Training Program:

DISTRIBUTION POWER TRANSFORMER

Introduction:

Installation of high voltage distribution and transmission equipment has increased significantly over the years due to ongoing global demand for power. As a result, the need to ensure the reliability of operation of power systems is paramount. Power transformers and switchgears are among the most important and most expensive components of power systems, their failure can impose extraordinarily high costs on plants, factories and utilities of all descriptions. It is critical that all personnel operating and working with such equipment have a sound knowledge of their operational requirements and maintenance. This course introduces the new technologies of electrical equipment maintenance and monitoring. On the other hand detailed knowledge on both the theory and operation of Transformers, Switchgear components are introduced. The course will develop and enhance an understanding of what is involved in the maintenance of these essential components of the power systems, through the tips and tricks learnt and developed by some of the World's pre-eminent electrical engineers.

Course Objectives:

By the end of this course delegates will be able to:

- An understanding of the new technologies of electrical equipment maintenance and monitoring.
- An understanding of the fundamental theory and principles of the construction and the operation of power transformers
- An insight into the identification and application of transformers' types
- Knowledge of power transformer protection

- An understanding of power transformers oil and oil tests and interpretation of results
- Knowledge of the most effective power transformer electrical tests
- Skills in how to manage power transformer breakdowns to ensure minimum disruption
- An understanding of Instrument Transformers (CT &VT) and its applications for measurements and protection
- An understanding of earthing system and electrical safety
- An understanding of Protection relays types, operation and maintenance
- An understanding of Circuit breakers types, operation and maintenance
- An understanding of Capacitor banks, cables and batteries types, protection and maintenance

Course Outline:

NEW TECHNOLOGIES OF ELECTRICAL EQUIPMENT MAINTENANCE AND MONITORING

- Approaches Based On Mathematical Models
- Partial Discharge
- Testing and Monitoring Solid Insulation of Electrical Equipment
- Insulation resistance test (IR)
- Megger test
- Polarization index test
- Dc hi-pot test
- Measuring insulation degradation
- Insulation Power Factor
- On Line Measuring Partial Discharge Activity For Insulation

- On-Line Monitoring Of Transformers
- Local Indications
- Thermography
- PDA - Partial Discharge Analysis
- Insulating Oil Properties and Tests
- Test for Dielectric Strength
- Water Content in Oil
- Acidity Test (Neutralization Number)
- Oxidation Inhibitor
- Interfacial Tension Test (IFT)
- Oil Color
- Oil Power Factor Test
- Recording Test Results

Insulating Oil Dissolved Gas Analysis (DGA)

- Objective of Periodic Sampling and Analysis
- Drawing Oil Samples
- Dissolved Gas "Alert" Limits
- Rate of Change of Gas Concentration
- Frequency of DGA
- Release of CO2 and CO
- Fault Gas Release
- Release of Acetylene
- DGA Test Report

- DGA Trends
- Continuous Gas Monitoring

Optical cable Temperature Monitoring

- Understanding cable thermal behaviour after installation
- Distributed Fiber Optic Sensors
- Raman Distributed Temperature Sensors
- Distributed Temperature Sensing (DTS)
- Features that allow DTS to work

INSTRUMENT TRANSFORMERS (CT &VT)

- Voltage Transformers Theory, Characteristics And Applications
- Installation Of Voltage Transformers
- Maintenance Of Voltage Transformers
- Current Transformers Theory ,Characteristics And Applications
- Equivalent circuit
- Errors (Ratio and Phase)
- AC saturation
- Selection of CTs
- CT magnetization curves
- Burden and Calculation of maximum impedance for current transformer
- Precautions when working with CTs
- Ratings Of Current Transformers
- Installation Of Current-Transformers

- Testing of CTs and VTs

TRANSFORMERS

Transformer Fundamentals

- Transformer theory
- Transformers main functions and classification
- Operation of power transformers in a power system
- Transformer Types
- Power Transformers Earthing Systems
- Power Transformer Electrical Tests
- Ac Tests
- Power factor tests (Insulation, Oil, and Bushings)
- Single Phase Excitation Current Test
- Transformer Turns Ratio Test

Dc Tests:

- Insulation Resistance Test
- Dielectric Absorption Test
- Polarization Index Test
- Step Voltage Test
- Hi-Pot Test
- Preventative Maintenance On Power Transformers
- Power Transformer Oil And Oil Quality
- Power Transformer Protection

EARTHING SYSTEM AND ELECTRICAL SAFETY

- Equipment Earthing

- System Earthing
- Unearthed Systems
- Solid Earthing
- Resistance Earthing
- Reactance Earthing

Classification Of Supply / Installation System Earthing

Earthing Via Neutral Earthing Compensator

- Distribution Transformers
- Zig Zag Transformers
- Lightening Arresters
- Electrical Hazardous And Safety
- Touch And Step Voltage
- Effect of electric shock on human beings
- Sensitive earth leakage protection
- Arc Flash
- Arc Flash PPE
- Reducing Hazard by Design
- Reasons of Arc Flash Occurrence
- Main Characteristics of Arc Flash

PROTECTION RELAYS

Relays Basic Design Principles And Applications Electromechanical Relays

- Time – Over-current Relays
- Instantaneous Current –Voltage Relays
- Directional -Sensing Power Relays

- Polar Unit
- Distance Relays (Source Impedance Ratio)
- Directional Comparison Relaying
- Phase Comparison Relaying
- Ground Over-current Relays (Earth fault relays)

Transition From Electromechanical To Digital Microprocessor Based Relay

- Protective Relays Testing and Maintenance
- Introduction
- Electromagnetic Compatibility Tests
- Product Safety Type Tests
- Environmental Type Tests
- Software Type Tests
- Dynamic Validation Type Testing
- Troubleshooting
- Commissioning Tests
- Production Testing

CIRCUIT BREAKERS

- Arc Phenomena and Circuit Interruption
- Arc Phenomena and Circuit Interruption
- ARC EXTINGUISHERS
- Arc Control Techniques
- Arc Control Methods
- Breaking Capacity

- Duties of Switchgear
- Circuit Breakers types and its Fundamentals
- Importance of adequate H.V. Circuit-Breakers Testing and Maintenance
- Type Tests for High Voltage A.C. C.B.
- Routine Tests for High Voltage Circuit-Breakers :
- Safety precautions to be taken in maintenance of a circuit-breaker:
- Commissioning Tests :
- HV Circuit Breaker Routine Maintenance
- Acceptance and maintenance requirements For Low voltage CB