

**Training Title**

**LV/MV/HV CIRCUIT BREAKERS (SWITCHGEAR): INSPECTION, MAINTENANCE, DESIGN, REPAIR & TROUBLESHOOTING**

**Training Duration**

**5 days**

**Training Venue and Dates**

<b>REF</b> <b>EE027</b>	<b>LV/MV/HV Circuit Breakers (Switchgear): Inspection, Maintenance, Design, Repair &amp; Troubleshooting</b>	<b>5</b>	<b>01-05 September 2025</b>	<b>\$5,500</b>	<b>Dubai, UAE</b>
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**In any of the 4 or 5 star hotels. The exact venue will be intimated once finalized.**

**Training Fees**

- \$ 5,500 per participant including Very useful Materials/ Handouts, Tea/Coffee, Breakfast, Snacks, Refreshments, Lunch.

**Training Certificate**

**Define Management Consultants & Training Certificate of course completion will be issued to all attendees.**

**INTRODUCTION**

**Circuit breakers (switchgear) are vital components in electrical systems, designed to protect circuits from overcurrents and faults. They are categorized by voltage levels:**

- **Low Voltage (LV) Circuit Breakers:** For residential and small commercial systems (up to 1,000 V).
- **Medium Voltage (MV) Circuit Breakers:** For industrial plants and power distribution (1,000 V to 72 kV).
- **High Voltage (HV) Circuit Breakers:** For power plants and transmission networks (above 72 kV).

**Key aspects of circuit breaker management include inspection, maintenance, design, repair, and troubleshooting. Regular inspections ensure reliability, maintenance extends lifespan, and troubleshooting helps identify and fix issues. Proper functioning is crucial for electrical system safety, preventing damage, downtime, and hazards.**

**TRAINING OBJECTIVES**

**This course is designed to enable participants to:**

- **Specifications & overviews of switchgear components, selections & ratings up to 33 kV.**
- **Describe switchgear construction: metal-enclosed & Metal-clad**
- **Describe the four basic types of low and medium voltage circuit breaker.**

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- Switchgear rating (breaking & making capacities).
- Testing and Maintenance policies of Switchgear testing & failure analysis.
- Electrical Safety Practices.
- Safety Aspects of some switchgear elements.
- Importance of arc flashing and relay co-ordination studies from operation & safety point of view.
- Evaluate the advantages of modern state-of-the-art switchgear protection for your applications, including preventative maintenance information

### WHO SHOULD ATTEND

Managers, Engineers and Technicians, responsible for the design, installation, testing and operation of electrical substations and power stations, who require to refresh their knowledge and skills in working with circuit breakers at low and medium voltage level. Technicians and engineers who are responsible for maintaining, testing and troubleshooting of HV/MV/LV switchgear.

### TRAINING METHODOLOGY

A highly interactive combination of lectures and discussion sessions will be managed to maximize the amount and quality of information and knowledge transfer. The sessions will start by raising the most relevant questions, and motivate everybody find the right answers. 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.

Very useful Course Materials will be given.

- 30% Lectures
- 30% Workshops and work presentation
- 20% Group Work & Practical Exercises
- 20% Videos & General Discussions

### COURSE OUTLINE

Overview of HV switchgear

- Related Standards
- Switch board layout
- Ratings
- Switchgears types & function
- Switchgear Components
- Types of MV switchgear
- Switch
- Disconnecter/Isolator
- Circuit breaker

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- CB behavior under fault conditions
- Contactors
- Insulation methods
- Oil circuit breakers
- Air break switchgear
- Sulphur-hexafluoride (SF<sub>6</sub>)
- GIS switchgear
- Vacuum breakers
- Comparison of insulating methods for CBs
- Types of closing mechanisms
- Circuit-Breaker Control

#### Overview of Low Voltage Switchgear

- Purpose of LV Switchgear.
- Construction
- Main Air Break Circuit-Breaker
- Contactors
- Moulded Case Circuit-Breaker
- Miniature Circuit-Breaker
- Earth Leakage Circuit-Breaker
- Low Voltage Switchboards
- Centre (Incomer) Section
- MCC Section
- Fuses
- LV CB Nameplate

#### Hazards of Electricity

- Electrical Safety Hazards.
- Electric Shock.
- Effects of current on human beings based on IEC 60479.
- Shock Hazard Analysis.
- Arc-Flash and Arc Blasts.
- Electrical Arc Flash Characteristics
- Arc-Flash Metrics.
- Arc-Blast Effect.
- Light and Sound Effects.
- Elements and characteristics of an Arc Flash Event.
- Arc Flash Hazard Analysis.

#### Different Tests

- Insulation Testing
- Insulation Resistance Testing
- Components of DC Leakage Current
- Polarization Index

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- DC Hi-Pot Test
- Insulation Power Factor
- On-Line Monitoring
- Thermography
- PDA - Partial Discharge Analysis
  - What is a Partial Discharge
  - Measuring Partial Discharge Activity
  - PDA Curves
- Contact Resistance Test.
- Timing Test.
- Motion Analyzer Test.
- Turns Ratio Test.
- Protective Relay System Tests.
- Oil Analysis.

#### CT & VT and Relays maintenance & Tests

- Introduction
- Relay Maintenance Testing and Commissioning
- Type tests
- Routine factory production tests
- commissioning tests
- Periodic maintenance tests
- Secondary Injection Testing
- Frequency of Inspection and Testing
- Relay Maintenance Tests
- Protection Scheme Design for Maintenance
- Primary Injection Tests
- Current Transformer Tests
  - CT Ratio Check
  - CT Polarity Check
  - CT Magnetization Curve
- Voltage Transformer Tests
  - Polarity check
  - Ratio check
  - Phasing check

#### CBs Failure investigation

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

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- 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 SF<sub>6</sub>
- Failures due to degradation of the SF<sub>6</sub>
- Failures due to SF<sub>6</sub> 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

**NOTE:**

**Pre & Post Tests will be conducted**

**Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.**

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P.O BOX 45304  
ABU DHABI, U.A.E

T +971 2 6264455  
F +971 2 6275344

[www.definettraining.com](http://www.definettraining.com)