

MV, HV AND EHV SWITCHGEAR TESTING & COMMISSIONING



**EPE149
Electrical &
Power
Engineering**

COURSE TITLE

MV, HV AND EHV SWITCHGEAR TESTING & COMMISSIONING

COURSE DATE/ VENUE

11– 15 October 2021

Kuala Lumpur, Malaysia

COURSE REFERENCE

EPE149

COURSE DURATION

05 Days

DISCIPLINE

Electrical & Power Engineering



COURSE INTRODUCTION

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 equipment
- Testing of Low and Medium CB

COURSE OBJECTIVE

Upon successful completion of this course, the delegates will 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
- ✓ Calculate the short circuit level
- ✓ Explain the transient phenomena in power systems
- ✓ Explain the arc phenomena and circuit interruption
- ✓ List the different types of circuit breakers and industrial switchgears
- ✓ Select the proper specifications of CB and switchgears
- ✓ Recognize the maintenance procedures
- ✓ Perform all tests on circuit breakers
- ✓ Detect circuit breakers troubleshooting
- ✓ List the methods of system earthing and protection requirements
- ✓ Control circuit breakers with associated relaying systems

COURSE 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.

COURSE CONTENT

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
- 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)
- 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 SF6 CB Introduction

- Basic Features of SF6 Breakers
- Dielectric properties of SF6
- Quenching properties of SF6
- Construction of SF6 breaker
- SF6 CB types
- Puffer type SF6 breakers
- Double Pressure System
- Single Pressure Puffer-Piston System
- Single Pressure Self Blast System
- Improvement in SF6 Breakers for HV

10. Other Type of Circuit Breakers

- 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
- 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
- Equipment 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 poles does not close
- Breaker operation too Slow During opening timing from trip command to contact separation instant too large

COURSE CERTIFICATE

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

COURSE FEES

\$5,650 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