CABLE FAULT LOCATION & TESTING of Under Ground Power Cables
Course Introduction:

The Electricity Companies have to supply electricity to the consumers at the lowest possible cost commensurate with safety. Power cables represent a major capital asset for electricity suppliers. While in service power cables must be maintained and monitored in order to anticipate faults and possibility avert any failure.

Faults in underground cables can occur at any time, and the causes are many and varied. When faults do occur, they generally cause loss of supply to customers and loss of revenue for suppliers. So it is imperative that the fault location process is efficient and accurate to minimize excavation time, which results in reducing the inconvenience to all concerned. For fault locating to be efficient and accurate technical staff needs to have expert knowledge accompanied with experience in order to attained service reliability.

This course is designed to ensure that those responsible for selection, laying, operation, and maintenance and monitoring of power cables understand the technical issues involved and comply with relevant specifications and requirements.

Course Objectives:

At the end of the course, participants will be able to:

- Understand the essential characteristics and requirements of underground cables.
- Appreciate the technical options for selection, laying and maintenance of Power Cables.
- Apply practices for Fault detection and location for Power Cables.
- Identify Problems and failure modes of Cables
- Perform routine & preventative Maintenance and testing of Power System.

Who Should Attend?

- Engineers and Technicians from Electrical Power Utilities
- Companies, Manufactures and Distributors of Power Cables, Engineering Professional in Petrochemical Companies and Commercial Buildings.
- Participants need no specific requirements other than basic understanding of Electricity and Magnetism and knowledge of nature and operation of Power supply and underground distribution system.

Course Outline:

Module (1) Introduction of Power Cable Testing

1.1 Cable Construction
1.2 Cable Pipe  
1.3 Joints  
1.4 Terminations  
1.5 Accessories for XLPE cables

**Module (2) Testing of Distribution Cables**

2.1 Life Cycle / Test Cycle of a cable System  
2.2 Routine Tests  
2.3 Special Tests  
2.4 Type Tests  
2.5 Site Tests after installation

**Module (3) Testing of High/Extra H. Voltage**

3.1 Heat Sources in Power Cables  
3.2 AC & PD and Tan δ Testing Equipment’s  
3.3 Test Hole  
3.4 Impulse Voltage Test  
3.5 AC Voltage Test of the Insulation

**Module (4) Dielectric Losses**

4.1 Dissipation Factor (tan δ)  
4.2 Cables Measurements  
4.3 Three Conductor Cable Insulation Diagram  
4.4 Loss Measurement of Dissipation Factor  
4.5 Analysis of Cable Measurements Results  
4.6 Tan δ Instrument (Schering Bridge)  
4.7 Tan δ Instrument (Latest Technology)

**Module (5) Partial Discharge Techniques**

5.1 What is Partial Discharge?  
5.2 PD Detection for Cable Diagnostics  
5.3 Why Test for Partial Discharge?  
5.4 Physical Background of PD  
5.5 Types of Partial Discharge  
5.6 Characteristic of Discharge Patterns  
5.7 Breakdown Cable Voltage  
5.8 Partial Discharge Test Facility  
5.9 Test Circuit inside Shielded Room  
5.10 How to Calibrate the Partial Discharge System?
5.11 How to measure Partial Discharge?
5.12 Charge in Fault versus measured apparent charge and Measurement Results
5.13 P D Measurement methods Available
5.14 Importance PD for insulation of old XLPE cables

**Module (6) Very Low Frequency VLF**
6.1 Standard for onsite testing including VLF
6.2 Principle of VLF Generator
6.3 Dissipation Factor (tan δ)
6.4 Evaluation of tan δ measurements based on XLPE
6.5 Water treeing in Polymeric Insulation
6.6 Comparison of Electrical Treeing and Water treeing
6.7 Comparison Channel Growth
6.8 Simplified Dielectric Equivalent Circuit of a new Cables
6.9 Examples of Water Trees
6.10 Application of VLF / PD Diagnosis

**Module (7) Cable Fault Location and Tracing**
7.1 Introduction
7.2 Cable Fault Location Procedures
7.3 Cable Fault Types
7.2 PD Tracks in Slip Joins for Cables
7.3 Methods of Cable Fault Location
7.4 Time Domain Reflectometry (TDR)
7.5 Impulse Reflection Method (IRM)
7.6 Secondary impulse Method (SIM)
7.7 Multiple Impulse Method (MIM)
7.8 Fault Distance from Cable End
7.9 Bridge Method (Wheatstone)
7.10 Cable Tracing
7.11 Cable Locator
7.12 Acoustic Fault Location
7.13 Propagation Time Measurement
7.14 Pin Pointing Set
7.15 Audio Frequency Twist Method
7.16 Cable Sheath Fault location
7.17 Cable Test Van

**Module (8) Benefits of Cable Testing**
8.1 Reduction of in service cable failures  
8.2 Prioritization of cables in a cable replacement  
   - Program Schedules  
8.3 Answers with the ‘repair or replace’ question  
8.4 Development of a Documented History of Cable Condition.  
8.5 Cost Reduction due to reduce in Services Cable Failures  

**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