BOOST
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Electrical Engineering

Power Cable Failure Analysis & Investigation Techniques

Course Introduction

Underground power cables are becoming more and more important for a number of reasons. Firstly, they are being used more widely due to increased electricity consumption, the fact that overhead lines are being replaced by underground cables, and the trend towards offshore wind power generation.

Secondly, underground power cables are being developed for higher electric stresses and higher currents. This creates considerable challenges. Thirdly, there is a tendency to push existing underground power cables to their limits, which is associated with a range of issues. And all this is happening at a time when society increasingly depends on a reliable and efficient energy supply, The increased use of power cables means that in many urban areas cables now often form a significant portion of the capital invested by network operators.

You will learn how to carry out a thorough and well-documented investigation following a catastrophic failure, including procedures at the incident scene for recovery, handling and analysis of evidence, how to establish a panel of inquiry and how the data from failure analysis can be used for future asset management decisions.

Target Audience

- Circuits Engineer
- Design Engineer
- Electrical Controls Engineer
- Electrical Design Engineer
- Electrical Engineer
- Electrical Project Engineer
- Electronics-research engineer

Learning Objectives

- Understand the principles that cause failures and the skills to identify causes of failures
- Mitigate against the risk of future failures through improved asset management
- Improve procurement and specifying processes to reduce the risk of future failures
- Learn the processes needed to recover and handle evidence
- Gain essential knowledge of your legal obligations in a failure investigation
- Improve safety and enhance the reliability of key power assets

Course Outline

- **DAY 01**

  Module (01) Introduction

  - 1.1 Cable Construction
  - 1.2 Types of conductors
  - 1.3 Conductor Arrangement
  - 1.4 Cable Types
  - 1.5 Insulations
  - 1.6 Shielding and SEMICONDUCTING Tape
  - 1.7 Finishes and Jackets

  Module (02) Procedures and Techniques in Failure Analysis

  - 2.1 Stages of an Analysis
  - 2.2 Data Gathering
  - 2.3 Visual Examination
  - 2.4 Analytical Methods

- 2.5 Determining the Failure Mechanism
- 2.6 Actions following an Investigation

- **Day 02**

  Module (03) Failure Investigation in the Field

  - 3.1 Information Gathering
  - 3.2 Initial Actions
  - 3.3 Examination and Testing
  - 3.4 Selection of Samples
  - 3.5 Oil Sampling
  - 3.6 Handling and Transportation

  Module (04) Soil Thermal Resistivity

  - 4.1 Component Materials
  - 4.2 Density and Thermal Resistivity
  - 4.3 Water Content and Thermal Resistivity
  - 4.4 Customized Backfill
  - 4.5 Thermal Resistivity Measurements

- **Day 03**

  Module (05) Grounding System Impacts on Cables

  - 5.1 Solid Resistance Grounding
  - 5.2 Impact on Voltage During Fault
  - 5.3 Impact on Insulation Thickness
  - 5.4 Effect on Fault Current

  Module (06) Cable Failure and Their Analysis

  - 6.1 Mechanical Failures

- 6.2 Corrosion of Sheath
- 6.3 Moisture in The Insulation
- 6.4 Heating of Cables
- 6.5 Fire and Lighting Surges
- 6.6 Electrical Puncture
- 6.7 Inherent Causes
- 6.7.1 Sheath or Jacket Defects
- 6.7.2 Insulation Defects
- 6.7.3 Conductor Defects
- 6.8 Noninherent Causes
- 6.8.1 Corrosion of Sheath
- 6.8.2 Local Galvanic Action
- 6.8.3 Chemical Action
- 6.8.4 External Fire and HV Surges
- 6.8.5 Over Heating
- 6.8.6 Mechanical Damage
- 6.9 Other Causes
- 6.10 Failure Case Studies

- **Day 04**

  Module (07) Cable and Joint Failure Modes

  - 7.1 Electrical treeing
  - 7.2 Water Treeing
  - 7.3 Effects of DC Testing
  - 7.4 Failures of Joints and Accessories

  Module (08) Partial Discharge Techniques

  - 8.1 What is Partial Discharge
  - 8.2 PD Detection for Cable Diagnostics
  - 8.3 Why Test for Partial Discharge
  - 8.4 Physical Background of PD
  - 8.5 Types of Partial Discharge
  - 8.6 Characteristic of Discharge Patterns

    - 8.7 Breakdown Cable Voltage
    - 8.8 Partial Discharge Test Facility
    - 8.9 Test Circuit inside Shielded Room
    - 8.10 How to Calibrate the Partial Discharge System?
    - 8.11 How to Measure Partial Discharge
    - 8.12 Charge in Fault vs Measured Apparent Charge and Measurement Results
    - 8.13 PD Measurement Methods Available
    - 8.14 Importance PD for Insulation Of Old XLPE Cable Systems
- **Day 05**

  Module (09) Very Low Frequency VLF

    - 9.1 Standard for Onsite Testing Including VLF
    - 9.2 Principle of VLF Generator
    - 9.3 Dissipation Factor (Tanδ)
    - 9.4 Evaluation of Tan Δ Measurements Based On XLPE
    - 9.5 Water Treeing In Polymeric Insulation
    - 9.6 Comparison of Electrical Treeing and Water Treeing
    - 9.7 Comparison Channel Growth
    - 9.8 Simplified Dielectric Equivalent Circuit of a New Cables
    - 9.9 Examples of Water Trees
    - 9.10 Application of VLF / PD Diagnosis

  Module (10) Cable Fault Location and Tracing

    - 10.1 Introduction
    - 10.2 Cable Fault Location Procedures
    - 10.3 Cable Fault Types
    - 10.4 PD Tracks in Slip Joins For Cables
    - 10.5 Methods of Cable Fault Location
    - 10.6 Time Domain Reflectometry (TDR)
    - 10.7 Impulse Reflection Method IRM)
    - 10.8 Secondary Impulse Method (SIM)
    - 10.9 Multiple Impulse Method (MIM)
    - 10.10 Fault Distance from Cable End
    - 10.11 Bridge Method (Wheatstone)
    - 10.12 Cable Tracing

- 10.13 Cable Locator
- 10.14 Acoustic Fault Location
- 10.15 Propagation Time Measurement
- 10.16 Pin Pointing Set
- 10.17 Audio Frequency Twist Method
- 10.18 Cable Sheath Fault Location
- 10.19 Cable Test Va

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
April 7, 2025	April 11, 2025	5 days	4950.00 $	Netherlands - Amsterdam
July 7, 2025	July 11, 2025	5 days	2150.00 $	Virtual - Online
Dec. 22, 2025	Dec. 26, 2025	5 days	4250.00 $	UAE - Dubai