

# **PRACTICAL TROUBLESHOOTING OF ELECTRICAL EQUIPMENT & CONTROL SYSTEMS**



**EPE101  
Electrical &  
Power  
Engineering**

**COURSE TITLE****PRACTICAL TROUBLESHOOTING OF ELECTRICAL EQUIPMENT & CONTROL SYSTEMS****COURSE DATE/VENUE**

06 Jan - 10 Jan 24'

Istanbul, Turkey

**COURSE REFERENCE**

EPE101

**COURSE DURATION**

05 Days

**DISCIPLINE**

Electrical & Power Engineering

**COURSE INTRODUCTION**

To successfully inspect and test electrical equipment, Electrical personnel must first fully understand the technology of the electrical equipment. After the successful start-up and subsequent continued operation, electrical equipment requires periodic inspection and testing.

This will ensure the electrical equipment operates correctly so that production is maximized in a safe, cost effective and efficient manner.

Delegates are encouraged to raise queries both during and at any time after attending the course and are also asked to bring with them any technical issues that they may have.

**COURSE OBJECTIVE**

Participants attending this program will:

Return to their respective organizations equipped with new or refreshed skills to ensure that electrical equipment is inspected, tested and operated in safe and a fashion that ensures reduced costs. On successful completion of this course, participants will have:

- A better understanding of maintenance purposes and types.
- A better understanding of inspection and testing methods
- A better understanding of the updated electrical condition monitoring.
- A better understanding of troubleshooting procedures
- An improved capability in testing equipment
- A better understanding of safety issues.
- A refreshed outlook on reading electrical drawings
- A refreshed awareness of electrical safety concerns

### **COURSE AUDIENCE**

This course is intended for Electrical Engineers, Electrical Supervisors and Electrical Technicians engaged in the maintenance, inspection and testing of Electrical Equipment. Because the methods and examples are generic, personnel from all industries will benefit. Participants require a good understanding of electricity and magnetism and possess some relevant experience.

### **COURSE CONTENT**

#### **I. Principles Of Maintenance**

1. Preventive Maintenance (PM)
2. Predictive Maintenance(PdM) (Condition-Based Maintenance) (CBM)
3. Impact of Maintenance

#### **II. Maintenance Scheduling For Electrical Equipment**

1. Introduction
2. Maintenance and Test Procedures
  - General.
  - Infrared Scanning

- Fault and Load Flow Studies/Equipment Ratings
- Electrical Equipment Monitoring
- Maintenance Schedules and Documentation.

### 3. Electrical equipment maintenance schedules

(Transformers, Generators, Power Cables, Batteries and Battery Chargers)

## III. Testing, Troubleshooting Principles and Commissioning Guide Of Electrical Equipment

1. Introduction
2. Basic principles in using a drawing and meter in Troubleshooting circuits
3. Checks for circuit continuity with disconnected supply
4. Checks for circuit continuity with live supply
5. Tests and methods
6. Testing devices
7. Testing and Commissioning Methods
8. Testing and Commissioning Procedures.
9. Maintenance of Particular Types of Electrical Equipment
10. Nomogram for temperature correction
11. Test voltages for Commissioning and Maintenance
12. Recommended insulation values for equipment

## IV. Condition Monitoring For Electrical Equipment

1. Approaches Based On Mathematical Models
  - Reliability Centered Maintenance (RCM)
  - Condition Based Maintenance (CBM)
  - Partial Discharge
2. Insulation Resistance Monitoring
  - 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

### 3. 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
  - Insulating Oil Dissolved Gas Analysis (DGA)

### 4. Understanding cable thermal behavior after installation

- Optical cable Temperature Monitoring

## V. Generator Fundamentals Maintenance ,Testing And Trouble Shooting

### 1. Principles of Generators

- AC Generators
- GENERATOR EXCITATION AND VOLTAGE CONTROL
- DIESEL GENERATOR SETS
- SYNCHRONISING OF GENERATORS
- LOAD SHARING
- LOAD SHEDDING

### 2. Preventative Maintenance

### 3. Trouble Shooting

- General Procedure
- Generator Does Not Produce Voltage
- Generator Produce Low Voltage

- Generator Produce High Voltage
  - Generator Voltage Fluctuating
4. Fault analysis for Generator Control Circuit

## VI. Motors, Motor Controller, Motor Starters Fundamentals, Maintenance And Troubleshooting

### 1. Fundamentals

- Types of A.C Electric Motors
- Principles of Operation of the Induction Motor
- Enclosures and Cooling
- POWER FOR INDUCTION MOTORS
- STARTING OF INDUCTION MOTORS
- Motor Operation at Reduced Voltage
- Power Factor Correction

### 2. Motor Testing

### 3. Motor Failures

## VII. Circuit Breaker Fundamentals, Maintenance, Service ,Testing And Troubleshooting

### 1. Fundamentals

- Air Circuit Breakers.
- Vacuum Circuit Breaker
- SF6 Circuit breaker
- Oil Circuit Breaker Ratings
- Fuses
- Trip Circuit Supervision
- Circuit-Breaker Control
- Low Voltage Molded Case Current Limiting Circuit Breakers

### 2. HV Circuit Breakers Maintenance

### 3. H.V Circuit-Breakers Tests

### 4. Low voltage Circuit Breaker Maintenance

## VIII. Transformer Fundamentals, Maintenance, Testing And Troubleshooting

### 1. Principles of Transformers

- Saturation Curve & Voltage Ratio of Transformers
- Current Ratio & Impedance of Transformers
- Transformer Construction
- Transformer losses and efficiency
- Transformer Cooling & Types
- Transformer Polarity
- Transformer Applications
- Transformer Accessories
- Maintaining Transformers

### 2. Preventative Maintenance

- Transformer Inspection
- Transformer Liquids
- Dielectric Test
- General Testing
- Other Important Tests
- Transformer Failure
- Disassembly for Inspection

### 3. Common Transformer Abnormalities

### 4. Transformer Oil Tests

### 5. Fault Analysis

## IX. UPS, Rectifiers, Inverters And Batteries Fundamentals Maintenance ,Testing And Troubleshooting

### 1. UPS Fundamentals

- Rectifications & Inverters
- Inverters
- Batteries And Battery Charging

- Battery Charging Tests
  - Safety During Battery Charging
  - Mixing Electrolyte
2. Battery discharge test.
  3. Troubleshooting Guide
    - Typical case studies.

### **COURSE CERTIFICATE**

**TRAINIT ACADEMY** will award an internationally recognized certificate(s) for each delegate on completion of training.

### **COURSE FEES**

£4,850 per Delegate. This rate includes participant's manual, Hand-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

### **COURSE METHODOLOGY**

The training course will be highly participatory and the course leader will present, guide and facilitate learning, using a range of methods including formal presentation, discussions, sector-specific case studies and exercises. Above all, the course leader will make extensive use of real-life case examples in which he has been personally involved. You will also be encouraged to raise your own questions and to share in the development of the right answers using your own analysis and experiences. Tests of multiple-choice type will be made available on daily basis to examine the effectiveness of delivering the course.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Case studies & Practical Exercises
- 10% Role Play
- 10% Videos, Software or Simulators (as applicable) & General Discussions