CONCEPT

Power and Distribution Transformers: Operation, Testing, Protection and Maintenance

2 – 6 August 2027
Barcelona - Eixample district four-star



Power and Distribution Transformers: Operation, Testing, Protection and Maintenance

Ref: 141_10027 **Date:** 2 – 6 August 2027 **Location:** Barcelona - Eixample district four-star **Fees:** 23500 SAR

Introduction:

Power transformers are among the most expensive and slowest-to-replace assets in any substation or plant, yet many fail early because loading, oil condition, tap changer wear and protection settings are not checked against clear criteria. This Core Concept course gives engineers and technicians the working knowledge to operate power and distribution transformers within thermal limits, run and interpret routine electrical and oil tests, verify differential, Buchholz and overcurrent protection, and plan maintenance on evidence. Participants produce a Transformer Condition Assessment and Maintenance Plan for a real unit.

Course Objectives:

- Interpret transformer nameplate data, vector group codes, cooling modes and tap changer arrangements before switching or loading a unit
- Operate power and distribution transformers within loading and thermal limits using oil and winding temperature indications
- Perform and interpret turns ratio, winding resistance, insulation resistance and oil quality tests against baseline results
- Diagnose incipient faults from dissolved gas analysis using the Key Gas, Rogers Ratio and Duval Triangle methods as described in IEEE C57.104 and IEC 60599
- Verify transformer differential, Buchholz and overcurrent protection and investigate trips and alarms safely
- Build a Transformer Condition Assessment and Maintenance Plan that ranks units by health and sets test and overhaul intervals

Target Audience:

- Electrical engineers responsible for substation and plant transformer operation
- Maintenance technicians who carry out transformer inspections, oil sampling and routine electrical tests
- Protection and testing engineers who commission and check transformer relays and trip circuits
- Asset and reliability engineers who track transformer condition and plan overhauls
- Shift supervisors who switch, load and respond to transformer alarms in power, utility and industrial sites

Course Outline:

Day 1: Transformer Principles, Construction and Ratings

- Electromagnetic Induction, Turns Ratio and Equivalent Circuit of a Transformer
- Laminated Silicon Steel Core, Hysteresis and Eddy Current Losses
- Winding Construction with Oil-Impregnated Paper and Pressboard Insulation
- Nameplate Reading: kVA and MVA Ratings, Impedance Voltage and Cooling Class
- Power Versus Distribution Transformer Duty and Efficiency Comparison

Day 2: Vector Groups, Tap Changers, Cooling and Loading

- Dot Convention, Polarity and Three-Phase Vector Group Codes for Wye and Delta Connections
- Parallel Operation Conditions: Matching Ratio, Vector Group and Impedance
- Off-Circuit Tap Changer Versus On-Load Tap Changer Selector and Diverter Operation
- Oil Natural, Forced-Air and Forced-Oil Cooling Stages and Fan and Pump Controls
- Loading Limits, Hot-Spot Temperature and Oil and Winding Temperature Indicators

Day 3: Transformer Testing and Oil Analysis Procedures

- Turns Ratio Test Procedure and Interpretation of Ratio Deviation
- Winding Resistance Measurement and Tap Changer Contact Condition
- Insulation Resistance and Polarisation Index Testing with Temperature Correction
- Insulating Oil Sampling, Breakdown Voltage and Moisture Checks
- Dissolved Gas Analysis: Key Gas, Rogers Ratio and Duval Triangle Interpretation

Day 4: Transformer Protection, Faults and Troubleshooting

- Transformer Differential Protection: Ratio Correction and Stability During Inrush
- Buchholz Relay Gas Alarm and Surge Trip with Conservator Gas Sampling
- Overcurrent and Earth Fault Protection for Transformer Feeders
- Sweep Frequency Response Analysis for Winding Deformation and Core Movement
- Fault Tracing Flowchart for Trips, Overheating, Oil Leaks and Abnormal Noise

Day 5: Condition Assessment Walkthrough and Maintenance Plan

- Substation Transformer Safety: Isolation, Earthing and Safe Approach for Inspection
- Inspection Walkthrough: Bushings, Conservator, Breather, Radiators and Gaskets
- Transformer Health Index Scoring from Test, Oil and Operating History
- Life Management Options: Oil Treatment, Tap Changer Overhaul, Refurbishment or Replacement
- Transformer Condition Assessment and Maintenance Plan Presentation

Skills You Will Gain:

- Transformer Nameplate Interpretation
- Vector Group Analysis
- Thermal Loading Control
- Electrical Test Interpretation
- Fault Gas Diagnosis
- Protection Scheme Verification
- Transformer Fault Tracing
- Health Index Scoring

Why Attend This Course:

- Return with a Transformer Condition Assessment and Maintenance Plan that ranks your units and sets test and overhaul intervals
- Read test and oil results with confidence and tell a developing fault from normal ageing before it causes an outage
- Respond to Buchholz, temperature and differential alarms with a clear fault-tracing sequence and safe isolation steps
- Compare transformer practice with engineers from power generation, electricity networks, oil and gas, water and heavy industry

Conclusion:

Power transformers stay in service longest when they are loaded within thermal limits, tested against a baseline and protected by schemes that are known to work. This course moves from construction, ratings and vector groups, through tap changers, cooling and loading, to ratio, resistance, insulation, oil and dissolved gas testing. It then covers differential, Buchholz and overcurrent protection and fault tracing, before the final day applies an inspection walkthrough to produce a Transformer Condition Assessment and Maintenance Plan.