



# EE044: Practical Troubleshooting of Electrical Equipment and Control Circuits



## Training Description:

There is a chasm between the theory of electron flow, magnetic fields and troubleshooting electrical equipment and control circuits in the plant. This intensive course shows participants how to troubleshoot electrical equipment and control circuits.

The course helps individuals and employers. It does this by increasing all participant's knowledge and skills in improving equipment productivity whilst reducing maintenance costs.

Attendance on this course will help all participants identify, prevent and fix common electrical equipment and control circuits. The focus is "outside the box". The emphasis is on practical issues that go beyond typical electrical theory and focus on providing those that attend with the necessary tool-kit of skills in solving electrical problems, ranging from control circuits to motors and variable speed drives.'

This course focuses on the main issues of troubleshooting electrical equipment and control circuits of today to enable the participants to walk onto their plant or facility to troubleshoot and fix problems as quickly as possible.

## Training Objectives:

By the end of the training, participants will be able to:

- ✓ Troubleshoot electrical equipment and control circuits
- ✓ Diagnose electrical problems "right first time"
- ✓ Reduce down time

## Training Designed for:

This course is designed for personnel who want to understand the design and engineering principles involved in process plant layout and piping design. Those who will benefit the most from this course include the following; Consulting engineers, Electrical and electronics engineers, Electricians, Maintenance engineers, Plant maintenance personnel, Production managers and Project engineers.

## Training Program:

### DAY ONE:

#### PRE-TEST

- ❖ **MODULE 01: TYPES OF PROBLEMS**
  - Introduction
  - Problems and their genesis
  - Problem categories
- ❖ **MODULE 02: TROUBLESHOOTING FUNDAMENTALS**
  - Basics of troubleshooting
  - Drawings
  - Documentation and historical records





- Skill sets for troubleshooting
- Relationships between early resolution of problems and plant productivity
- ❖ **MODULE 03: USE OF APPROPRIATE INSTRUMENTS**
  - Instruments for troubleshooting
  - Insulation tester (Megger)
  - Continuity testers
  - Voltage indicator
  - Multimeter
  - Clamp-on meters
  - Ohm-meter and ducer
  - Special instruments

DAY TWO:

- ❖ **MODULE 04: TROUBLESHOOTING ROTATING ELECTRICAL MACHINES**
  - Basic principles of electrical machines
  - Rotating machines - AC
  - Rotating machines - DC
- ❖ **MODULE 05: TROUBLESHOOTING TRANSFORMERS**
  - Basic principles
  - Transformer failures
  - Monitoring of transformer parameters and oil properties
  - Early warning of internal failures
  - Use of dissolved gas analysis for problem detection
  - Use of partial discharge detection/measurements
  - Use of furan analysis/degree of polymerisation tests for residual life prediction
  - Failures in auxiliary systems and tap changers
  - Case studies of typical transformer failures, analysis and remedial measures

DAY THREE:

- ❖ **MODULE 06: TROUBLESHOOTING CABLE PROBLEMS**
  - Construction of HV and LV cables (overview)
  - Joints and terminations
  - Types of cable failures and reasons
  - Detecting cable failures
  - Prevention of failures by proper jointing/termination quality and by periodic testing
  - Use of thermo-graph for hot spot detection
  - Case studies of typical failures and detection
- ❖ **MODULE 07: TROUBLESHOOTING OF SWITCHGEAR AND CIRCUIT BREAKERS**
  - Overview of HV, MV and LV switchgear
  - Basics of circuit breakers
  - Problems faced in power circuits of panels, remedies and prevention
  - Problems faced in circuit breakers
  - Problems caused by bad contacts
  - Internal short circuits due to rodents
  - Problems due to dust accumulation



- Useful role of thermo-graphic examination in pre-empting problems
- Case studies of failures/malfunctions and remedial measures

#### DAY FOUR:

##### ❖ **MODULE 08: PROBLEMS CAUSED BY POOR POWER QUALITY**

- Overview of power quality
- Effects of poor power quality on equipment
- Voltage limits and equipment tolerance
- Power factor and its effects
- Problems due to frequency drifts
- Voltage unbalance (negative sequence)
- Harmonics (waveform distortion) and its effects on equipment

##### ❖ **MODULE 09: PROBLEMS ASSOCIATED WITH ELECTRICAL CONTROL CIRCUITS**

- Devices and symbols
- Language of control circuits
- Reading and understanding electrical drawings
- Reading and understanding ladder logic
- Wire and terminal numbering
- Motor control circuits
- Motor control strategies
- Problems due to incorrect wiring
- Problems due to poor terminal connections and contacts
- Problems in power and control (auxiliary) contactors
- Tracking problems using drawings and continuity/voltage tester
- Precautions while performing insulation tests on control circuits

#### DAY FIVE:

##### ❖ **MODULE 10: TROUBLESHOOTING PLCS**

- Principles of programmable control
- Programming tools
- Typical controls using PLC
- Problems experienced in PLC controls
- Use of status lamps in I/O cards to troubleshoot
- Rectification approach
- Internal failures and diagnostics

##### ❖ **MODULE 11: TROUBLESHOOTING POWER ELECTRONIC EQUIPMENT**

- Power electronic devices
- Power electronic applications in industry
- AC variable speed drive fundamentals
- Controllers used for power electronic equipment
- Device failures and checking of devices using simple instruments
- Common problems faced in power electronic equipment, reasons and remedial measures
- Examples/case studies
- Course Conclusion

#### **POST-TEST and EVALUATION**





## Training Requirements:

“Hands-on practical sessions, equipment and software will be applied during the course if required and as per the client’s request”.

Please note that the above topics can be amended as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

## Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

## Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

## Training Fees:

**As per the course location** - This rate includes participant’s manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01<sup>st</sup> of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

## Training Timings:

### Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

**For training registrations or in-house enquiries, please contact:**

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Training & Career Development Department

