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INSTALLATION AND TESTING
of Underground 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 possibly avert any failure. While requirement for underground cables have been increasing, there has been a rapid development of new cable types and accessories including the use of polymeric cables (predominantly XLPE). Evaluating technical and economic aspects of new cable systems is not easy. Furthermore the installation of underground power requires unique skills and knowledge. Tasks involved cover many aspects: laying, jointing, testing and commissioning underground cables, to cable location and fault-finding. Changes in systems also bring additional costs in stores holdings, job instruction preparation and jointer training.

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 the selection, laying, operation, maintenance and monitoring of power cables understand the characteristics, technical issues involved and comply with relevant specifications and requirements.

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Course Objectives:

After the course, participants will be able to:

- Understanding of the cable installation
- Understand the essential characteristics and requirements of underground cables
- Appreciate the technical options for selection, laying and operation of power cables
- Carry out jointing and termination of high voltage underground cables
- Apply practices for fault detection and location and for power cables
- Identify problems and failure modes of power cables
- Perform routine and preventative maintenance, monitoring and testing of power cables

Who Should Attend?

It is suitable for Managers, Engineers and Technicians responsible for the management, operation and maintenance of Electrical Power Networks who require refreshing their knowledge and skills

Course Outline:

DAY ONE

- Identify the various types of cables, connectors, materials and methods of connection.
- Cable insulation resistance
- Testing Insulation Quality with AC
- Testing Insulation Quality with DC
- Spot Check test
- Polarization Index test
- Step Voltage Test
- Effects of Humidity and Temperature on cable insulation resistance
- Describe the construction of cables, classification, conductors materials and configurations, the different applications and voltage of cables
- Apply the latest techniques in HV/MV cable splicing jointing, terminating and testing
- Apply the theory of joints and terminations
- Underground cable capacity
- Cables installed in ducts
- Short circuit

DAY TWO

- Practice cable jointing, splicing, testing and terminating
- Raisons for cable failures, analysis and predictive maintenance
- Method of repairing the damaged cable outer sheath for XLPE cables.
- Method of repairing the silicone oil leak of XLPE cable sealing ends
- Short circuit effect on cables
- Permitted voltage drop
- Visual inspection of the cable sealing ends, stop joints & transmission joints.
- XLPE cable and cable system standards
- High and low voltage cables inspection

DAY THREE

- Joints.
- Open terminations
- Resistive stress control
- Cable termination design
- Enclosed terminations
- Crimp connection
- Pulling the cable
- Installing cable racks
- Cable jacket and sheath removal

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- Cable metallic shielding removal
- Cable semi-conducting material removal
- Cable insulation removal
- Cable splice connector
- Installing taped cable insulation

DAY FOUR

- Identification of conductors
- Conduits
- Cable supports
- Cable tray
- Trenches
- Service entrance
- cable maintenance
- cable termination
- 0.1 Hertz Test Set
- IEC tests of cables , joints and terminations, type tests , routine tests, commissioning tests and maintenance tests
- Routine tests of XLPE cables and accessories
- PD-measurement test.
- High-voltage test of main insulation
- Electrical test of over sheath, if required
- Visual inspection
- Sample tests
- Sample tests are carried out with a frequency according to applicable IEC standards.
- Conductor examination
- Electrical resistance of conductor
- Check of dimensions
- Capacitance test
- Hot set test
- Electrical tests
- After laying tests
- DC voltage test of over sheath
- AC voltage test of main insulation

DAY FIVE

- Steps for fault location
- Fault location methods
- Surge generator method

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- Electromagnetic Impulse Detector method
- Time domain reflectometry (Control and inputs to the TDR)
- Acoustic Detection method
- Voltage Decay Reflection method
- Arc Reflection method
- Resistance Ratio-Wheatstone (resistance) bridge
- Sectionalizing method
- safety precautions and the use of spiking tools

Case Study

Appropriate case studies will be used during the training to consolidate delegates' learning Delegates should come to the training with an example of a project they may wish to undertake and deliver in future. Delegates will be asked to work in groups to practice planning skills and learn various concepts and techniques

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

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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

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