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# POWER CABLES: OPERATION, MAINTENANCE, LOCATION AND FAULT DETECTION



## OBJECTIVES:

Participants can use the skills and knowledge gained in this course to select and operate power cables and to perform testing and preventative maintenance to ensure safety and longer equipment life.

## WHO SHOULD ATTEND:

Anyone associated with power cable operation, maintenance, location and fault detection techniques. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting.

Typical personnel who would benefit are:

- Operations Personnel
- Electrical Maintenance Technicians and Supervisors
- Process Control Engineers
- Service Technicians
- Maintenance Personnel



## THE WORKSHOP

Faults in underground cables may cause loss of supply to customers and loss of revenue for suppliers therefore it is imperative that the fault location process is efficient and accurate to minimise excavation time. For fault locating to be efficient and accurate technical staff need to have expert knowledge accompanied with experience in order to attain service reliability.

This workshop is designed to ensure those responsible for the selection, laying, operation, maintenance and monitoring of power cables understands the technical issues involved and comply with relevant specification and requirements.

### PRE-REQUISITES

A fundamental knowledge of basic electrical concepts would be useful.

## PRACTICAL SESSIONS

- Study of manufacturer's specifications and data of typical cable types
- Examples of selection and sizing of cables in actual applications
- Study of manufacturer's information for different types of MV cable accessories
- Case studies of investigations of cable systems for residual life assessment
- Study of manufacturer's application notes of typical test instruments



## ON-SITE TRAINING

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- ✓ Have the training delivered when and where you need it.

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## THE PROGRAM

### DAY ONE

#### INTRODUCTION

- Historical perspective
- Development of cables for LV and HV systems
- Role of cables in modern power distribution systems
- Cable accessories and their role
- Cable failures and installation practices
- Detection of faults

#### BASIC THEORY

- Construction
- Conductor materials and configurations
- Insulation materials
- Use of screen in HV cables
- Use of armor for ground continuity and mechanical protection
- Special and single core cables
- Voltage rating
- Stress distribution in single core and multi-core power cables
- Electrical breakdown of insulating materials
- HV cables using XLPE insulation
- Treeing in XLPE and need for end sealing of cables
- Manufacturing process
- Standards for cables

#### *Practical Session*

#### SELECTION OF CABLES AND INSTALLATION

- Criteria for selection
- Cable sizing
- Installation - Directly buried
- Installation - Conduits
- Installation on structures
- Special needs Eg. Bending radii

#### *Practical Session*

#### JOINTS AND TERMINATIONS

- Basic approach
- Broad classification
- Comparative merits
- Pre-fabricated
- Site fabricated
- Additional requirements of outdoor terminations
- Reconstitution of cable properties
- Special joints
- Mechanical protection
- Stress control

#### *Practical Session*



### DAY TWO

#### JOINTING AND TERMINATIONS

##### PRACTICE

- Kits for joints and terminations
- Shelf life issues
- Matching diameter of insulated conductor with kit specifications in pre-fabricated kits
- Preparation of cable
- Connection
- Reconstitution of cable properties
- Continuity and earthing aspects
- Sealing
- Healthiness
- Installation aspects for joints

#### COMMISSIONING AND PERIODIC TESTING

- Review of codes for testing requirements
- Drum length checks
- Post installation checking
- Pre-commissioning and periodic tests
- Tests as tools for condition monitoring and early failure alarm
- HV tests using DC and very low frequency AC
- Partial discharge tests and mapping of results
- Dielectric dissipation factor measurements
- Micro destructive and non-destructive tests for life assessment
- Operation and maintenance of cables

#### *Practical Session*

#### FAILURE MODES AND FAULT DETECTION

- Types of failures
- Reasons for failures
- Fault Location
- Electrical tests for detection of cable faults
- Safety issues in fault location
- Analysis of failures

#### *Practical Session*

#### NEW TRENDS IN CABLE TECHNOLOGY

- Increasing preference to underground cables
- New technologies for very high capacities and voltages
- EHV XLPE in sub transmission systems
- High temperature superconductivity in cables

#### SUMMARY, OPEN FORUM AND CLOSING