



POWER TRANSFORMER

Construction, Testing and O&M

Course Introduction:

Transformers are major components of electrical power systems. Their ratings can vary from small size distribution transformers of a few kVA up to very large power transformers of 1000 MVA or more. In terms of voltage ratings transformers can have operating voltages up to several hundreds of kilovolts. Failure of a transformer can be very costly because of the damage to the transformer itself and due to the consequences of such failure. This may include disruption of supply, explosions or fire damage. Therefore, the power transformers should be properly operated and maintained.

This course combines theoretical and practical aspects of transformer design, operation, maintenance and troubleshooting. The course emphasizes the importance of the magnetic properties of the core design on the transformer's operational performance and electrical properties. It addresses economic trade-offs of transformers in real-world applications.

The course covers transformers used in commercial and industrial power distribution systems, including oil and dry-type units. Larger power transformers used in utility applications are also covered.

Course Objectives:

Upon completion of the course, participants will be able to:

- Understand transformer life cycle and maintenance planning.
- Understand transformer standards
- Understand transformer factory testing and quality assurance
- Understand the electrical testing methods performed on transformers such as insulation resistance testing, excitation and power factor testing.
- Have practical solutions for specifying, operating and maintaining power transformers in a utility or plant environment.
- Have comprehensive understanding of principles, selection, testing and commissioning, protection, maintenance and troubleshooting of distribution and power transformers.
- Know the necessary safe procedures relating to transformer operation and related circuitry.

Personal Impact:

Delegates will gain an overall appreciation of Transformer Operational Principles, Selection and Troubleshooting in electric power systems. The delegates will be able to:

- Understand the principles of operation of transformers
- Identify the different features of power transformers, distribution transformers and instrument transformers
- Understand the principles of transformer design, ratings, windings, core structure and materials, insulation and cooling methods, insulation and lifetime

- Be familiar with construction of the transformer and its winding connections
- Recognize the effects of transformer load changes and off-load and on-load tap changers
- Utilize thermal limits and loading guides of transformers.
- Perform transformer maintenance and transformer testing

Organizational Impact:

The course will allow delegates to interact and gain from shared experiences of others. Many practical examples and case studies will be used to illustrate the material being discussed and in particular, emphasis will be given to ensure that the material is appropriate to the organisations represented. Each delegate should leave with an awareness and understanding of the latest trends in transformers operation and maintenance. Safe working practices will be stressed and diagnostic techniques suitable for monitoring purposes will be introduced allowing hands-on approach to judging companies maintenance requirements for the future.

Competencies Developed:

At the end of the course the attendees should be able to better understand the key role of the Transformer Operational Principles, Selection and Troubleshooting in the safe, secure and economic operation of power networks. They will have a thorough understanding of the application, installation, maintenance and testing issues related to transformers.

At the end of the course the delegates will be aware of the trends in modern power transformers design and fault diagnostic techniques. The requirements of Health and Safety will be paramount in their approach to design and maintenance. Delegates should leave feeling that they are equipped with safe working practices and understanding of cost-effective preventative maintenance.

Who Should Attend?

- Engineers and technicians from electricity supply industry
- Engineering professionals from companies manufacturing and operating Power and Distribution Transformers
- Engineers and technical personnel from petrochemical plants and service managers of buildings and hospitals

Course Outline:

Day 1: Theory and Principles

- Air Core Transformer
- Iron or Steel Core Transformer
- Equivalent Circuit of an Iron-Core Transformer
- The Practical Transformer

Magnetic Circuit - Leakage Reactance - Load Losses - Short-Circuit Forces - Thermal Considerations - Voltage Considerations
Standards for Transformers, Types and Requirements
Case studies

Day 2: Transformer Types

- Power Transformers
- Distribution Transformers
- Phase-Shifting Transformers
- Rectifier Transformers
- Dry-Type Transformers
- Instrument Transformers
- Step-Voltage Regulators
- Constant-Voltage Transformers

Case Studies and Workshop Discussion

Day 3: Transformer Features and Thermal Performance

- Thermal performance and Cyclic Rating of Transformers.
- Transformer Impedance, Electromagnetic Forces
- Transformer Construction: Cores, Assembly
- Transformer Windings Construction
- Transformer Tanks and Radiators, Tank Losses, Paint Treatments
- Transformer Fittings: Lifting Lugs, Undercarriages, Jacking Pads, Tie-Down Lugs, Bleed Pipes, Thermometers

Case Studies and Workshop Discussion

Day 4: Transformer Operation and Maintenance

- Distribution Voltage Adjustment, Off-Load Tap Changing, On-Load Tap Changing
- Switching of high voltage underground cables supplying Distribution Transformers
- Grounding and Over-Current Protection of Distribution Transformers
- Transformer Maintenance: Oil preservation, Deterioration of oil, Breathers, Condition Monitoring
- Faults in Transformers, Tappings and Windings
- Advanced Transformer Maintenance

Case studies and Workshop Discussion

Day 5: Transformer Testing

- Transformer Routine Tests

- Measurement of winding resistance
- Measurement of voltage ratio
- Measurement of impedance voltage short-circuit impedance and load loss
- Measurement of No-load loss and current
- Insulation resistance
- Harmonics testing
- Separate-source power-frequency voltage withstand test
- Induced overvoltage withstand test
- Transformer Type Tests
- Temperature-rise test
- Lightning impulse test
- Sound level
- Special Tests: Transformer Partial Discharge testing
- Accuracy and Interpretation of test results and of test reports

Case studies and Tutorials

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 Questionnaires
- Group Work
- Discussion
- Presentation

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
