ICTD

المركز العالمي للتدريب والتطوير

International Centre For Training & Development

FAULT ANALYSIS in Electrical Network

H.H. Sheikh Sultan Tower (0) Floor | Corniche Street | Abu Dhabi – U.A.E | www.ictd.ae | ictd@ictd.ae

Course Introduction:

The detection and identification of faults on an electrical network has been and still is one of the problems facing Transmission and Distribution companies. The characteristics and operation of a network system are major considerations in creating or reducing the effects of electrical faults on the system.

Effective modern protective systems are designed to sense faults and send a warning signal or initiate disconnection of the faulty system in an appropriate time.

Delegates are encouraged to participate by active involvement in group discussions and sharing experiences.

Course Objectives:

The objective of this course is to introduce to the trainees the types and causes of the different faults in power systems. The nature of the different causes and the methods to elevate such causes are also presented. The tools of analysis are to be addressed and discussed. Along with the faults, system behavior under different abnormal conditions is also presented. Many case studies are to be discussed with the trainees.

Who Should Attend?

This course is designed to be suitable for both generation and transmission lines electrical operation and protection engineers and technicians.

Course Outline:

1. Power System Components and System Grounding

1.1 Introduction

1.1.1 General

1.1.2 Importance of Continuity of Supply

1.1.3 Power System Components

1.1.3.1 Causes of Faults

1.1.3.2 Types of Faults

1.2 System Grounding

1.2.1 Introduction

1.2.2 Ungrounded Generation Units & Transformers

1.2.3 Transient over Voltages in Ungrounded Systems: Generators and Transformers

1.2.4 Grounded Detection Methods for Ungrounded Systems: Generators & Transformers

1.2.5 High Impedance Grounding Systems: Generators & Transformer
1.2.6 System Grounding for Mine or Other Hazardous Type Applications
1.2.7 Low Impedance Grounding: Generator & Transformers
1.2.8 Solid (Effective) Grounding Generators & Transformers
1.2.9 Ferro--resonance in 3-Phase Power Systems: Distribution Systems
1.2.10 Ferro-resonance in 3-Phase Power Systems: Transmission Systems
1.2.11 Arrangements of Grounding in Power Systems
1.2.12 Grounding Summary and Recommendation
1.2.13 Electric Shock and Its Effects on Humans
1.2.14 Ground Resistance
1.2.15 Transmission Line Grounds
1.2.16 Substation Grounding

2. Analysis of Power Generation & Transformer Systems and Analytical Tools for Fault Analysis

2.1 Power Generation Systems
2.1.1 General
2.1.2 Factors Affect the Fault Current Contribution & Continuity of Supply
2.1.2.1 General
2.1.2.2 Balanced Three–Phase Faults at No Load Generator
2.1.3 Relation between Substation Equipments Connections and the Fault Contribution
2.2 Transformers
2.2.1 Vector Group
2.2.2 Parallel Transformers with Different Vector Groups
2.2.3 Grounding Transformers
2.2.4 Common & Separate Grounding Resistance (High & Low Values)
2.3 Fault Calculations
2.3.1 System Configuration
2.3.2 Per-Unit Values
2.3.3 Symmetrical Components
2.3.4 Symmetrical & Unsymmetrical Fault Calculations
2.3.5 Short Circuit Level
2.3.6 Effect of Induction Machines on Short Circuit Level
2.3.7 Rupture Capacity of Circuit Breakers
2.3.8 Methods to Reduce the Short Circuit Level & Peak Current Limiters
2.3.9 Numerical Examples
2.4 Fault Analysis in Power Generation Plants
2.4.1 Generation Plants Outline

2.4.2 Types of Electrical Faults in Generating Plants

2.4.3 Methodology of Generator Fault Analysis

3. Mal & False Operation of Common Protective Relays Which Leads to Power System Disturbances

3.1 Introduction

3.2 Directional & Non-Directional over Current and Earth Fault Relays

3.3 Sensitive Earth Fault, Differential & Restricted Earth Fault, Directional and Distance Relays

3.4 Gas Actuating Relays

3.4.1 Buchholz Relay

3.4.2 Sudden Pressure Relays

3.5 Over Fluxing Relays

3.6 Case Study

3.6.1 A Case of a False Operation for an Out–Of–Step Relay (OS)

3.6.2 A Case of a False Operation of a Circuit Breaker

4. System Behavior due to some Abnormal Operational Conditions

4.1 Introduction

4.2 Shortage of Active Power & Frequency Deviation

4.3 Shortage of Reactive Power

4.3.1 Introduction

4.3.2 Voltage Deviations & Voltage Rise

4.3.3 Voltage Stability and Voltage Collapse with Case Studies

4.4 Maintenance Management and Fault Forecast

4.4.1 Maintenance Strategies

4.4.1.1 Run to Failure (RF)

4.4.1.2 Scheduled Maintenance (SM)

4.4.1.3 Condition Based Maintenance (CM)

4.4.2 Fault Forecast (Fault Detection)

5. Faults due to Unavoidable Causes and Network Improvement

5.1 Faults due to the Following External & Internal Influences

5.1.1 Lightning

5.1.2 Switching

5.1.3 Pollution

5.1.4 Harmonics

5.2 Network Performance Evaluation

5.3 Cause of Blackouts in Electrical Networks

5.4 Blackout in Power Systems

5.5 Preventive Measures of Blackout (Network Improvement Methods)

5.6 Case Studies Discussions

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 Questionaires
- 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