Frequency
- 10.5 Over Voltage, Under Voltage
- 10.6 Over frequency, Under Frequency
- 10.7 Loss of Excitation
- 10.8 Overspeed Protection
- 10.9 Phase Faults

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 Certificate:

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

Course Fees:

To be advised as per course locations. This rate includes participant's manual, Hand-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

