

# H.V SWITCHING

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**TRAINING TITLE**  
**H.V SWITCHING**

**VENUE**  
**Dubai, UAE**

**DURATION**  
**5 Days**

**DATES**  
**24 – 28 July 2022**

**PRICE**  
**US\$4,000 per attendee including training material/handouts, morning/afternoon coffee breaks and Lunch buffet.**

**TRAINING INTRODUCTION**

**This course introduces the basis of understanding the theory of high voltage switchgear covering LV/MV/HV circuit breakers and the equipment included in the switch gears. It also introduces the practice and testing of switchgear & by the end of this course the trainee should be able to:**

- Demonstrate the components of different voltage switchgear
- Demonstrate the maintenance, testing procedures used for different voltage switchgear
- Apply the safety precautions of P.M. on switchgear
- Know how to calculate the short circuit level
- The transient phenomena in power systems
- Understand the arc phenomena and circuit interruption
- Know the different types of circuit breakers and industrial switchgears
- Be able to select the proper specifications of CB and switchgears
- Know the maintenance procedures
- Be able to do all tests on circuit breakers.
- Be able to detect circuit breakers troubleshooting.
- Know the methods of system earthing and protection requirements.
- Be able to control circuit breakers with associated relaying systems.

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## **TRAINING OBJECTIVES**

**Delegates will gain an overall appreciation of the applicable standards and working practices for:**

- ◆ Fundamental of Circuit Breaker
- ◆ Types of Low and Medium Voltage Circuit Breaker
- ◆ HV
- ◆ Switch Gears
- ◆ Insulation and maintenance of CB
- ◆ Over current trip equipments
- ◆ Testing of Low and Medium CB

## **TRAINING AUDIENCE**

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 OUTLINE**

### **1. Introduction**

- Electrical engineering basic concepts
- Three phase review and per unit
- Voltage levels
- One line and three line diagram
- Generation system layout
- Transmission system layout
- Substation system layout
- Distribution system layout

### **2. Industrial Switchgears**

- Fuses
- Auto-reclosers
- Automatic sectionalizer
- Circuit Breakers
- Isolator switches
- Load switches
- Relays
- Current transformers

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- Voltage transformers

### **3. CB Design Specification Based on Short Circuit Current Level**

- Per unit system
- Faults on power systems
- Transient phenomena in power system.
- Symmetrical component analysis of three phase network
- Network connection for various fault types
- Current and voltage distribution in system due to a fault
- Effect of system on zero sequence quantities
- Computer programs based short circuit calculation.

### **4. CB Design Specification Based on Arc Phenomena and Circuit Interruption**

- Arc phenomena
- Maintenance of the Arc
- Properties of Arc
- Arc Interruption theory
- Circuit Breaker Rating
- Circuit constants and circuit conditions
- Conditions of severity
- Restriking voltage transient
- Switching transients
- Duties of Switchgear

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

- Introduction
- Basic principles in using a drawing and meter in Troubleshooting circuits
- Checks for circuit continuity with disconnected supply
- Checks for circuit continuity with live supply
- Tests and methods
- Testing devices
- Testing and Commissioning Methods
- Testing and Commissioning Procedures.
- Maintenance of Particular Types of Electrical Equipment
- Nomo gram for temperature correction

- Test voltages for Commissioning and Maintenance
- Recommended insulation values for equipment

## **6. Condition Monitoring For Electrical Equipment**

- Approaches Based On Mathematical Models
  - Reliability Centered Maintenance (RCM)
  - Condition Based Maintenance (CBM)
  - Partial Discharge
- 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
- **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)

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- Understanding cable thermal behavior after installation
  - Optical cable Temperature Monitoring

## **7. LV Circuit Breakers**

- Low voltage molded case current limiting circuit breakers
- Low voltage molded case circuit breakers with high breaking capacity
- Insulated case circuit breakers
- Low voltage air circuit breakers
- Low voltage circuit breakers specification

## **8. Modern MV and HV Vacuum CB**

- Introduction
- Advantages of vacuum interruption
- Vacuum contactors and interrupters
- The vacuum medium
- The vacuum arc
- Vacuum arc stability
- Vacuum break down
- Vacuum switch construction
- Applications of vacuum circuit breakers

## **9. Modern MV and HV SF<sub>6</sub> CB Introduction**

- Basic Features of SF<sub>6</sub> Breakers
- Dielectric properties of SF<sub>6</sub>
- Quenching properties of SF<sub>6</sub>
- Construction of SF<sub>6</sub> breaker
- SF<sub>6</sub> CB types
- Puffer type SF<sub>6</sub> breakers
- Double Pressure System
- Single Pressure Puffer-Piston System
- Single Pressure Self Blast System
- Improvement in SF<sub>6</sub> Breakers for HV

## **10. Other Type of Circuit Breakers**

### **a) Air Circuit Breakers**

- Method of increasing arc resistance
- Plan break type
- Magnetic blow out type
- Arc splitter type
- Application
- Construction and operation
- Axial air CB
- Blast air CB

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## **b) Oil Circuit Breakers**

- Arc rupture under oil
- Advantages of oil
- Disadvantages of oil
- Plan break oil circuit breakers
- Arc control circuit oil breakers
- Minimum oil circuit breakers
- Construction and operation

### **11. Circuit Breaker Inspection, Maintenance and Services**

- Inspection
- General inspection technical procedure
- Daily inspection of circuit breakers
- Monthly inspection of circuit breakers
- Annual inspection of circuit breakers
- Disassembly
- Cleaning
- Tightening
- Lubrication
- Equipments used in testing
- Testing procedure
- Direct testing
- Contact resistance test.
- Insulation resistance test
- Test report
- Indirect testing
- One hour Video, HV CB Maintenance and Repair)

### **12. Circuit Breakers Control, Protection and Testing**

- Switchgears control devices and wiring
- Switchgears protection devices and wiring
- Testing Classification
- Testing laboratories
- Description of a simple testing station

### **13. CB Troubleshooting**

- Low insulation Resistance (below 2000 Mega-ohms) between a) Phase terminal and earthed frame, with breaker closed b) Phase terminals of a pole.
- Resistance between Terminals of Pole contact.
- Unequal contact Wipe and Travel in 3-pole Measured from top surface of interrupter flange and the contact lip by a simple rod with a) breaker open and b) breaker closed
- One of the pole docs not close.

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- Breaker operation too Slow During opening timing from trip command to contact separation instant too large

### **TRAINING CERTIFICATE**

**MAESTRO CONSULTANTS** Certificate of Completion for delegates who attend and complete the training course

### **METHODOLOGY**

Our courses are highly interactive, typically taking a case study approach that we have found to be an effective method of fostering discussions and transferring knowledge. Participants will learn by active participation during the program through the use of individual exercises, questionnaires, team exercises, training videos and discussions of “real life” issues in their organizations. The material has been designed to enable delegates to apply all of the material with immediate effect back in the workplace.

