Training Program:

Transformers & Circuit Breakers Testing & Maintenance

Introduction:

Your transformer is a valuable device with many mechanical and chemical processes taking place all the time. This course combines theoretical and practical aspects of transformer design, operation, maintenance, testing, and troubleshooting. Switchgears play an important role in the distribution and control of electrical power in manufacturing or power plant and in a utility distribution system. Negligent maintenance practices can lead to power system inefficiency and loss of system reliability. Detailed knowledge on both the theory and operation of Transformers, circuit breakers 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.

This seminar is designed to update participants with the latest development of Circuit Breakers and to present some of the more common and updated aspects of low, medium and high voltage switchgear maintenance and troubleshooting. In addition to, necessary knowledge to maintain and test power transformer efficiently and safely is covered. Moreover, the course offers the participant the information necessary in helping him prevent premature failure and costly unplanned outages. The participant will learn the oil and electrical test requirements and how to interpret the test data as well as setting up a proper preventative maintenance program.

Who Should Attend?

Electrical Engineers, Power Generation Engineers, Mechanical Maintenance Personnel, Power System Protection Engineers, Gas turbine newcomers and more experienced persons who desire an overview of the many available gas turbine

technologies, Process Control Engineers & Personnel, Electrical and Instrumentation Technicians & Design Engineers, Maintenance Technicians & Supervisors, Plant Operators & Technicians, Oil & Gas Industry Personnel

Course Objectives:

This course aims are to provide understanding of the basic fundamentals and constructional features of Power Transformers and circuit breakers with particular reference to the design, testing, operation and maintenance aspects. Upon completion of this course, the participant should be able to:

- Explain the basic operation of a transformer as a main component in any electrical network.
- Discuss the electrical testing performed on transformers such as insulation resistance testing, excitation and power factor testing.
- Discuss the various tests performed on insulating oil.
- Understand Safe and proper maintenance and troubleshooting procedures on power transformer.
- Examine the possibilities of maximizing efficiency and economic performance of your transformer fleet
- An understanding of Circuit breakers types, operation and maintenance
- Evaluate the advantages of modern state-or-the-art switchgear protection for your applications, including preventative maintenance information
- Gain knowledge of both the underlying principles and practical applications of power transformers and breakers in today's competitive world

Course Outline

New Technologies of Electrical Equipment Maintenance and Monitoring

- 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

Transformers

- Transformer Fundamentals
- Transformer theory & performance
- Transformers main functions and classification
- Operation of power transformers in a power system
- Transformer Types
- Nameplate data
- Transformer parameters
- Various vector groups
- Transformer tap changer (off-load and on-load)
- Parallel operation
- Maximum efficiency
- Dry type transformer
- Transformer noise
- Permissible loading of oil-immersed transformers
- Special transformers
- Power Transformers Earthing Systems
- Power Transformer Electrical Tests

- Preventative Maintenance on Power Transformers
- Power Transformer Oil and Oil Quality

Transformer Testing

- Test data
- Abnormal operating conditions of power transformer
- Reasons for transformer testing
- Transformer performance assurance
- Classification of transformer tests
- Winding resistance test
- Polarity test
- Ratiometer test
- No-load losses test
- Load losses test
- Percentage impedance voltage measurement
- Leakage reactance measurement
- Efficiency test
- Winding insulation resistance test
- Winding insulation capacitance & dissipation factor (tan δ) test
- Sudden short circuit withstand test
- Oil pressure test
- Temperature rise test
- Impulse testing
- Transformer arrival: Handling, Inspection And Pre-Commissioning

Circuit Breakers

- 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
- HV CB Routine Maintenance
- Acceptance and maintenance requirements for LV CB

CBs Failure investigation

- Failure investigation
- Procedure for the investigation of circuit breaker failures
    - Immediate action
    - Investigations

  - Recommended plan of action

- Failure analysis
  - Operating mechanism failures
  - Failures due to degradation of external solid insulation
  - Failures due to voltage transients
  - Failures due to misapplication
  - Failures due to animals
  - Other causes of failures
  - Failures due to loss of SF6
  - Failures due to degradation of the SF6
  - Failures due to SF6 gas liquefaction
  - Failures due to degradation of Internal solid insulation
  - Interrupter failures
- Bulk & Minimum oil circuit breakers
- Vacuum circuit breakers
- Air magnetic circuit breakers
- Air blast circuit breakers

- circuit breakers
- Failure modes and causes
- Diagnostics & Diagnostic tests

Accreditation:

BTS attendance certificate will be issued to all attendees completing a minimum of 80% of the total course duration.